WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY.

THE

PRESIDENT'S ADDRESS;

THE

COUNCIL AND AUDITORS' REPORTS FOR 1872,

AND

A LECTURE ON THE AQUARIUM AND ITS CONTENTS,

Delivered in the Crystal Palace by J. JENNER WEIR, ESQ., PRESIDENT, *at the Soirée, November 6th,* 1872.

ALSO

RULES, LIST OF MEMBERS, AND CATALOGUE OF BOOKS.

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FOR 1873–74.

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*** *All communications to be addressed to the Secretaries, Lee Bridge, Lewisham.*

THE PRESIDENT'S ADDRESS,

By J. JENNER WEIR, Esq., F.L.S.

Annual Meeting, February 26th, 1873.

GENTLEMEN,

In accordance with annual custom it becomes my duty, as your President on this occasion, to deliver an address.

During the past year, both my time and thoughts have been occupied with official duties, which have prevented my giving to the subject that attention which it demands, and must therefore beg your forbearance for any shortcomings.

My observations are addressed to you as men of science, all more or less devoted to its cultivation, and showing, by the support you give to this local Society, a desire to make the great truths of Science more generally known and appreciated in this neighbourhood.

Professor Huxley has defined Science to be "trained and organized common sense," and in this light I regard it; but it unfortunately happens that it is by many persons regarded with suspicion, and by others with positive dislike.

This is due in a great measure to different tones of thought.

The retrospective philosopher is constantly seeking for authority, and the prospective philosopher is constantly seeking for truth, by investigation, observation, and experiment.

To the latter class only I address myself.

The truly scientific man is ready to give up his most cherished views, as soon as he finds they will not bear the closest investigation. His mind is ever ready to consider the claims which any new theory may have for acceptance; if it sufficiently well explains what he has hitherto regarded as a phenomenon, and brings into coherency a number of ascertained facts, and is not opposed to other facts, but is in harmony with them, then the Phenomenon becomes to him a Noumenon, and he feels he has made a step forward in his search after truth.

The study of Physical Science should be undertaken in the same spirit that the highest branch of it is pursued by those great men who make Astronomy their special subject.

The movements of the Planets and their Satellites are calculated with extreme accuracy.

The exact period that an eclipse, occultation, or transit will take place, is calculated and known to the fraction of a second; and for this reason, that all the movements of the heavenly bodies are subject to law.

I may here remark that even the most ignorant do not dispute these facts of Science, but accept them without question.

No one doubts that an eclipse will take place at the exact moment predicted, and even the motions of such erratic bodies as comets are ascertained with approximate precision; so that the popular mind can be easily led to believe in the approach of a comet.

Now it becomes the duty, and should always also be the pleasure, of the Naturalist, to try and discover the laws which govern the evolution of life on the earth.

To this end he should seek for assistance from the Astronomer, Geologist, Palæontologist, Zoologist, Phytologist, and Chemist.

It has always been a subject of regret that each specialist has pursued his investigations without reference to the light which could have been thrown on his studies by the help of other Sciences.

I do not mean by this that a scientific man should be acquainted with all the sciences thoroughly; this would be an impossibility. But I do maintain that a general knowledge of all the sciences is necessary to enable any one to make a proper and safe progress in the particular science to which he devotes himself.

It is well here to note that a general is not to be confounded with a superficial knowledge; the former is sound as far as it goes, the latter at the best is a smattering.

I have deemed these preliminary remarks necessary before dealing with the particular science of Natural History, for the study of which, and for aiding those studies by the assistance both of Microscopy and Photography, this Society was constituted.

I propose, therefore, during the short time at my disposal, to draw your attention to certain facts well known to most of you, or at any rate which all can verify, which to my mind offer evidence tending to prove that the forms of life as they at present exist in the earth have been evolved.

That the higher and most complex forms have been developed from lower and less complex, and these latter from the lowest and most simple forms.

I should have been glad to have added to this sentence, and also that the lowest forms of life have been developed, and are still being developed, from organic matter, but I cannot fully satisfy myself on this latter point; and having read over most of the arguments used by Dr. Bastian in favour of Archebiosis, supported as they are by experiments, I must say that I am not convinced that inert matter is in the present condition of the earth, without the interposition of life, capable of being changed into living matter.

It is well here to observe that by the action of vital force inorganic substances do become organic. The whole Vegetable Kingdom may be said to feed, and therefore to be developed from inorganic matter, under ordinary circumstances.

It is therefore patent to every one that plants can change lifeless matter into living; and it will form the great problem for future investigation, whether, without the intervention of life, living forms can be evolved.

It is, I think, quite satisfactorily shewn that lower forms of life do appear in closed glass vessels, the contents of which have been boiled and hermetically sealed; this fact, I think, Dr. Bastian has proved, and further, Dr. Burdon Sanderson has made similar experiments, the account of which has been published by him in "*Nature,*" January 9th, 1873, pages 180 and 181. The result fully satisfied his mind of the fact, and, I think, would satisfy the mind of any candid person.

But then it does not necessarily follow that the life shewn to exist in the turnip infusion, experimented with, was spontaneously produced.

The germs of life of very low organisms might not be destroyed by boiling for ten minutes, nor by the fact that almost the whole of the air had been expelled from the glass vessel by boiling.

Further, it may be remarked that the Bacteria Torulæ and other low forms of life were developed from decaying organic matter, and that they were developed, as Dr. Bastian claims to have been the case in other experiments, from inorganic matter, is, I think, not proved. Still, the whole question must be regarded in a proper scientific spirit, and not treated dogmatically.

Dr. Bastian's book may be considered a valuable addition to the literature of the subject of spontaneous generation, and he deserves great credit for the labour he has bestowed in the preparation of it.

He has certainly shewn beyond a doubt that it is almost impossible to keep life out of solutions of vegetable matters.

But Dr. Bastian does not stop at maintaining that life is constantly being produced on the earth, *de novo;* but in his arguments on Heterogenesis, which I can do no more than briefly advert to, he maintains that in some instances animals with distinct and specific organs arise from the reproductive elements of a plant.

He strengthens his view by quoting the opinions and detailing the experiments of other observers.

I do not wish to misquote Dr. Bastian, nor to dispute his conclusions, without going more deeply into the subject than I am able in this short address, and therefore give an extract of his own words:—

> "No other conclusion remains for us but that the several organisms (found "in infusions) are products of the direct developmental unfolding of new-born "specks of living matter. And yet among these forms we see Bacteria, Vibri-"ones, Leptothrix, and Torulæ, Fungus filaments, with and without fructifica-"tion, Protamœbæ and Flagellated Monads, Pediastreæ and Algoid filaments. "All these are therefore proved with the greatest certainty to be interchangeable "forms, which may be assumed on different occasions by newly evolved specks "of living matter."

Dr. Bastian quotes Dr. Braxton Hicks as having observed the production of Amœbæ by the transformation of the chlorophyll and protoplasmic contents of the cells of moss radicles, and Mr. H. J. Carter as having observed the formation of Monads and Amœbæ in the cells of Nitella, one of the Characeæ.

I think I have said sufficient to shew that if Dr. Bastian and others can substantiate the truth of the views here adverted to, a great revolution will take place in the ideas of Naturalists on the subject of Heredity. Instead of like producing like, the converse would often be the case.

It may here be remarked that although, by boiling infusions at high temperatures, the whole of the life which had assumed a concrete form therein might be destroyed, it does not follow that germs of life, or the power of reassuming the same concrete forms, would be destroyed; and I can myself better conceive the idea of life becoming latent, than that it could be produced *de novo*, or that vegetal spores could be transformed into animal.

I shall now quit this subject and proceed with the few remarks I have to make on the general theory of the evolution of life.

There is one argument in favour of the Theory of Evolution which I think is patent to every one, and that is, that highly developed forms are almost invariably larger than the lowly developed; or at any rate, that all animals of a large size are highly developed, or, in most cases, at the head of the group they belong to.

I will illustrate this argument.

The vertebrates are larger in size collectively than the invertebrates. Amongst the latter, the Mollusca and Annulosa are larger than the Cœlenterata, and the Cœlenterata than the Protozoa.

But these postulates must be taken with certain limitations. All animals are affected in the struggle for existence by so many surrounding conditions, and their size depends very much upon whether their bodies are sustained in the air, as in birds and bats; in the water, as in whales and fishes; or simply by their legs on the land, as in the case of the mammalia, reptiles, &c.

It is quite clear the rule holds good when the two extremes of the animal kingdom are compared, and no one could dispute that the Protozoa, mostly microscopic, are not only collectively, but in all cases individually smaller than the vertebrates.

But let us see whether the rule holds good amongst the vertebrates themselves.

The highest vertebrates, the mammalia, are larger than the birds; but these latter suffer in size by the fact that most of the species have occasionally to sustain their bodies in the air. But if we take into consideration the ostrich family, the members of which do not fly and are probably descended from wingless ancestors, we must admit that the largest bird, even including the extinct genus Dinornis, falls very short in size of the larger mammalia.

The rule holds good when the Birds are compared with the Reptiles, keeping steadily in mind that Birds have to sustain themselves in the air as a general habit.

The largest Reptiles, the Crocodiles and the Aligators, are aquatic, and must therefore be considered as not affecting the general question.

The rest of the genus of Saurians are mostly of very small size, such as Lizards, Geckos, and Skinks.

The other large Reptiles, as the Turtles, are also aquatic; and there are numerous small species even of them, and also of land Tortoises.

The Batrachians, or Amphibians, are very much smaller than the Reptiles; indeed, there is amongst them but one moderate sized species, the Gigantic Salamander of Japan, and this rarely exceeds three feet in length.

The Fishes are all aquatic; and the only comparison that can be made between them and the higher Vertebrates is with those species of the latter which exist under similar conditions to the former. The Fishes fall short of the size of the Whales, Spermaceti Whales, and Grampuses.

The Dolphins, Porpoises, Dugongs, Manatees, Walruses, and Sea Elephants, are all of a size which would be considered very large among Fishes.

If a closer examination is made of the Mammalia alone, the rule shews itself with force; not, perhaps, that the highest groups always contain larger species than the lowest, although, speaking roughly, that even is the case to a great extent.

Man attains a larger size than any of the Anthropoid Apes, and of these the Gorilla, Chimpanzees, and Orangs are larger than any other Quadrumana.

The Dog is the largest of the Canidæ, although, by artificial selection, some small varieties have been obtained.

The Elephant is by far the largest of all the Pachyderms, and is probably the most intelligent animal in existence.

The Horse and the Ass are highly developed and large animals, and to these may be added the Camel, Ox, Buffalo, Sheep, and Goat.

When these are compared with the Rodents, all lowly developed animals very numerous in species, but containing only one large species, the Capybara, and that both aberrant and also aquatic, the rule under consideration is exhibited with great force.

Most of the Rodents are very small; the familiar Mouse, Rat, Squirrel, Rabbit, Hare, Guinea-pig, cannot for one moment be thought large when compared with the higher Mammalia, and even amongst these Rodents the rule holds good. We all know how far more easy it is to capture the small Mouse than it is to trap the larger and more intelligent Rat.

The Placental Mammalia are also much larger, taken collectively, than the Implacental or Marsupial.

The largest of the latter, the great Kangaroo, is by no means a bulky animal. Many of the Kangaroos are very small; their name, Kangaroo Rats, clearly shews this.

The lowest of all the Marsupials, the Monotremata, containing the two genera Ornithorynchus and Echidna, although larger than some of the minute Rodents, are small animals.

The rule holds good equally among the Birds, but the conditions of Bird life are so intricate and involved, that it is not very clearly seen.

At the head of the Raptorial Birds stand the Falcons and Eagles; the latter are among the largest Birds of flight. No one could stand in the presence of an adult Imperial or a Golden Eagle without feeling he saw one of the highest developments of Bird life. Man in all ages has felt this, and the Eagle has been used as the emblem of majesty and power by many nations, both Occidental, European, and Oriental.

The Eagles are the largest in size of the Noble Birds of Prey.

At the head of the Falcons are placed by all Naturalists as the type of the group, the Gyrfalcons. These grand birds are the largest of the Falcons and are highly developed, and so intelligent and docile that a perfectly wild bird may be tamed and trained to come to the lure of the Falconer in a few weeks.

The Raven, among the Perching Birds, is one of the highest developed and sagacious birds in existence, and it is also the largest of the Insessores, except the Hornbills.

It is scarcely necessary to multiply the instances of the truth of the rule among the Birds, but the Ostriches, a small group containing only about sixteen species, ought to shew the rule within the limits of their own division, and I think they do so.

All Naturalists have invariably placed the Ostrich at the head of the Ratitæ, or birds which have no keel to the breast bone.

It is hardly necessary to say it is the largest species by far.

The Emeu is usually placed next, and it is next in size.

The Rheas and Cassowarys follow, the largest species of which are five feet in height, but smaller than the Emeu, and are more aberrant from the type.

Lastly, the still more aberrant, lowly developed, and nocturnal species of Apteryx are very much smaller than any of the species named. The Apteryx Mantellii weighs but little more than four pounds, and two other species are barely larger, and one Apteryx Owenii is much smaller.

In these five genera the species of the Ostrich group at present existing are contained, and very fairly illustrate the rule I am dealing with.

The group is an interesting one, and probably originated on the south side of the equator. All the species except the Ostrich are still found in the southern hemisphere only, but the continuity of the African continent has enabled the Ostrich to pass the equator, the conditions being also favourable to its existence in North Africa.

The Rheas have not, however, passed the equator in South America, the Pampas not extending sufficiently far north.

The Humming Birds, although very elegant and gorgeously coloured birds, are lowly organized as birds; their habits are almost the same as those of insects, and in some points of structure they assimilate more to the reptiles than other birds.

It is almost unnecessary to add that, of all birds, they are by far the smallest, some species not being more than two and a half inches in length.

The Sunbirds of the Old World are nearly as small as the Humming Birds, and but a little higher in organization.

The different divisions of the Annulosa appear to confirm the rule that size is correlated with high development.

Amongst the Crustaceans the Stalk-eyed are larger than the Sessile-eyed, and in the former the highly developed Crabs and Lobsters are larger than the more lowly developed Prawns, Shrimps, and Squills.

The time at my disposal will not allow me to draw your attention to many of the groups of Insects and other divisions of the Annulosa.

The highly developed Lepidoptera attain a larger size, in the typical families, than the lower Neuroptera and Homoptera.

Amongst the Lepidoptera Rhopalocera, the true Papillionidæ, placed at the head of the order, are also of the largest average size; and the largest of the true Butterflies are also the largest of the Lepidoptera, in the expanse of wing, and inferior in the bulk of their bodies only to some of the Sphingidæ and Bombycidæ, which are placed at the head of the Lepidoptera Heterocera.

The aberrant groups, such as the Tortricidæ and Tineinæ, are of very small size—none large, and thousands of species only a few lines in length, the alar expansion of the smaller species being under three lines, and the length of the body not more than one line.

Amongst the Mollusca and Cœlenterata there are scarcely any species invisible to the naked eye, and some are large, particularly the highly organized Cuttlefishes and other Cephalopoda ; a few of the Bivalves attain to large dimensions.

But turning from all the groups treated of to the Protozoa we find nearly all the species, except the Sponges Microscopic.

The Gregarinida, Rhizopoda and Infusoria are nearly all quite invisible to the naked eye, and many of the lower forms require to be magnified from a thousand to fifteen hundred times to enable an artist to figure them.

Upon the whole, I think, it has been fairly shown that increase in size is correlated with higher developement, although the fact is much obscured in the higher animals, because natural selection acts upon them with great force, and it may be very disadvantageous to some of the species to be of large size and often even fatal to their existence. Mr. Darwin has shown that during a severe drought, which occurred in South America, the larger Mammalia perished, but the mice survived because the dew furnished them with sufficient moisture.

I think there can be little doubt that large animals, with a complex structure, are more sensitive to external relations than smaller and more lowly organized creatures; and, therefore, I am not surprised to find that so many of the largest Mammalia that have once existed on the earth have failed in the struggle for existence and have perished.

Amongst the highest Mollusca nearly all the genera have become extinct and but very few of the thousands of species remain, by which we are enabled to form some little idea what the extinct species were like.

One fact, I think, is clearly established, that Microscopic animals are always very lowly organized, and that the lowest forms of animalculæ require the highest power of the microscope even to distinguish them at all.

I have, thus far, endeavoured to show that increase in size is, in animals, correlated with a greater complexity of organization, and I now wish to draw your attention to another rule, which obtains that the most highly organized animals require comparatively the longest periods of time for their development.

To put the point concisely, I wish to prove that what is true of the development of life in space is true in time.

Commencing with the lowest Protozoa, the Amœbæ, so short a time is necessary to produce an independently existing specimen, that the evolution may be said almost to be instantaneous.

It sometimes happens that an Amœba changing its form, as it does every moment, shoots out a portion of its body to a greater distance than usual; sometimes the piece so projected will be in the form of a finger, the end furthest from the body will increase in size, and the expanded end retain its position. The contraction of the parent causes the connecting portion to become thinner and thinner, until at last it is broken, and the continuity between parent and offspring entirely ceases.

Seeing that an Amœba is alive, but is entirely without any organ differentiated for a special purpose, it is probable that this mode of reproduction is very commonly resorted to, at any rate it is certain Amœba are so produced; and it is impossible to conceive a more rapid production of an independent existence.

The very short time required for Infusoria to increase from units to millions is a fact well established; one illustration will suffice.

A Paramecium, well supplied with food, undergoes fissiparous division daily; therefore 16,384 would be produced in a fortnight and 268,435,456 in four weeks.

I believe, however, there are species which reproduce even more rapidly than the above.

It must be noted, however, that the Paramecia not only multiply by spontaneous scission as stated, but also by genuine sexual reproduction. Their multiplication by gamogenetic reproduction is perhaps not quite so rapid as by agamogenetic; the period of gestation, if it can be so called, is usually from five to six days, but of course several young are produced at a time.

Turning to the higher Infusoria, the Rotatoria, we find the time for reproduction very short. Ehrenberg wrote, that he insulated a single specimen of Hydatina senta, and kept it in a separate vessel for eighteen days; that during this interval it laid four eggs per diem, and that the young so produced, at two days old, began to lay a like number.

It can be easily seen that one million independent existences would thus be produced in a few days.

The Cœlenterata stand next the Protozoa in an ascending scale of organization.

Many of the species of the Actinozoa, one of the two divisions into which the Cœlenterata are divided, reproduce by fissiparous divisions, but in consequence of their organization being so much higher the independent existence so produced is not at once perfect, but becomes so in a few days. Those who have kept the Actiniæ in Aquaria know how commonly they split into one or more pieces, and after the lapse of a few days each fragment becomes a perfect Sea Anemone. Mark, however, that more time is necessarily consumed in the production of the adult form when independent existence is commenced in an imperfect state.

In the other division of the Cœlenterata, the Hydrozoa, the element of time becomes very important, because many of the species pass through a metamorphosis, or alternation of generation; to describe the mode of reproduction in the Hydrozoa would be quite impossible within the limits of this address. Those members who may wish to understand the subject should consult Professor Allman's monograph of the Gymnoblastic Hydroida, a copy of which is in our library.

Turning to the Annulosa and selecting the Insecta for consideration.

How short a time it takes to develope some of the low forms of insects all who have gardens know very well.

In Spring the winged males and females of the Aphids appear; one or two may be seen resting on the young shoot of a rose; in a few days the solitary specimen has produced hundreds and even thousands of young, generation after generation appearing, and the leaves and stem of the shoot becomes entirely concealed by wingless Aphids, which often go through nine or even more generations in a few weeks.

Amongst the higher Insecta it is by no means unusal for one brood only to be produced in the year; but it generally happens that the species is dormant during a great part of the year, either in the egg, larva, pupa, or imago form.

It must also be observed, that in cases of insects of the higher orders, that the life of the individual commences with the egg which contains at first almost no organization, but is entirely self-dependent from the moment of exclusion; therefore, to make any comparison between the length of time required to develope an insect and a mammal, the fœtal life period of the latter must be taken into consideration.

I shall now pass on to the Vertebrates.

The lowest order, the Fishes, contains numbers of species which have no definite adult size, but so long as they are supplied with sufficient food, increase indefinitely in size from time to time; but I am not here dealing with growth but rather with the length of time which is required to develope genetically an independent existence, and the further time occupied before maturity is reached.

So very little is positively known about the reproduction of Fishes, that my observations on the subject must be brief.

Take, however, for illustration, the small fish with which we are all familiar, the Stickleback, Gasterosteus aculeatus.

In this species the young of one year are adult, and themselves parents in the next.

Compare this fish with the Salmon and it will at once be seen how much longer time is required to develope an adult Salmon.

Willoughby says that the Salmon requires six years to attain its full growth, and that the yearly stages were so well marked that at each season the fish received a different name among the fishermen on the river Ribble; these names he gives as Smolt, Sprod, Mort, Fork-tail, Half Fish, and Salmon; but there is reason to believe that well fed fish become mature in half the time stated by Willoughby.

Still the rule holds good that the little Stickleback becomes mature in a much shorter time than the Salmon.

The Sharks, the highest developed fishes, resemble in many respects the mammalia; several of the genera are viviparous, and appear also to take care of their young when in an immature condition.

Many of the Sharks grow to an enormous size, often weighing several tons, and from the great difference in size of those captured I apprehend maturity is slowly arrived at.

Passing over the Reptiles and Batrachians, the Birds form the next class for consideration.

Here the postulate, that the larger the size the longer the time required for development, can, I think, be logically proved.

Amongst Birds, however, two widely different conditions of development obtain, although all are hatched from eggs yet the young birds so produced differ essentially.

Hesthogenous Birds produce their young clothed, with their eyes open; and from the first day of their existence capable of feeding themselves.

Gymnogenous Birds on the other hand produce their young naked, blind, helpless, and quite incapable of feeding themselves.

The period of time occupied in incubation, in both divisions of birds above adverted to, varies almost always in correlation with the size of the bird.

Thus among the Hesthogens we find the Partridge sits 21 days; the Pheasant, 24 to 26 days; the Guinea Fowl, 28 or 29 days; the Turkey, 30 days; the Swan, 40 to 45 days; the Emeu, about 60 days.

Among the Gymnogenous Birds the smallest species are found, and the period of incubation varies with their size. The Humming Bird sits 12 days; the Whitethroat, 13 days; Canaries, 13 to 14 days; Starlings, 16 days; Pigeons, 16 to 17 days; the Raven, 20 days; the larger Eagles and Vultures, several weeks, but the exact duration of their incubation is not well known; they build in inaccessible place, and but few observations have been made.

With regard to the length of time occupied in arriving at the full size, by birds after their escape from the egg, there is a great difference between those that are produced clothed and those hatched naked.

The latter, when young, have two parents always engaged in feeding them, often with half digested food. The young ones make almost no exertion to obtain food, and their growth to the full size is consequently rapid; but the time occupied varies with the size of the birds.

Wrens leave the nest in less than a fortnight after hatching; Linnets, Goldfinches, and other Finches remain but little longer in the nest; Thrushes and Blackbirds appear fledged and nearly as large as adults in about a fortnight after being hatched.

The young Raven is fully fledged when about one month old.

The Eagles are from two to three months in the nest after being hatched, and several species both of Eagle and Vulture do not attain their complete adult plumage before the sixth year of their age.

Many of the smaller species of Gymnogenous birds have a succession of nests during the year.

The familiar farmyard Hesthogenous birds conform to the rule under consideration.

The Turkey is longer in coming to maturity than the Fowl; the Goose than the Duck.

Most birds acquire their full growth during the first year of their lives, but the Ostriches, the largest of all birds, do not attain adult size till they are two years of age.

If my views are right as to birds, that the larger species occupy more time in development, both in the egg and from the immature to the mature state, the same principle should hold good among the Mammalia in the duration of time in the fœtal and immature state; and this can very easily be shewn to be the case.

The period of gestation is, in the Elephant, 20 to 21 months; the Giraffe, 14 months; the Dromedary, 12 months; the Mare, 11 months; the Cow, 9 months; the large Deer, 8 months; the Bear, 6 months; the Sheep and Goat, 5 months; the Sow, 4 months; the Dog, Wolf, and Fox, 63 days; the Cat, 56 days; the Hare, 30 days and upwards; the Rabbit, 28 days; the Squirrel and Rat about the same time; and in the Mouse, the period of gestation is a fortnight.

The Implacental, or Marsupial animals, which produce their young in an imperfect state, have shorter periods of gestation than the Placental of similar size.

The period in the Kangaroo is 39 days, in the Opossum but 26 days, and in the small Australian species a much shorter period.

I will not trouble you with many illustrations of the fact that large animals require after their birth a longer time to attain maturity than small ones.

The "Right Whale" is believed to be full grown in its twenty-fifth year.

The Elephant is many years old before he is adult, and the same may be said of the Hippopotamus and the several species of Rhinoceros. The Horse and Ox are full grown at three to four years of age, the Sheep during the second year of its life. Hares and Rabbits are full grown at four to five months old, and Rats and Mice in a still shorter period.

I think the facts stated are sufficient to establish the truth of the postulate I started with, that the higher an animal is developed the longer the time required for its development both in the fœtal and immature state.

There appears to me to be another law, to which however I can but very briefly advert, and that is, that the higher the development and the larger the size, the less the number, both in species and specimens, at present existing on the earth.

I will illustrate my meaning by comparing the relative number of species in three of the orders of Mammalia, which I have selected because the affinities and position of the smaller orders are neither well known nor their limits defined.

The Quadrumania, confessedly the highest order, contains about

220 species. The Carnivora, including the Insectivora, about 420 species. The lowly organized Rodentia, about 620 species; thus shewing a gradual decrease in species in an increased ratio to higher development.

With regard to the lowly organized creatures being more numerous in specimens.

All who use microscopes will probably agree with me that an ordinary stagnant pond would probably contain more animalculæ than all the specimens of warm blooded Vertebrates existing in the world put together.

It is a fact also that these small creatures were equally numerous at very early geological periods.

Ehrenberg calculated that a cubic inch of the Bilin polishing slate contained the skeletons of forty-one thousand millions of fossil animalcules.

Now it appears to me that all the facts I have brought together are such as *a priori* might have been expected to be the case on the hypothesis of evolution; it would have been only reasonable to predict that the more highly developed creatures would require the longest time for their development individually, and also that they would in the process of development attain to the largest bulk; this I have shewn to be the case, and further, as development has taken place very slowly, the higher the organization the fewer both species and specimens.

It further appears that the highly organized creatures are very sensitive to external influences, and therefore numbers of species have become extinct, whilst on the other hand many of the lower forms have remained to the present day almost unchanged from those existing in very early geological periods.

Man at the present day is the commonest of all the warm-blooded Vertebrates, and there is every probability of his continuing so.

The time cannot be far distant when the noxious and most of the wild animals will be exterminated, and the domesticated races will occupy their feeding grounds.

Thus we may with confidence look forward to the time when mind shall completely dominate over matter, and a very comforting confidence it is, as it teaches us that what man has to do is to develope the latent forces of nature in accordance with his needs, and not look forward with gloomy forebodings to the failure of the supply of any valuable product of the earth, however necessary it may appear to be.

No doubt when man subsisted entirely by the products of the chase, when the wild animals daily became scarcer and more wary, he saw nothing before him but starvation.

Then the pastoral state arose, to be followed by the agricultural, and subsequently by the commercial.

We are now at the dawn of the scientific age of the world, and it behoves us all to take care, in the interest of humanity, to do our utmost to promote the victory of science over nescience.

COUNCIL'S REPORT

FOR THE YEAR 1872.

The Council, in submitting their Annual Report, are able to refer with satisfaction to the continued prosperity of the Society. The ordinary meetings have been well attended, several papers on scientific subjects have been read, many objects of interest have been exhibited, and animated discussions have arisen on topics suggested at the meetings.

The total number of members on the register at the close of the year was 135, including nine honorary members. During the year, 20 members have been elected, nine have resigned, two, Messrs. Samuel Brown and John Shove, have died, and two have been removed from the register for non-payment of subscriptions.

With a view to promote the study of Entomology and Botany amongst the members of the Society and their families, the Council, in the early part of the year, announced their intention of giving two prizes of £5 5s. each—one for the best Botanical collection, the other for the best collection of Lepidopterous Insects; all specimens to be gathered or taken within the West Kent District. The conditions to be observed by intending collectors were published and circulated amongst the members, and the Council hope that when the time arrives for adjudication, it will be seen, from the number of competitors, that the proposal of the Council has met with a hearty response, and that this attempt to foster amongst the members, the habit of personal collection, investigation, and independent research in these departments of science, has been productive of beneficial effects.

Meetings of the Society, 1872.

January 24th.—Mr. Glaisher made some observations on the Storm of the preceding morning, during the continuance of which the barometer at Greenwich fell to 28·22, being the lowest recorded reading of the present century, except 13th January, 1843, when it fell to 28·096. In the further discussion of the meteorology of the season, Mr. Glaisher stated that from the 2nd November to 12th December, 1871, the temperature was the lowest known at that period for 98 years, being 20° below the average.

Mr. Weir made some remarks on the geographical distribution of the Phasianidœ, elicited by a statement, which had recently been made in a celebrated trial, that a pheasant had been shot by the plaintiff when in South America; it being a well ascertained fact that the Phasianidœ are entirely confined to the Old World.

Specimens of the Lepidopterous families, Heliconidæ and Acræidæ, were exhibited and commented on by the same gentleman.

February 28th.—The Annual Meeting of the members was held, and the various officers for the year elected. After the formal business, the retiring President, F. Currey, Esq., F.R.S., Sec. & F.L.S., delivered an able address, reviewing the chief points of scientific discovery and investigation during the year 1871. This address was published in the last report of the Society.

March 27th.—The President exhibited a collection of the Pieridœ. He pointed out how they differed from the families exhibited on the 24th January, by possessing six legs in the perfect state in both sexes. He also directed the attention of the meeting to the curious fact, that in an order in which eye-like spots are so common, the Pieridœ are entirely without ocelli on the wings.

April 24th.—Dr. Spurrell exhibited a series of drawings of Fruits, Flowers, and Insects from Jamaica, and gave some interesting information respecting them.

The Rev. E. S. Dewick then read a paper on the sections exposed by the railway tunnel and cuttings at Sundridge Park, near Bromley. The paper was illustrated by drawings, and a collection of the fossils found in the cuttings.

May 22nd.—The President exhibited specimens of Gonepteryx Rhamni, the eggs of which had been deposited on the Rhamnus Alaternus in his own garden. From these eggs the perfect insect had been reared. The wonderful instinct of the butterfly had enabled it to select this shrub, which is a continental species, and totally different in appearance from the two species of Rhamni indigenous to this country.

June 29*th.*—On this day a Field Meeting was held. Dr. Spurrell very kindly conducted the members from Greenhithe, through Darenth Wood, to Dartford; and under his able presidency the meeting passed off pleasantly.

October 23*rd.*—Mr. Barrett exhibited a case of exceedingly rare British Lepidoptera, including Argynnis Lathonia, of which species, several specimens have been captured in the South of England during this year. The President also exhibited a collection of insects, caught by himself during the year at Abbot's Wood, Hailsham, Sussex, including two specimens of Agrotera Nemoralis.

November 27*th.*—Mr. Ritchie showed a singular cluster of pears, exemplifying pleiotaxy and prolification. From one stalk, four pears were produced by pleiotaxy. From the third pear in the series, a second stalk projected bearing a fifth perfect pear. Mr. Clift stated that in the beginning of the month a heron was killed in the grounds of John Penn, Esq., at Lee.

December 18*th.*—At this meeting Mr. J. C. Breese, an abstract of whose paper on the Earthworm was published in the transactions of the Society last year, was unanimously elected an Honorary Member.

Mr. Gooding exhibited two Slow-worms, which had been captured in a walled garden of a house situate in the Circus, Greenwich. It was considered remarkable that any of the lizard family should linger in so old an inhabited neighbourhood as Greenwich.

Mr. Hingeston read a paper on Gold and the methods of its refinement, upon which followed an interesting and animated discussion.

Soiree at the Crystal Palace.

The Council co-operated with the Directors of the Crystal Palace Aquarium Company in arranging for a Soirée to be held on November 6th in the Crystal Palace Aquarium, to which the members of this Society, with their friends, were invited.

The president delivered an able and instructive lecture on the Aquarium and its Inhabitants, an abstract of which is appended to this Report. Numerous appropriate microscopical objects were exhibited by members of the Society, thus adding greatly to the interest of the evening.

The Library.

The Council have much gratification in being able to state the circulation of the books is gradually increasing amongst the members, shewing that at last their exertions, in getting together a valuable collection of works on various subjects of Natural History, are being appreciated. They have been enabled to make a few useful additions in the past year, and they propose adding several standard scientific books during the present.

The following are the books purchased during 1872:—

Drury's Butterflies. 3 vols.
My Garden. *Alfred Smee.* 1 vol.
The Expression of the Emotions. *Darwin.* 1 vol.
The Tubularian Hydroids. *Allman.* Part II.
Popular Science Review, 1872.
Quarterly Journal of Science, 1872.
Quarterly Microscopical Journal, 1872.

Also have been received:—

Proceedings of the Manchester Literary and Scientific Society; Report and Papers of the Eastbourne Natural History Society; and Report of the Queckett Microscopical Club.

To facilitate members in obtaining books, the Library has been placed under the charge of Mr. Hodgson at the Post Office, Lee Bridge, Lewisham, and is open daily from 9 a.m. to 12 noon, and from 6 p.m. to 8 p.m.

AUDITORS' REPORT OF THE WEST KENT NATURAL HISTORY, MICROSCOPICAL AND PHOTOGRAPHIC SOCIETY.

For the Year ending December 31st, 1872.

Receipts.	£	s.	d.
Balance in Treasurer's hands Dec. 31st, 1871	37	1	7
Subscriptions in arrear collected in 1872 ...	12	1	6
Subscriptions, 1872	45	3	0
Subscriptions paid in advance for 1873	7	7	0
Sale of Moeller's Slide, damaged	1	11	6
	£103	4	7
Balance in Treasurer's hands, Dec. 31st, 1872	43	1	11

Payments.	£	s.	d.
Postages..	3	15	2
Clerk and Librarian	5	5	0
Printing..	11	14	6
Books, Periodicals, and Stationery	8	10	11
Expenses of Meetings, including attendance, teas, &c.	13	6	3
Total cost to the Society for Soirée at Crystal Palace..	17	4	1
Insurance	0	6	9
Balance in Treasurer's hands Dec. 31st, 1872	43	1	11
	£103	4	7

Audited and found correct,

LEONARD BIDWELL.
BRACKSTONE BAKER. } *Auditors.*

A LECTURE

DELIVERED BY

J. JENNER WEIR, Esq., F.L.S.,

President of the West Kent Natural History, Microscopical, and Photographic Society,

AT THE CRYSTAL PALACE SOIREE, NOVEMBER 6TH, 1872,

ON

"THE AQUARIUM AND ITS INHABITANTS."

THE aquarium in this building has now been open to the public since 22nd August, 1871. The perfection of the arrangements for insuring the health of the marine animals, which will survive in confinement, has now been put to the test of experience; and I therefore have had the greatest pleasure in responding to the wish of the Directors that I should on this evening give a lecture on the subject.

But before proceeding further, I wish to define what an aquarium really is.

All breathing animals breathe air, but in two different ways. Those that breathe by lungs oxygenate their blood by the oxygen contained in the atmospheric air drawn into the lungs; those that breathe by gills oxygenate their blood by the oxygen contained in the air always existing in water in its ordinary state; and some of the lower forms of life appear to be able to oxygenate their circulating fluids by simple exposure of the surfaces of their bodies to the water, but have no organs differentiated for the purpose.

An aquarium, therefore, is intended only for those animals which, in ordinary language, breathe or sustain life by absorbing the oxygen contained in the air always found in the water; and although a tank may be used for an animal that breathes the atmosphere, a tank made for such a purpose is no more an aquarium than is the tank in which the Hippopotamus bathes at the Zoological Gardens. In such tanks the water can never be kept in a pellucid state, and in most cases the body of the animal immersed is invisible, owing to the turbid state of the water.

You will thus at once understand why an elaborate and expensive apparatus is necessary to aerate the water in which, in a small space, numerous animals are confined, amounting often, in the case of the tanks in this building, to many hundreds in a single compartment.

The aeration of the water in the ocean is effected by the constant lashing of the waves into foam, and it is well known that during periods of long continued calm, especially in the tropics, multitudes of creatures perish, and the surface of the water is covered with their dead bodies, and the air above is tainted by the products of decomposition.

An aquarium, therefore, should be so constructed that by artificial means the same aeration takes place as is produced in the sea by natural means.

All this has been, in the Crystal Palace aquarium, carefully thought out and thoroughly provided for; and I cannot but consider that the result is a triumph of intellect which reflects the highest credit on the designer and constructor.

Nature has been followed, and her suggestions have been adopted.

For all the details of the construction of this aquarium, and for a complete description of the creatures in the several tanks, I must refer you to Mr. Lloyd's Official Handbook, in which the subject is admirably treated.

I shall confine my observations to some of the ideas which have arisen in my own mind when examining the creatures in this aquarium.

I now propose to run rapidly through the different classes of animals in the aquarium, and to draw your attention to some of the most remarkable facts connected with their organization and habits.

Beginning with the highest forms, the first creature I have to notice is well worthy of attention.

The Axolotl (*Siredon pisciformis*) belongs to that class of animals which in some respects are intermediate between Reptiles and Fishes. They commence life by breathing water through gills, and are Fishes; they then undergo a metamorphosis, lose these gills, acquire lungs, and may be said to be Reptiles. The Frog, Toad, and Newt are representatives of the class.

There are, however, in the class some which do not lose their gills, but which breathe water during the whole of their existence, and, until quite recently, the Axolotl was thought to be a perennial gilled species. Mr. Tegetmeyer kept several of these animals, which multiplied rapidly in the gilled state, and it was therefore thought that the perennial character of the gills was settled. Imagine, therefore, his surprise, and that of all naturalists, when one of these Axolotls, went through a metamorphosis, lost its gills, and during the rest of its existence breathed air. Here, therefore, we find a creature which, in the *adult* state, is sometimes a Tadpole, or Fish-like animal, and at other times a Newt, or Lizard-like animal. This interesting discovery was made by keeping these creatures in an aquarium, for up to the time of Mr. Tegetmeyers observation, the Tadpole form had been described by naturalists as Siredon, and the adult Newt-like form as Amblystoma.

I cannot but think that the extraordinary fact now substantiated throws a flood of light on the theory of evolution, the creature under consideration appearing in one species, or even in one specimen, to bridge over the gulf separating lung-breathers from gill-breathers.

This aquarium does not at present possess any other amphibian, but the order contains a great many species of interest, such as the eyeless Proteus, from the dark caverns of Carniola, which breathes both by lungs and gills, and the gigantic Salamander, from Japan, often three feet in length. This latter would be one of the most interesting additions to the aquarium, and would probably attract more attention than any acquisition that has hitherto been made.

It has been exhibited at the Zoological Gardens, but in a pond, where its form can with difficulty be seen; and being observed from above only, its extraordinary appearance is but dimly visible. If I might use the expression for any natural object, I should say it is the most hideous creature in existence.

The advantage of exhibiting an animal in an aquarium as compared with a pond is well illustrated by the fact that, at the Zoological Gardens, Turtles and Water Tortoises have been shewn for many years, and have attracted but little attention; but no sooner are Turtles seen in the aquarium at Brighton, than every one talks of their beautiful movements.

I shall now pass on to the true Fishes, of which several species exist in this aquarium.

All Fishes breathe air through the medium of water and invariably through their mouths, thus differing essentially from the

Mammals, Birds, and Reptiles, which breathe principally through the nose; the nostrils in Fishes, however, do not communicate with the breathing organs.

At the head of the Fishes stand the Cartilaginous Fishes. Their forms are familiarly known as the Sharks, including the Dog Fishes, and the Rays, including the Skates.

The smaller species of the Sharks, which are very numerous on our coasts, have not yet survived in this aquarium, but I do not doubt that the difficulty will be ultimately overcome.

As to the larger species, it would require a very large aquarium for them. The Basking Shark, by no means rare in the British waters, as many as sixty having been seen at one time, attains to the enormous weight of six tons.

Mr. Yarrell saw one at Brighton which measured thirty-six feet in length.

But to return to this aquarium. The Cartilaginous Fishes are here represented by the Angel Fish, a kind of flat Shark, and by the Skates. Both these thrive well, and the latter appear very lively.

The Skates are true flat fish; both the eyes are above, and are placed symmetrically in the head. The homologues of the fore-legs in the higher vertebrates are here modified into broad expansions on each side of the body, and are waved by the will of the animal. The two claspers which you will see them moving when endeavouring to climb the glass front of the tanks are the homologues of the hinder feet of the Reptiles and Mammals.

I think none of us who had seen only the repulsive looking Skates as they appear at the fishmongers, could have formed any idea of their graceful movements as here seen.

Most of the Fishes in the aquarium belong to the second division or sub-class of Fishes, the Osseous Fishes. These are divided into two great divisions or orders, the Spine-finned—the Perch is an example—and the Soft-finned, of which the Cod is an illustration. There are also two other smaller orders of Osseous Fishes, the Plated-mouthed Plectognathi; the Sun Fish is a fine example, which looks rather like the ghost of a Cod's head and shoulders.

The remaining order is the Tufted-gilled Lophobranchii. The strange form of the Fishes composing this order is well shewn in the Hippocampus, or Sea Horse.

The shape of the scales in Osseous Fishes also forms a good basis for their division; one division has the scale smooth and rounded, the other deeply toothed at the edges.

Perhaps the most singular Fishes in the aquarium are the Brills, Plaice, Flounders, and Soles. These Fish are not depressed as the Skate, which swims with its back uppermost; but they are compressed, and swim with one side upwards, the upper side being generally dark coloured and the under nearly white.

In the Holibut, Plaice, and Sole, the eyes are directed towards the right; in the Turbot and Brill, towards the left; in the Flounder, to the left, but nearly as often to the right. Several of the species commonly have more or less of the brown colour on the under side, and others more or less wanting in colour on the upper side.

It is very difficult to imagine what can be the determining cause as to which side a species should incline to, and still more in the case of individuals of the same species.

I believe myself the prevailing current of the sea frequented, combined with the direction of the shore, gave an advantage to one side over the other, and then by heredity the dextral or sinistral advantage became fixed.

Flounders, inhabiting the mouths of rivers and seeking their prey sometimes on the left and sometimes on the right bank, have not yet had their eyes determinately fixed either sinistral or dextral.

But let this be as it may, one fact is certain, that these asymmetrical flat fish are in their young state symmetrical, or, in other words, have their eyes like other fish, one on the right and the other on the left side of the body; and that afterwards the head is bent either to the left or right and the eye which would then have been underneath is moved round to the upper side.

An adult Turbot has been figured by Scleep, in which the eyes were still one on each side of the head. Other very curious cases have been figured both by Yarrell and Couch, in which the twisting round of the head had been imperfectly effected. All such abnormal fishes are equally or similarly coloured on both sides; the fish probably swam with either of its sides uppermost, and Dr. Traquaire, in his paper on the subject published in the the Transactions of the Linnean Society, observes that the "bony tubercles usually characteristic only of the ocular side of the Turbot are found equally distributed on the eyeless side in these abnormal specimens."

It would be exceedingly interesting to rear some of these young Turbots in the aquarium, and it perhaps may be done if sufficient food of a very small size could be given them, such as the roe of small fish; but it must be clearly understood that an aquarium and a breeding pond have little or nothing in common.

It has often struck me, when seeking for fish at the sea-side, and still more when quietly examining them in the aquarium, how very much the colour of these side-swimming flat fish assimilate to the sand or gravel on which they repose; the Brill, for instance, appears uniform and light-coloured when on sand, and dappled when on pebbles.

It appears that these fish can, apparently at will, change their colours in response to their environment, and that they have the power of contracting the dark colour into dapples or expanding it over the body until, by suffusion, the upperside becomes of a whity-brown.

In a most interesting communication made, I am told, on this subject to the British Association this year, it was shewn that by dividing the nerves by which the animal communicates its will to the muscles charged with the function of changing colour, the pigment cells were no longer under the control of the fish, but the colour remained in an accumulated patch in a certain space, which was surrounded, or nearly so, with white.

I have not had the pleasure of reading the paper, but shall be curious to ascertain whether the small bony tubercles on the back of the Brill, before adverted to, are points of attachment for these muscles.

The subject is a peculiarly interesting one, and the experiments are precisely of that kind which an aquarium would give the best facilities for.

One thing, however, appears certain, that these bony tubercles do not exist on the white or under side of the fish, unless it is abnormally partially coloured.

It must have struck every one that the size to which many adult fish attain is indefinite; quite unlike the higher vertebrates in this respect, which generally attain an average size, varying more or less in condition only.

Now, speaking generally, this arises from the law, that the size of an animal is determined by the quantity of food it can obtain, combined with the amount of exertion necessary to obtain it.

Take the common Jack as an illustration. When the Jack is young he can feed on fish so small that they must weigh but a few pennyweights; as he attains a larger size he can swallow prey weighing a few ounces, and as his size and powers of swallowing increase, he is able to take fish weighing a few pounds.

Therefore, if at the different periods of his life he is equally capable of finding food in profusion of the size he can master, his growth will not be stopped, but proceed indefinitely until he sometimes reaches a size of fifty pounds.

It would very rarely happen that in the whole course of his life these conditions were fulfilled, and therefore his growth would be stopped at a size much short of this.

And this is what occurs in nature. In a pond where the Jack are small they are generally numerous, and the contrary occurs in waters where the Jack are large.

Thinking it would be interesting to ascertain the food consumed in the aquarium during the year, I applied to Mr. Lloyd, who has been good enough to furnish me with the Billingsgate Bill of Fare. I find that during the year from August, 1871, to October, 1872, both inclusive, that the following quantity of food has been consumed, viz.:—

Food consumed by the Marine Animals in the Crystal Palace Aquarium from August, 1871, *to October,* 1872.

Mussels . .	2,604	Quarts.
Shrimps . .	869	,,
Cockles . . .	48	,,
Whelks . . .	8	,,
	3,529	,,
Whitings . .	329	
Haddocks, &c. .	32	
	361	in number.
Expense . .	£82	12s. 8d.

My brother sends me word that his fishmonger took 5lbs. weight of undigested Sprats from the stomach of a Cod which weighed only 14lbs, and from another a piece of serge about a yard square. But this fish often feeds on Crabs and Lobsters and easily digests them, shells and all, completely.

The Sharks are even more voracious. The stomach of one only six feet in length contained a Gurnard, a Conger, and a large Dogfish. Another contained a Garfish, four Mackerel, and as many uninjured Herrings as sold, even on the shore, for eighteen pence. Blumenbach writes of one which swallowed a Horse entire. There was exhibited at the further end of this aquarium a case containing stuffed specimens of two Pike of nearly equal size, which had perished in the endeavour made by the larger to swallow the somewhat smaller. The teeth of fish being generally directed backwards, render disgorging difficult, and, where the fish swallowed is large, impossible.

But all these instances of voracity fall far short of the case I now bring under your notice.

I have had a representation drawn to scale of a specimen of a fish in the British Museum, where it may be seen preserved in spirits, which has swallowed and actually forced into its stomach another fish three or four times as large as itself.

The fish was captured in the West Indies, near Dominica, where it is well known, it belongs to the same family as our own voracious Cod. It is named by naturalists Chiasmodus Niger. Dr. Günther is not quite certain of the name of the fish swallowed, but thinks it Scopelus Macrolepidotus. This very hearty meal proved the destruction of the specimen figured. The species is probably an inhabitant of the deep sea, having been captured at a depth of 312 fathoms, where, after a moderately hearty meal, it can remain in quiet and calmly digest his food below the disturbing influence of the waves; but in the present instance, having swallowed a fish of perhaps a less specific gravity than its own, it was quite unable to keep itself below the surface, on which it was found alive, but hopelessly gorged and incapable of escaping.

There are now living in the aquarium nearly fifty species of fish, all in excellent health, and many have increased very much in size. These high organisms might have been expected, seeing also the quantity of food they have consumed, to have made the water impure and turbid, but such is not the case; it is perfectly transparent, and you will observe no sediment at the bottom of the tanks, and I am told by Mr. Lloyd that there is almost none, even in the large tank underneath, which supplies the water for circulation. Notwithstanding more than a ton of food has been given to the creatures, the products of decomposition have been all dissipated by aeration and only pure sea water remains.

The health of the creatures is the strongest proof that the water in which they live is pure.

This I consider most creditable to the manager. How by induction Mr. Lloyd could have arrived at such perfect results, I do not know; but the results have been so arrived at, for he knows nothing of these creatures from sea-side observation, but he has developed this aquarium from his own mental consciousness within the bricks and mortar of London, Paris, and Hamburg.

It is a lesson to us all of the pursuit of knowledge under difficulties, that the best designed aquarium should have been thought out by one who absolutely has had no advantage on his side beyond indomitable tenacity of purpose, and, on the other side, a constant succession of hindrances.

To return again to the fishes, the order under consideration.

As I observed before, the pair of fins next the gills are the homologues of the fore-legs of the higher vertebrates, and the other pair of the hind-legs.

If you examine the fishes exhibited, you will observe that many of them, to make a bull, have the hind-legs before the fore-legs, that is to say, the ventral fins are more forward in the body than the pectoral. This is the case in the Blennies, Gobies, and Gurnards.

There are three species of Gurnard in tank 34, and I have watched their movements with the greatest interest. The ventral fins, which are distinctly in front of the pectoral fins, are not webbed together throughout; half of each fin is divided into three fingers.

It is very interesting to observe the use made of these fingers. The Gurnards are ground fish; they stealthily creep along the bottom of the sea and slowly approach within a short distance of their prey, and then suddenly pounce upon it, catch it in their capacious jaws and swallow it. In doing this they move deliberately forward by the action of these fingers on the ground, without moving their fins, which would disturb the water and frighten their prey; in fact, the action reminded me of that of a cat.

Compare this with the rapid dash a Cod makes as soon as he sees anything eatable, and, by a sudden action of the gills, he draws a stream of water into his mouth, and thus sucks in his prey.

The time at my disposal will not allow me to make any further remarks on the true fishes, and I shall therefore pass on to the consideration of the highest mollusca, the Cuttle Fishes and their allies, the Octopus and the Eledone.

I never think of this class of animals, known as Cephalopoda, or head-footed, without reflecting on the causes which could have led to the extinction of three of the families entirely, and the proximate extinction of a fourth family of the class. These four families, of which 2,333 species are known in the fossil state, are reduced in these days to the six species of Nautilus only.

Their places seem, in the present day, to be taken by the lower Mollusca, such as the water-breathing shelled Prosobranchiate Gasteropoda, of which about 8,500 recent species are known, and only 5,800 fossil; whilst of the Gasteropoda, which breathe by lungs, only 588 are known as fossil, against 6,335 recent.

The conditions of the struggle for existence must have very much changed at different epochs of the world's duration and favoured races, responding to their environment, became dominant, to give way when the environment was changed, to others better fitted under the new conditions to survive; so that, by the plasticity of natural objects, the world, in all the geological changes it has passed through, appears always to have had an abundance of ever-varying life.

Two genera of these Cuttles have survived in the aquarium, Octopus and Eledone, and they have been the most attractive creatures exhibited. It is much to be regretted that when in health they hide in the rocks, and are with difficulty made to exhibit themselves.

These two species crawl over rocks by means of their eight arms, so called, but in no way homologues of the arms of vertebrates, and move rapidly through the water by means of the forcible expulsion of water through a siphon, and also by a contraction of their tentacles, like the quick shutting of an umbrella.

The mode in which the suckers are attached and detached when the animal crawls in the glass is well worthy of observation. The creature makes a partial vacuum by drawing from the glass the central part of each sucker, and when it wishes to detach the sucker, it simply pushes the central part forward and draws back the edges of the disk, detachment at once takes place.

Sepia, the species which produces the pounce used for taking out ink blots, has lived in the aquarium a few days, and I had the delight of seeing it. The changes of colour when the creature was startled were wonderful; it may be said to have constantly blushed a most lovely purple. It was one of the most charming sights I ever witnessed; the change of colour in the Chameleon was not to be compared to it. I hope Mr. Lloyd's acumen will ultimately get over the difficulty of keeping this very interesting species, which has the great advantage over the Octopus in swimming about like a fish, by means of a membraneous expansion on each side of the body taking the place of a fin. The small species, Sepiola, has also lived for a short time in the aquarium.

Some of the species of Cuttle-fishes attain a large size. One was taken in the Atlantic which weighed two hundredweight.

I do not think that it will be necessary to note in so short a lecture any of the peculiarities of the shelled Mollusca, whether bivalve or univalve, and shall therefore pass on to the next class.

The well known Crabs, Lobsters, Prawns, and Shrimps, with which the Aquarium is amply supplied, are included in the Class Crustacea, which I shall now consider.

We are all so accustomed to the sight of the common Crab, that the strangeness of its form does not strike us. The name Crab is derived from a Greek word, which signifies an animal which walks on its head; and it really looks as if the ten legs were so attached, but this is only apparent, it is in no way real. The Crab, in common with most of its allies, has the body formed of 21 segments.

Probably all I address know perfectly well that a Butterfly commences life as a Caterpillar, hatched from an egg, changes its skin four times in that state, then becomes a Chrysalis, and ultimately a Butterfly.

It is not, however, so well known to you all that the Crab undergoes quite as remarkable a metamorphosis.

The female Crab brings forth a very large number of eggs; these each produce a minute creature, which is called a Zoea, and is so unlike a Crab that so recently as the year 1835 the fact was doubted by scientific men of eminence; however, by keeping Crabs in aquaria, and watching their development from the egg, the question has been long placed beyond the domain of controversy.

The Zoea is an active little creature, but of very small size; thousands have been produced in this aquarium, but owing to the impossibility almost, of supplying them with sufficiently small atoms for food, they have all probably perished, though of this I am by no means sure, and I should not be surprised to find that hundreds are still living, having discovered some food for themselves.

The change from a Zoea to a Crab is not effected *per saltum*, but in the next stage, which may be in some respects likened to the pupa state of Insects, the Zoea becomes a creature bearing a considerable resemblance to a Lobster, or Crayfish; that is to say, like those crustacea it has a long tail; it is, however, more like a species of Crab exhibited in the tanks of this Aquarium, called a "Galathea."

In this state the young Crab was known to Naturalists as a distinct genus, under the name of Megalopa.

The Megalopa changes into a Crab, the first change, however, not being quite the perfect form, which is attained in the fourth change.

After the last change the Crab is about the eighth-of-an-inch long, with a hard shell; it grows to the utmost contents of the shell, and as the shell is non-elastic, growth would be stopped but for the power the Crab has of casting its shell; this is one of the most wonderful facts in nature.

I have, myself, had numerous Crabs which have come out of their shells, molting both the exterior as well as the interior parts, the whole being cast together and remaining entire, so that I was constantly deceived into the impression that one of my Crabs had died.

Several molts take place before a Crab reaches its full size; it may be known whether it is quite mature by the fact that when the shell has remained unmolted for some time it becomes covered with barnacles, and in some cases Sea Weeds and Polyzoæ, this shows that the final size has been reached.

The changes from a Zoea to Crab are more marked than from a Zoea to a Lobster or Prawn, but they are similar in kind, and a metamorphosis may be said to exist in a greater or less degree throughout the Class Crustacea, being most marked, as might be expected, in the highest forms, and least in the lowest.

The highest forms, indeed, such as "Crabs," during their metamorphosis pass through stages closely resembling the perfect state of lower forms. The Zoea state of the Crayfish, Palinurus, so lately as 1855, was described and figured as a new species, under the name Phyllosoma, but Mr. Lloyd bred it at Hamburg, in 1866, and proved it was a Zoea.

The observer looking into one of the Aquaria cannot but be struck with the easy mode in which the Crabs, Lobsters, and Crayfish move about, so different from the movements of the marine species on land; this is due to the fact that their bodies are in most cases only slightly heavier than the water, the weight being thus taken off their legs gives them buoyancy. Some species, of which there are several in the Aquarium, have their hindmost legs flattened into paddles, with which they swim with ease. A Crayfish of 5 lbs. weight weighs but 2 oz. in water. The Hermit Crabs have very soft bodies, and for this reason seek the protection of a Whelk, or other shell; and I have always found the shell was also tenanted by a red worm, about three or four inches long, and not uncommonly by a Sea Anemone; all the species probably dependent on the Whelk shell to sustain and protect them from injury in the struggle for existence.

There are also some very small Crabs, common on the coast, which habitually live in the shells of Muscles, Cockles, and sometimes Oysters, choosing often shells even smaller than the extent of their outstretched legs, and always shells with the owner still living in them, whose occupancy they do not disturb.

I have often found these small Crabs in some numbers in the Muscles adhering to the wooden piles driven in to protect the shore at Brighton.

It would seem there is some mutual advantage, both to the Crabs and the Sea Anemones, in these singular associations; selection is certainly shown on the part of the Anemone; the Parasitic Anemone always chooses a whelk shell inhabited by the Bernhard Hermit Crab, but another species of Anemone, called Adamsia, is found adherent to a shell inhabited by Prideaux's Hermit Crab.

The Eyed Anemone *(Sagartia Coccinea)* is never found attached to a shell inhabited by a Crab, but often attaches itself to the shell of Turritella Communis, with its real owner still occupying it. I am naturally led on by these associations of Crabs and Anemones to the consideration of the Sea Anemones generally.

The extreme beauty of these lovely creatures, their general resemblance to flowers, combined with the possibility of keeping them in a very small quantity of water for years, caused them to be kept in Aquaria at an earlier date than almost any other marine creatures.

I am inclined to think it probable that the desire to grow these flower-like creatures was the strongest incitement towards the original invention and perfection of the Aquarium.

Although I have said they are flower-like in appearance, the resemblance is superficial only, it is in no way real. The Sea Anemones are as much Animals as are Fishes, Crabs, or Lobsters.

The sense of touch appears very highly developed, and they seize with great avidity any prey coming within reach of their outstretched tentacles.

The struggles of their victims are soon subdued by the power they have of stinging and paralyzing them.

This stinging property may be tested by any one sceptical on on the point, by allowing an Actinia to seize the tongue with its tentacles, the effect is very disagreeable, and a pain continues for hours.

These apparently soft and inoffensive-looking creatures are very voracious, Shrimps, Prawns, and Crabs are swallowed whole, and digested with ease; one has been known to swallow an Escallop, and another a Sea Hedgehog, in spite of its spines; it would have been thought these latter would have pierced the lining of the stomach, but the contrary took place; the action of the stomach rubbed off the spines and exhausted all the nutrition, the shell of the Sea Hedgehog being disgorged in a few days perfectly empty.

The Sea Anemones are the easiest kept in captivity of any marine creatures, and are certainly amongst the most beautiful. I have had one living in my hall for 14 years; during this period the sea water has been unchanged, and the only attention bestowed upon the Actinia has been to give it an occasional worm.

It was about ten years without moving from the spot to which it had adhered, and it would probably never have moved, had not an accident happened which rendered its chosen site untenable.

The time at my disposal is nearly exhausted, but I wish to say a few more words on the Ascidians. The larval or young stage of these creatures shews traces of structure approximating to vertebrates.

Mr. Darwin says, "We should be justified in believing that "at an extremely remote period a group of animals existed re- "sembling in many respects the larvæ of our present Ascidians, "which diverged into two great branches, the one retrograding in "development and producing the present class of Ascidians, the "other rising to the crown and summit of the animal kingdom "by giving birth to the vertebrate."

Now these Ascidians have appeared by hundreds in this aquarium, their active larvæ having been introduced with the sea water unwittingly. Tank 33 contains some fine specimens.

I beg you, however, to observe that, in the perfect form, the Ascidian in no way resembles a vertebrate. It is in the larval stage only that the trace of a common origin can be made out.

There is one more singular creature to which I shall draw attention, and it will be the last.

Few, perhaps none of the visitors this evening, know that existing alive in this aquarium is one of the longest creatures in creation, but such is the case.

The Nemertes Borlasii, in Tank 20, is about 150 feet long. I confine myself to 150 feet, but Mr. Lloyd tells me I could easily stretch the creature to 200 feet.

I have now finished my task. I am sure the subject has suffered at my hands, but I do trust some who have heard me may have their attention turned to that science which has to me been the solace of my life.

Marine Zoology may, in this aquarium, be studied in a manner our ancestors never dreamt of, and the study of Natural History becomes every day more and more important in a sanitary point of view. The peaceful nature of its pursuits have a most beneficial effect both upon the mind and the body, conducing, in these busy days, to health and longevity.

I was asked recently by a distinguished writer the average duration of life of the Fellows of a Society of Naturalists. I took the average for one year, and found it 70 years of age, and another year 73 years.

Lord Brougham said, "Blessed is the man that has a hobby," and it may be added, "Thrice blessed is he whose hobby is Natural Science."

RULES.

1.—The Society shall be called THE WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay in advance 10s. 6d. each per annum, and of honorary members.

3.—The affairs of the Society shall be managed by a council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of council shall be annually elected by ballot. The council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretary immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting 14 days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

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1873.

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Reptiles of British India. *Gunther.*
Shoulder Girdle, Monograph of. *Kitchen Parker.*
Tyneside Naturalists' Field Club, Transactions of.
Vegetable Teratology. *Masters.*
Voyage of the Novara. Vol. I. *Karl Scherzer.*
Ditto ditto Vol. II.
Ditto ditto Vol. III.
Zoological Record, 1864. *Gunther.*
Ditto ditto 1865. „

N.B.—The Books are now in the custody of the Librarian, Mr. Hodgson, Post Office, Lee Bridge, Lewisham, and may be obtained daily, from 9 a.m. to 12 noon, and from 6 p.m. to 8 p.m.

EDWARD CLIFT,
W. G. LEMON, } *Hon. Secs.*

WEST KENT

NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY.

THE

President's Address;

THE

COUNCIL AND AUDITORS' REPORTS FOR 1873;

AND

RULES, LIST OF MEMBERS, AND CATALOGUE OF BOOKS.

PRINTED BY
W. H. CROCKFORD, JUN., LEWISHAM, AND BLACKHEATH ROAD.
1874.

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LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society.

Elected at the Annual Meeting, February 25th, 1874.

FOR THE YEAR 1874–5.

President.

CHARLES HEISCH, Esq., F.C.S., &c.

Vice-Presidents.

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FLAXMAN SPURRELL, Esq., F.R.C.S.
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THE PRESIDENT'S ADDRESS,

By J. JENNER WEIR, Esq., F.L.S.

Annual Meeting, February 25th, 1874.

GENTLEMEN,

It is now two years since you did me the honor to elect me President of this Society, and, in accordance with the rules, I this evening vacate the chair.

The address which I purpose to deliver is therefore valedictory.

The study of Physical Science is daily growing in importance: the age in which we live is more remarkable than any other which has preceded it for the pursuit of truth.

Thinking men require some sound basis for their thoughts, this a knowledge of Physical Science supplies.

I am daily more and more convinced of the advantages of scientific study for training the mind to accuracy of thought, enabling the student to take a broad view of all subjects which may be brought before him.

In my last address I drew your attention to the numerous experiments which had been made by Dr. Bastian and others, to prove that under certain circumstances spontaneous generation takes place.

These experiments prove beyond all doubt that in certain turnip solutions, to which a little cheese had been added, life was developed after the solution had been boiled for some minutes, and hermetically sealed during ebullition.

So startling a result has caused other eminent men to make similar trials, and also to vary some of the conditions under which those adverted to were made.

The most important of these testing experiments were those of Dr. Burdon Sanderson, Mr. Ray Lankester, and the late Dr. Pode.

In an address of this character it is not necessary to detail the experiments they have made, but the result, I think, may very shortly be summed up.

It appears that if the experiment is very carefully performed, and the possibility of *Bacteria* contamination guarded against, if the infusion is boiled long enough, and further, if the temperature be raised some degrees above 212° Fahrenheit, then in all cases the tubes containing the infusion are barren of results.

With regard to another statement made by Dr. Bastian, in his work on "The Beginnings of Life," that transmutation of species often takes place amongst the lower forms of life, and that the same kind of spores will at one time produce a plant, and at another an animal, further investigation seems to entirely negative that view.

Professor Smith and Mr. Archer, of Dublin, who have made the study of the microscope *algæ* a speciality of their lives, have written a paper which has been published in the "Quarterly Journal of Microscopic Science," 1873, the tenor of which is utterly opposed to Dr. Bastian's doctrine of Heterogenesis.

These gentlemen go so far as to state that the asserted "facts of transmutation are not facts."

Upon the whole I am disposed to think that, if "abiogenesis" takes place in the present condition of the earth, it has yet to be proved.

It may occur to many of you that it matters little practically whether abiogenesis and heterogenesis are true or false ; I shall not pause to discuss this from a *cui bono* point of view, but at once admit there is much to be said in favor of economic science, without, however, disparaging the value of abstract science.

I was myself trained by a deep thinking economist, who held that knowledge was of no value unless it ministered in some way to the advantage of the human race.

Entertaining as I do the most profound respect for the teaching of my deceased friend, I propose to show the value of economic science by a few illustrations, and more particularly that branch to which I have paid most attention, viz : Economic Entomology.

In the study of Natural Science generally, one is often struck with the pains taken by authors to demonstrate that two closely allied, perhaps very small, species are distinct, and this applies equally to the Animal and Vegetable world.

The careless observer is often disposed to consider such minute investigations as useless, particularly when carried on by the aid of the microscope; but for my own part, the longer I live the more I feel grateful to those Naturalists who have made a study of the more minute forms of life.

The practical bearing of these studies can only be demonstrated when time brings about circumstances, and opportunities are offered for their application.

It is easy to guard our fields from the depredations of enemies of a large size. In Southern India and Ceylon it is not difficult to defend the crops from the marauding elephants, but the coffee planter finds himself helpless to prevent the ravages of a small *coleopteron*, called by him the "Borer," *(The Xylotrechus quadripes* of Chevrolat) which soon destroys his plantations.

Now mark how important it becomes in such a case to know perfectly the species the pest belongs to, the period when the egg is laid, the length of time the insect lives in the larval, pupal, and perfect state, and whether it is in turn destroyed by any other insect; without such facts how is it possible to devise a remedy for the evil?

I have been led to make these remarks in consequence of the serious insect plague which has lately appeared on the vine.

The insect to which I advert is the *Phylloxera vastatrix*, a minute species, which in the perfect state is not more than one-twelfth of an inch in length.

The *Genus Phylloxera* is included by most Naturalists in the same family which contains our well known and troublesome *aphides*, which in this country have so often caused almost the entire destruction of the hop crop, and are also great enemies to the horticulturist.

As the grape is grown over the whole of Southern and a large part of temperate Europe, the destruction by the *Phylloxera*, which is, I regret to say, now taking place in the vineyards, becomes a very serious national and international evil.

To give some idea of the mischief wrought, I may mention that in the French department of Vaucluse alone, a district about the size of the English county of Bedford, the loss by the ravages of the *Phylloxera* during the three years ended 1871, amounted to one million sterling in value.

I read in the newspapers that the vinyards in the Bordeaux district will this year produce no more than one-fifth of a crop, and I am told by my own wine merchant that the wholesale price of claret has doubled. Now, the question may be asked, what can the Naturalist do to assist the Viticulturist in this extremity?

The reply is, much every way.

The insect is probably of American origin, where it has fed on the indigenous species of vines, and as the several species existing there, some thirteen or so in number, have hitherto survived its attacks, it is probable they will continue to do so.

But it is far otherwise with the European vine, *Vitis Vinifera*, and with the hybrids produced between that and the American species of *Vitis*, viz.: *V. Labrusca*, *V. Æstivalis*, *V. Riparia*, and *V. Vulpina;* they have never been subjected to the attacks of the *Phylloxera*, and it therefore remains to be seen whether the *Vitis Vinifera* or the hybrids obtained from it will ultimately survive the attack.

The Americans, however, are fully alive to the advantages derived from a scientific knowledge of "Noxious and Beneficial Insects," and several of the States have for years past appointed a State Entomologist. I have the pleasure of being on friendly terms with the gentleman who holds the post of State Entomologist of Missouri, a country somewhat larger than England and Wales.

Mr. Charles V. Riley, to whom I advert, has made the *Phylloxera* a subject of special study, and has traced the insect through all its changes from the egg to the perfect state. He has shown that it is polymorphous—the appearance it presents when feeding on the root being widely different from that which it presents when found feeding on the leaves of the vine.

He has shown also, which might have been predicted, that the American indigenous vines are not so much injured by the attack of the insect as the introduced European species.

The French viticulturists, already acting on this knowledge, are importing American species of vines into France. If they succeed we may in a few years expect from France new kinds of wine.

To be forwarned is to be forearmed. The Legislature of some of the Australian Colonies have passed Acts of Parliament prohibiting the importation into the colonies of any species of *uitis* whatever; a very wise precaution.

Natural Science having ascertained the cause of the failure of the vine, for it must be borne in mind that, the pest (being so small, and attacking the roots as well as the leaves of the vine) was at first attributed to a wrong cause, sought the aid of the chemist to devise means for the destruction of the insect.

I find by Mr. Riley's fourth report to the State Board of Agriculture, Missouri, 1872, that the application of carbolic acid has produced the best result in America.

It is stated that an effectual remedy for the disease has been discovered in France by MM. Monestier Lautand and D.Ortoman, of Montpelier. These gentlemen place close to the root of the infected vine an uncorked bottle containing bisulphide of carbon. The vapour permeates the ground and kills the insect without, it is stated, injuring the roots of the vine.

It must be admitted that without Natural Science we might have remained ignorant of the cause of the vine failure, and without Chemical Science, carbolic acid and bisulphide of carbon would have been equally unknown. Still a more efficient remedy is wanted, as the prize of 20,000 francs offered by the French Government for an efficient remedy has not yet been awarded.

It is very much to be regretted that we have not in this country State Entomologists appointed, whose office would be to report on the subject of "Noxious and Beneficial Insects," and whose whole time might be given to the work.

Naturalists are not an ambitious class, and good men could be obtained for a very modest remuneration. A few hundreds a year would provide a Government Entomologist in each of the three kingdoms.

The failure of the vine would perhaps not be a very serious calamity in this country. Grapes grown out of doors are almost worthless, and most of the green-house and hot-house grapes are grown by the gardeners of the wealthiest classes in the community, and are purely articles of luxury.

The value of economic Entomology will perhaps be better appreciated if I draw attention to a threatened invasion from America of an insect pest highly destructive to that most valuable vegetable, the potato.

More than fifty years ago the insect to which I advert was known to Entomologists as inhabiting the Rocky Mountains, and feeding on a wild species of the potato genus.

Mr. Riley drew special attention to the insect, and figured the species as *Doryphora decemlineata* in his report to the Board of Agriculture of the State of Missouri for the year 1869. He then stated that the progress eastward of the insect from its home in the Rocky Mountains was at the rate of about seventy miles per annum, and at that rate it would reach the Atlantic Coast in 1878.

In the January number for this year of "Science Gossip," I find a most interesting letter on the subject, written by a gentleman apparently a German, under the initials of "Fr. H." from the "State of Illinois." It appears that the pest appeared in that district in 1865: "In 1868 Indiana was visited; in 1870 Ohio and the confines of Canada were reached, also portions of Pensylvania and New York, and its entrance into Massachusetts was notified."

He adds that before long we shall hear of them swarming in the streets of Boston and New York, and then their passage across the Atlantic is a mere question of time.

The ravages of this insect are so great, that where it exists it threatens to drive the potato out of cultivation, so that before long, if we wish to avert a potato famine, it will be necessary to pass a Contagious Diseases (Vegetables) Act, and place the American sacks of the esculent in Quarantine.

It is undoubtedly a very serious question. If the insect arrives in England it will probably be unaccompanied by the insects which prey upon it.

In America it has numerous enemies. Mr. Riley says that it is preyed upon by one *Dipteron*, four Ladybirds, five other species of Beetles, and four Bugs; and also that two species of Beetles, which are destructive to the potato, have this redeeming quality, that they occasionaly eat the pest under consideration, which is commonly called the "Colorado Potato Beetle."

Such numerous enemies have no doubt kept the beetle in check in the Rocky Mountains, and no doubt the balance of nature remained undisturbed so long as it fed on the wild *Solanum rostratum*—the plant and the insect throve together. But it is far different now it has attacked the Potato, the Tomato, and the Ground Cherry. These plants had all enemies enough to contend with before, and appear in most instances to have completely succumbed to the new pest, as the cattle of this country did recently when exposed to the contagion of the Rinderpest.

It is interesting to remark that a very closely allied species of the same genus, viz., *Doryphora juncta* (Germar), feeding also on a plant of the potato genus, viz., *Solanum carolinense*, Linn., has not yet attacked the Potato. This allied species is so like the true Colorado Beetle that an entomologist only could detect the difference; yet one species is extremely noxious and the other harmless. Here we have illustrated the advantages derived by closely allied species having been carefully described, and their distinctions shown by the entomologist.

No doubt the extension of the cultivation of the Potato to the base of the Rocky Mountains has enabled the insect to reach the most Eastern States by a vegetable bridge; and I must say I dread that the importation of potatoes from America will enable the insect to bridge the Atlantic. Besides, I have this week read in a horticultural publication that the more extended cultivation of the *Solanum rostratum* in England as an ornamental plant is recommended. If this insect does arrive in England it will establish itself, as other introductions from America, both animal and vegetable, have done, particularly so as the range of the species in the United States is so great both in latitude and longitude; and it appears to thrive better in the Northern than the Southern States.

I find from the returns of trade that Potatoes are imported into this country from the United States of America and from the Dominion of Canada; in a few years, therefore, the question will be settled whether we are to be visited by the Colorado Potato Beetle. I must confess that I entertain great anxiety on the subject, as I find that the insect progresses onward in its migration more rapidly in the Northern States and in Canada than in the more southern parts of North America. It is therefore probable that the climate of England would be favourable to its existence, if once a footing is established; and that it will shortly be introduced I entertain no doubt.

It has been proved that North American insects inhabiting the temperate region can exist in England, and that British insects do establish themselves and prove a pest in Canada and the United States.

Of the latter fact I could give several illustrations, but will content myself with one. Our common small cabbage butterfly has found its way into Canada. M. Provancher, writing in 1870 in "Le Naturiste Canadien," stated that since its arrival its *larvæ* had done more mischief than those of all other noxious butterflies put together in the same space of time—the value of the cabbages annually destroyed around Quebec alone amounted to about 240,000 dollars in value.

I think it very probable that the *Ichneumons Syrphi*, and other *Diptera* which prey on the *larvæ* of *Pieris rapæ*, have not been introduced into Canada with the small cabbage butterfly, and that, therefore, its ravages are unchecked by insect enemies; and I do not think from my own observations that the larva, pupa, or perfect insect are much eaten by birds.

This leads me to the consideration of another branch of economic Entomology, that of the introduction of indirectly beneficial insects—by this I mean those insects which prey upon noxious insects.

In this county, where the hop is so largely grown, and in some districts the greater source of the people's livelihood is obtained from its cultivation, economic entomology has been forced upon the farmers. Many habitually carry in their pockets a small magnifying lens, and examine the early leaves of the hop plants in fear and trembling, lest they may discover some of the dreaded *Aphides*. But, on the other hand, the farmer equally rejoices when he discovers the *larvæ* of the different species of lady-birds *Coccinellæ*, of the lace-winged fly *Panorpa*, and of the *Syrphi*, all engaged in preying upon the *Aphides* in their wingless but marvellously prolific state.

I do not think it is saying too much, that without the three kinds of insects named, the cultivation of the hop would in Kent be impossible.

A good illustration of the value of *Aphidivorous* insects was brought before the Entomological Society this year.

It appears that *Aphides* have been introduced into New Zealand, but at present no *Coccinella Panorpa*, or *Syrphus*, has accompanied them; their ravages are, therefore, very great. An application was made to the Entomological Society to suggest any mode by which the beneficial insects adverted to could be introduced.

The plan which found most favour was that proposed by Mr. R. McLachlan, also a member of this Society, to export the *ova*, *pupæ*, and, in the case of the lady-bird, even the perfect insects, to New Zealand packed in ice.

There is another difficulty in the agriculture of New Zealand, and, I believe, of Australia, arising out of the interdependence of plants and insects, which I will draw your attention to.

Mr. Darwin, in his work on the origin of species, mentions the fact that the red clover* was fertilised when growing strongly, only by the intervention of Humble Bees, the trunks of these insects alone being able to extract the honey from the flowers, and in so doing convey the pollen from plant to plant, and that where Humble Bees were plentiful, the red clover seed was produced in the greatest abundance; that the Humble Bees' nests were destroyed by field mice, and that field mice in their turn were killed by cats, so that where cats were numerous, as in the vicinity of towns, mice were less numerous, and Humble Bees more so; and that the yield of red clover seed might be expected to be greater near a town than in the less inhabited parts of the country.

You will observe that it would be a patriotic act if any emigrant would collect Humble Bees' nests in the autumn, and take them out to New Zealand packed in ice.

I trust that sufficient has been said to prove the importance of economic Entomology.

Now, the question naturally arises, is there an increasing love of Science in this country? I think there is.

The Government of the United Kingdom, interpreting as it always does the national will, has built for the accommodation of six learned societies, what may be fairly termed a palace at Burlington House. Here the Royal, Linnean, Chemical, Geological, and Astronomical Societies, and the Society of Antiquaries, are provided with ample space for their increasing libraries for years to come, and each society has good Council and Meeting rooms, and apartments for their librarians and attendants.

I am quite certain that the Government would not have thus recognized the claims of Science unless it felt that in so doing it would receive the support of the majority in this country.

Letters have lately appeared in *The Times* advocating the

* I have been always careful to use the words red clover, because, although red clover seed is not produced in New Zealand, owing to the absence of Humble Bees, but is always imported, the white clover (which, for the fertilization of the seed, does not require the intervention of Humble Bees, the corolla being shorter, the nectar is reached by the shorter trunks of other insects) spreads with truly wonderful rapidity, eradicating where it flourishes the indigenous herbaceous plants.

desirability of appointing a responsible Minister of State for Science.

It may be asked, How can this growth of scientific tastes among the people be shown? The reply to my mind is easily given.

The learned and scientific Societies of the Metropolis are constantly increasing in number, and the Fellows and Members of the old Societies are more numerous than ever. But there is another sign of healthy growth of scientific thought throughout the country, and that is the steady increase of local scientific societies and field clubs.

In one of the annual reports of this Society made not long ago, you will find a statement that this was the only scientific society on this side of the Thames within the Metropolitan district. Now I find there are six such societies in existence; one which has been established since our report was written has about 250 members. I believe our society stands next with about 150 members. The other four have a less number.

The local scientific societies throughout the country amount to little short of 150; some of these have more than 500 members on their registers. The societies which exceed this number in membership are the Cambridge Philosophical Society, Liverpool Naturalists' Field Club, Newcastle-on-Tyne Literary and Philosophical, Tyneside Naturalists' Field Club, Leeds Philosophical and Literary Society, and the Glasgow Philosophical Society. Many others have more than 400 members, and a still greater number have upwards of 300 members.

Of these societies I find that since the year 1860, inclusive, 70 of them have been established; and that prior to 1850 less than 50 of them were in existence. We may therefore say that within the last quarter of a century the number of local scientific bodies in this country has trebled.

In our own county there are now four scientific societies, viz., the West Kent, Mid-Kent, East Kent, and Folkestone Natural History, &c., Societies. The total number of members of these four falls but little short of 500—a very small per centage of the population, but still a hopeful number, inasmuch as it is greater than at any former period.

Addressing as I am a local society, it is not necessary that I should attempt a *resumè* of the various scientific treatises which have appeared during the past year; but I feel that I ought not to pass over without remark the valuable contributions made to Entomology in 1873 by Sir John Lubbock, who is both a Vice President of this Society and a resident in the West Kent district.

The most important work by Sir John Lubbock forms one of the series published by the Ray Society. It is entitled a "Monograph of the Collembola and Thysanura," hitherto very neglected groups of articulata, but now happily so thoroughly dealt with, so carefully described, and so accurately figured, that the study of them is rendered easy.

Most of the drawings for the anatomical plates have been executed by Sir John himself. In addition, there are figures of the species described, so lifelike that one has but to seek amongst decaying vegetation, and catch a few specimens, then return to the book, and in a few minutes their names are ascertained with ease.

The *Collembola* and *Thysanura* are very instructive groups for the consideration of the evolutionist, inasmuch as the structure of their mouths is in a measure intermediate between the haustellate and mandibulate forms of that organ in the articulata.

As regards the natural position of these creatures, Sir John is of opinion that they are not strictly insects, but that if the divisions of the *Articulata* are represented by a tree, the *Insecta Arachnida* and *Crustacea* might be said to form large branches; the *Collembola* and *Thysanura* also forming separate branches, but smaller than the other three.

The work is upon the whole a most welcome addition to the literature of science.

Another work produced by Sir John Lubbock during the past year forms one of the "Nature" series. It is entitled the "The Origin and Metamorphosis of Insects." Here in a crown octavo volume, so cheap as to be within the reach of all, a complete and well illustrated description is given of the metamorphosis of the whole of the *Insecta*.

The work is precisely of the class most wanted. Few students of Natural History could read it without edification, and the more general student may from its pages obtain a vast acquisition to his knowledge of the soundest scientific character.

Gentlemen, I now vacate the chair, and in doing so have heartily to thank you all for the cordial support you have given me during the two years I have had both the honour and the pleasure to preside.

It affords me great satisfaction to be succeeded by one so well qualified for the office of President as Mr. Heisch. He has made a study of a variety of subjects with which most of us are imperfectly acquainted, and I doubt not that under his able Presidentship we shall all be instructed and edified.

COUNCIL'S REPORT FOR 1873.

The Council have again the pleasure of reporting that the Society continues in a prosperous state, both as regards its finances and the number of its members. It will be seen from the Auditor's Reports, that though the receipts from Subscriptions during the year amounted to £66 5s., the balance in the hands of the Treasurer at the close of the year was somewhat smaller than at its commencement. This arises partly from the expenditure of about £12 at the time of the Soirée in the purchase of new tables and other articles of furniture which remain the property of the Society, available for use at its future meetings, and partly from the payment of a sum of five guineas as a prize for the best collection of Lepidoptera, awarded under the conditions mentioned in the last annual report.

There have been elected into the Society, during the past year, 18 new Members. Ten Members have resigned, and two have died, viz., Mr. Herbert Williams, and Mr. John Harding. The last-named gentleman was a member of the Council for many years ; and, prior to the failure of his health, was very regular in his attendance at its meetings, and took an active part in the affairs of the Society ; by his kind and genial nature he did much to promote the prosperity of the Society, and won for himself the respect and esteem of its Members.

Soiree.

On the evening of the 13th of May, a Soirée was given by the President, Vice-Presidents, and Council, to the Members of the Society and their friends, and was very numerously attended. Geological and Entomological Specimens, Microscopes, Photographs, Drawings, and other objects of scientific interest contributed by Members of the Society, were exhibited. The pleasures of the evening were much increased by the display of a brilliant series of experiments with the Magnetic Coil, under the direction of Messrs. Field and May, and by the exhibition of Natural

History Slides by means of the Oxy-hydrogen Microscope. The beautiful floral decorations of the room, contributed by John Wainwright, Esq., of Lee, were much admired.

At an early period of the evening, the President, in the name of the Society, presented to Mr. Clift a set of elegant mantle ornaments, consisting of a clock and pair of vases, which had been purchased by Members of the Society in recognition of Mr. Clift's valuable services as Honorary Secretary, and as a mark of their appreciation of his personal worth.

Meetings of the Society.

The ordinary Meetings have been well attended, and by the readiness with which Members have joined in the discussions, have afforded facilities for the interchange of scientific observations and ideas.

January 22nd.—The attention of the Members was chiefly directed to microscopic objects, and to the discussion of questions suggested by the objects exhibited.

February 26th.—The Annual Meeting was held. After the election of officers for the year, and other business, the President delivered a very able and instructive address, which has already been printed and circulated among the Members.

March 26th.—Dr. Armstrong read a paper upon "Some of the Chemical Changes which are supposed to take place in Plants." This paper was illustrated by elaborate diagrams, and was highly appreciated by the Members present.

April 23rd.—Mr. Barrett exhibited a Collection of rare Lepidoptera captured by him in the West Kent District during this season.

May 28th.—Mr. E. H. Robinson read a very instructive paper on "Flints," which he illustrated by numerous drawings and specimens.

October 22nd.—Dr. Spurrell exhibited specimens of various Grasses infected with Ergot, and remarked that this fungus was the cause of much illness amongst sheep, especially in wet seasons. The President exhibited Trigonophera Emphyrea, which he had captured at Lewes. Mr. Standring exhibited the upper jaw and palate of Gyrodus Cuvieri from the Norfolk gravel.

During the evening, the President announced that the Prize of Five Guineas offered by the Society for the best collection of Lepidoptera taken in the West Kent District, had been awarded to Mr. Barrett. In presenting the Prize, the President stated that the two judges (Mr. Stainton and himself) were of opinion that much credit was due to Mr. Barrett for having made so excellent a collection, and for the accurate knowledge of this department of Entomology displayed in the classification of the specimens.

November 26th.—The President read a paper on Hybridism, and brought before the Society instances of Hybrid birds which had proved to be fertile.

December 17th.—Mr. Billinghurst read a paper on "Cape Diamonds," which he illustrated by numerous and valuable specimens, showing the peculiarities of their form and colour, and gave explanatory remarks on the geographical distribution of diamonds, and on the various modes of diamond cutting.

Library.

The following books have been added to the Library during the year :—

- The Depths of the Sea. *By Wyville Thompson.*
- Monograph of Collembola and Thysanura. *By Sir John Lubbock, Bart.*
- Monograph of Numertean Annelids. *By Dr. Macintosh.*
- Popular Science Review, 1873.
- Quarterly Journal of Science, 1873.
- Quarterly Microscopical Journal, 1873.
- Astronomical Register. *Presented by T. W. Burr, Esq.*

There have also been received from the Societies :—

Proceedings of the Manchester Literary and Scientific Society, and Papers read before the Eastbourne Natural History Society.

According to the constitution of our Society, the President cannot hold office for more than two consecutive years, this necessitates the retirement of Mr. Weir from the chair he has so ably filled during the years 1872 and 1873. The Council desire publicly to record their high sense of the value of Mr. Weir's services as President, and especially of the great advantages which have accrued to the Members from his extensive and varied scientific acquirements, and from his readiness at all times to place before them the results of his labours and investigations. The Council have the satisfaction of recommending as his successor, Charles Heisch, Esq., F.C.S., who has consented to be put in nomination, and whose eminence as a chemist, and well-known attainments in other departments of science show him to be worthy of the acceptance by the Society.

In concluding their report, the Council would express the gratification it has afforded them to see some of the younger members take part in the proceedings at the Meetings. They hope that during the current year the Meetings will be yet more numerously attended, and that all the members will, either by contributing the results of their reading and observation, or by asking questions and in promoting one of the objects for which the Society was founded, viz., the cultivation of the true spirit of Scientific enquiry and research.

AUDITORS' REPORT OF THE WEST KENT NATURAL HISTORY, MICROSCOPICAL AND PHOTOGRAPHIC SOCIETY.

For the Year ending December 31st, 1873.

RECEIPTS.	£	s.	d.
Balance in Treasurer's hands, Dec. 31st, 1872	43	1	11
Subscriptions in arrear collected in 1873 ...	14	16	6
Subscriptions for 1873	43	11	0
Ditto · paid in advance for 1874	7	17	6
	£109	6	11
Balance in Treasurer's hands, Dec., 1873 ...	24	11	5

EXPENDITURE.	£	s.	d.
Two Years' Subscriptions to Ray Society	2	2	0
Prize for Entomological Collection	5	5	0
Clerk and Librarian	5	5	0
Bookseller and Stationer	5	15	4
Printer	14	18	9
Expenses of Meetings, including attendance, teas, &c.	12	0	6
Postages	5	1	1
Total cost of Soiree, including new tables, baize, &c.	33	16	5
Insurance and Sundries	0	11	5
Balance in Treasurer's hands, Dec. 31st, 1873	24	11	5
	£109	6	11

Audited and found correct,

LEONARD BIDWELL. }
HORACE FRANCIS. } *Auditors.*

RULES.

1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay in advance 10s. 6d. each per annum, and of honorary members.

3.—The affairs of the Society shall be managed by a council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of council shall be annually elected by ballot. The council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the council may determine. The chair shall be taken at 8 p.m , and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretary immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting 14 days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

HONORARY MEMBERS.

Bell, Professor T., F.R.S., F.G.S., Selborne, Hants.
Bossey, F, M.D., Oxford Terrace, Red Hill, Surrey.
Bowerbank, J. S., LL.D., F.R.S., 2, East Ascent, St. Leonard's-on-the-Sea.
Breese, Charles J., The Ferns, Lyonsdown Road, New Barnet, Herts.
Burr, T. W., F.R.A.S., 8, St. John's Park, Upper Holloway.
Collingwood, Dr. C., M.A., F.L.S., &c., Surrey Villas, Gipsy Hill.
Jones, Sydney, St. Thomas's Hospital.
Morris, John, F.G.S., Professor of Geology at University College, Gower Street.
Newman, Edward, Memb. Imp. L.-C., Acad., F.L.S., &c., 7, York Grove, Peckham.

LIST OF MEMBERS, 1874.

Airey, W., 15, Park Street, Westminster.
Armstrong, H. E., Ph. D., F.C.S., 8, Belmont Hill, Lee. *(Council.)*
Baker, Brackstone, 24, Belmont Hill, Lee.
Barnaby, Nathaniel, 18, Blessington Road, Lee.
Barrett, J. P., 33, Radnor Street, Peckham.
Barrow, R., Blackheath Park.
Battiscombe, Henry Ferdinand, 18, Lee Park, Lee.
Bayly, Henry, P. & O. Company, 122, Leadenhall Street.
Bidwell, Leonard, Lee Terrace, Lee.
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Claydon, Rev. E. A., 5, South Row, Blackheath.
Colchester, Henry S., 38, Manor Park, Lee.
Clift, Edward, Lee Bridge, Lewisham. (*Hon. Sec.*)
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Crosland, Newton, Lynton Lodge, Vanbrugh Park Road, Blackheath.

Currey, Frederick, M.A., F.R.S., Sec. L.S., 2, Vanbrugh Park, Blackheath. (*Council.*)
Currey, Fred. Innes, Vanbrugh Park Road, Blackheath.
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Dewick, J., Granville Park, Lewisham.
Dewick, Rev. E. S., Granville Park, Lewisham.
Dobell, H. W., Eltham.
Donkin, Bryan, Lloyd's Place, Blackheath.
Drew, Lewis, 8, Northbrook Road, Manor Park, Lee.
Drew, Thomas, 8, Northbrook Road, Manor Park, Lee.
Easten, John, jun., Stone House, New Cross.
Few, Rev. C. E., M.A., Belmont Park, Lee.
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Gordon, H. M., Courtyard, Eltham.
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Martin, Arthur, Shooter's Hill Road.
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Guide to study of Insects. *Packard.*
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Higher Cryptogamia. *Hoffmeister. Translated by F. Currey.*
Tubularian Hydroids. Part I. *Allman.*
Ditto ditto Part II.
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Microscope, History and Use of the. *Hogg.*
Microscope, Half-hours with the. *Lankester.*
Microscope, The, and its Revelations. *Carpenter.*
Ditto ditto (3rd edition) ,,
Microscopical Journal, 1859.
Ditto ditto 1860.
Ditto ditto 1861.
Microscopical Journal, 1862.
Ditto ditto 1863.
Ditto ditto 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
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Natural History Review. Vol. I.
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Photographic Journal. Vol. VI.
Ditto ditto Vol. VII.
Ditto ditto Vol. VIII.
Ditto ditto Vol. IX.
Ditto ditto Vol. X.
Popular Science Review, 1862.
Ditto ditto 1863.
Ditto ditto 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Ditto ditto 1873.
Prehistoric Times. *Lubbock.*
Ditto (2nd Copy.)
Pterylography. *Nitzsch.*
Quarterly Journal of Science, 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Ditto ditto 1873.
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Shoulder Girdle, Monograph of. *Kitchen Parker.*
Tyneside Naturalists' Field Club, Transactions of.
Vegetable Teratology. *Masters.*
Voyage of the Novara. Vol. I. *Karl Scherzer.*
Ditto ditto Vol. II.
Ditto ditto Vol. III.
Zoological Record, 1864. *Gunther.*
Ditto ditto 1865. ,,

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EDWARD CLIFT, } *Hon. Secs.*
W. G. LEMON, }

WEST KENT

NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY.

THE

PRESIDENT'S ADDRESS;

THE

COUNCIL AND AUDITORS' REPORTS FOR 1874;

AND

RULES, LIST OF MEMBERS, AND CATALOGUE OF BOOKS.

PRINTED BY
W. H. CROCKFORD JUN., LEWISHAM, AND BLACKHEATH ROAD.

1875.

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1875.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 24th, 1875,

FOR THE YEAR 1875-6.

President.

CHARLES HEISCH, Esq., F.C.S., &c.

Vice-Presidents.

H. F. BILLINGHURST, Esq.
FLAXMAN SPURRELL, Esq., F.R.C.S.
RICHARD THORPE, Esq.
H. G. NOYES, Esq., M.D., Lond.

Treasurer:

J. JENNER WEIR, Esq., F.L.S.

Hon. Secretaries.

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W. G. LEMON, Esq., L.L.B., F.G.S.

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H. E. ARMSTRONG, Esq., Ph.D., F.C.S.
E. CLIFT, Esq.
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JAMES GLAISHER, Esq., F.R.S., &c.
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JOHN STANDRING, Esq.
JAMES VOGAN, Esq.
B. WAINWRIGHT, Esq.
TRAVERS B. WIRE, Esq.

The President's Address,

By CHAS. HEISCH, Esq., F.C.S., &c.

Annual Meeting, February 25th, 1875.

Gentlemen,

When I thought over the addresses delivered by some of my predecessors, I felt that it would be idle for me to attempt to speak to you on any subject exclusively connected with Natural History; and when I turned to the other subjects embraced in the title of our Society, I found that, so far as my limited knowledge went, there had been so little of novelty during the past year, that I could find nothing with which worthily to occupy your time. I therefore determined to lay before you a few thoughts on a subject to which my attention has been recently much directed; I mean the advantages to be derived from free communication between the students of sciences, which at first sight, might be thought to have but little in common. It has been objected that the title of our Society is cumbrous; perhaps it is so, but the title proclaims the great fact that our Society is not exclusively devoted to one object, and I would willingly put up with a still more cumbrous title if, by so doing, I could insure the scope of our Society being still further enlarged. I propose to night to lay before you two or three instances in which subjects comparatively remote, have been found to have an important bearing on one another. We have among us several gentlemen devoted to mechanical studies, and who I happen to know would often gladly bring mechanical subjects before us, but they have hesitated to do so because they could not see how they came within the scope of our Society. Now let any microscopist look at an instrument by such a maker as the late Andrew Ross, and he must be struck with the difference in the perfection of its optical and mechanical parts, and be ready to say to himself, what a pity that man was not more of an engineer, or had not taken hints even from a good scaffolding carpenter. Take, for example, the adjustment of an objective for different thickness of covering glass. At present the front combination is screwed forward or backward, so that as it approaches the middle, it recedes from the object, and *vice versâ*, the result being that the object is thrown out of focus and the adjustment made, comparatively speaking, at hap hazard. Years ago Lister pointed out that the adjustment ought to be made by altering the position of the other portion of the objective, leaving the distance between the front and the object unaltered, by which means the observer could see when the best effect was obtained. One or two object glasses were made for him in this manner, but (it is almost a shame to have to say so) the mechanical difficulty of manufacture was so much greater, that though the objectives were very superior, no more have been made. Can we believe that if a real mechanic gave his attention to the subject this state of things would long remain? Again, we all know the necessity, both in microscopes and photographic cameras, for adjusting the aperture of a lens to the work it has to perform, and we know how perfectly this is done in the eye, the pupil expanding or contracting under different circumstances exactly to the extent required. Compare this with the sets of stops with different sized holes, which we are accustomed to put into our lenses one after another, till we get the best effect we can, but which we often feel is not just the thing we want, and you will at once feel the want of a good mechanically adjusting diaphragm. Well, at last an approach has been made to this by what has been called the Iris diaphragm, one of which I have in this condenser. It consists, as you see, of four thin pieces of metal, each with a notch cut in the end and placed over the lens in such a manner as to leave an octagonal aperture. Each of these pieces has a pin on it, and over them is a circle of brass with four curved slots in it, into which the pins fit, and it is so arranged that as the brass circle is turned in one direction, the four pieces which constitute the diaphragm are brought nearer to the centre of the condenser, at exactly the same rate, the aperture becoming gradually smaller, while if the circle be turned in the opposite direction the diaphragm pieces move away from the centre, and the aperture becomes larger. This movement can of course be made while we are observing, and thus the best possible effect be secured. The only disadvantage of this arrangement is, that there is a slight change of form in the aperture, as it is contracted, but for most purposes this is unimportant. Now this method of making four points simultaneously approach the centre of a circle had been known to mechanics for years before any one thought of applying it to this particular purpose. Free communication between optical and mechanical students might have given us this instrument much sooner. Again, would anyone look to obtain an illustration of the motion of air in storms while attempting to improve a gas burner? Yet such has been done; here is a burner just short of perfection, the supply of air in the centre not being quite sufficient to burn all the carbon, and the ignited particles of carbon show us the movement of the currents of air, which, rushing into the upward current of the burner from all sides, produce a circular movement illustrating to the eye the movement of air in a storm. One more illustration and I have done. There exists in the young bark of the willow and the poplar a substance called salicin. This white crystaline body which, chemically speaking, is a glucoside of saligenin, a substance having the composition $C_7 H_8 O_2$. When this is treated with oxidizing agents it yields water and salicylic aldehyde ($C_7 H_8 O_2 + O = C_7 H_6 O_2 + H_2 O$), a body bearing the same relation to saligenin that ordinary aldehyde does to alcohol. If we distil salicin with a mixture of sulphuric acid and bichromate of potassium, an operation which has been going on all this time in the retort before me, we obtain this body, which is you see, a yellowish oil, and which you will find has a very powerful odour. Now this oil is identical with that which exists in the common meadow sweet (*spirœa ulmaria*), and is, therefore, peculiarly interesting to chemists as being, so to speak, a natural product, artificially produced and connecting spirœa oil with the alcohols. These facts were known to chemists for years, but it was only in 1850 that Liebig made an observation which brought salicin within the domain of the naturalist, namely, that the larva of a beetle, the chrysomella populi, which lives on the poplar and willow, secretes, especially when frightened or irritated, spirœa oil from some small glands near the tail. There can be no doubt that this is produced by the oxidation of the salicin of the willow bark eaten by the larva. Processes of oxidation in the animal body are so numerous, that such an action is not in itself surprising, but we are led to ask why this larva is furnished with organs specially for secreting this oil, and why it is ejected when the creature is alarmed or irritated? Has this larva any special enemies to whom the smell of spirœa oil is offensive? This and other interesting inquiries naturally suggest themselves, and that which began as a chemical research ends by being a subject for the naturalist. Need I say more? When any subject is brought before us by our Members, do not let us ask too curiously, how does this come within the scope of our Society? Every well observed fact is a stone in the great fabric of truth, and which of us shall say when it will find its proper place in that edifice where alone its true use and beauty can be understood.

The Council's Report for 1874.

The Council in presenting the Sixteenth Annual Report, have the satisfaction of congratulating the Members on the general prosperity of the Society.

It will be seen by the Auditor's Report that the Financial condition of the Society was never better; the balance brought forward at the commencement of the year was £24 11s. 5d., and that after the usual expenses of the meetings, and purchase of books and binding had been defrayed, the sum carried forward to the next year's account amounts to £47 12s. 10d.

The number of Members remains the same as last year, the losses by death and resignation having been filled up by the election of new Members.

The Council have to regret the death of Mr. T. W. Bun, one of the original honorary members, who, although living at some distance from this neighbourhood, took a warm interest in the welfare of the Society.

The Council regret to announce that Mr. Clift, who for 16 years has so ably filled the office of Hon. Secretary, has resigned. They cannot allow him to retire without expressing their deep sense of the valuable services rendered by him to the Society since its formation.

The Council also regret that Dr. Noyes, who has held the office of Treasurer since the formation of the Society, has tendered his resignation, and they desire to record their thanks to him for his services during that period.

The papers read during the year have not been quite so numerous as could be wished, considering the number of Members and the high scientific attainments of many of them.

There has been no falling off in the attendance at the meetings, at which many interesting objects have been exhibited..

Mr. E. Purser read at the January Meeting a paper on Coprolites, in which he pointed out the distinction between true coprolites and the coprolites of commerce.

Mr. C. H. Jordan exhibited some sessile barnacles of very large size, taken from the bottom of an iron ship at Madras.

In February the usual business of the Annual Meeting was transacted, and the retiring President, Mr. J. Jenner Weir, delivered an address, which has been printed and distributed.

The meeting in March, when Mr. Heisch took the chair, was chiefly devoted to the exhibition of microscopes; many objects were shown, Mr. Wire exhibiting pleurusigma angulatum, with a new immersion lens of great power, by Gunlach, which defined very distinctly the fine markings of that diatom.

Mr. Graham shewed some very neatly prepared mountings of diptera on mica, so arranged that the upper and under side of the insects could be easily examined.

In April the President read a valuable and instructive paper on the use of gas for photographic and domestic purposes.

In May Mr. Weir made some remarks on the backwardness of the vegetation at Hailsham, the oaks at Blackheath being in full leaf, and in the former locality but just bursting their buds; he also exhibited a series of agrotera nemoralis, from Abbot's Wood, near Hailsham, and stated that he had found the woodcock breeding near Petersfield, the nest containing the usual number of four eggs.

In June the Members of the Society dined together at Gravesend, when an interesting discussion took place upon the true nature of the whitebait.

The usual field meeting was held at Greenhithe in October, when, under the guidance of the President, the hyoscyamus niger was found growing wild; this plant had not been seen in the district for twenty years or upwards.

At the Ordinary Meeting in the same month, Mr. Weir exhibited specimens of the mantis religiosa, which he had captured at Meran, together with the singular egg cases of the insect, found adhering to stones.

Mr. Heisch exhibited some specimens of tea which had been sunk in the Thames, afterwards redried and fraudulently thrown upon the market; the odour of the tea was partly retained, but the theine had been removed.

In November Mr. Standring exhibited specimens of the phylloxera vastabrix, from Portugal.

Mr. Wilfred Airy read a most interesting paper on the Shetland Islands, which he had visited during the summer.

The December meeting, owing to the severity of the weather and the heavy fall of snow, was attended by so few Members that nothing of importance took place.

The additions to the library have not been very extensive, but the following books have been purchased:—

Bukeley's Outlines of British Fungology.
Lowe's British and Foreign Ferns. 8 vols.
Bowerbank's British Spongiadœ. Vol. 3.
Monograph of British Annelids. Part 2.
Popular Science Review, 1874.
Quarterly Journal of Science, 1874.
Quarterly Microscopical Journal, 1874:—

Presented by the Societies:—The proceedings of the Manchester Literary and Scientific Society, of the Bristol Natural History Society, and the Eastbourne Natural History Society. Also, by the Author, a pamphlet on the Nervous System of Actinia, by Professor Martin Duncan.

WEST KENT NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

Auditors' Report for the year ending December 31st, 1874.

RECEIPTS.	£	s.	d.
Balance in Treasurer's hands, December, 1873	24	11	5
Subscriptions in arrear paid for 1871		10	6
Ditto ditto 1872	2	12	6
Ditto ditto 1873	10	10	0
Ditto paid for 1874	47	5	0
Ditto paid in advance for 1875	2	12	6
	£88	1	11
Balance in Treasurer's hands, December, 1874	17	12	10

PAYMENTS.	£	s.	d.
Expenses of Meetings, including refreshments and donation for rooms.....................	13	10	10
Clerk and Librarian	5	5	0
Bookseller and Stationer	7	4	0
Printer	9	13	3
Postages..	4	9	3
Insurance		6	9
Balance in Treasurer's hands, Dec. 31, 1874	47	12	10
	£88	1	11

Audited and found correct, LEONARD BIDWELL, HORACE FRANCIS, } *Auditors.*

RULES.

1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay in advance 10s. 6d. each per annum, and of honorary members.

3.—The affairs of the Society shall be managed by a council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of council shall be annually elected by ballot. The council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretary immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting 14 days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

HONORARY MEMBERS.

Bell, Professor T., F.R.S., F.G.S., Selborne, Hants.
Bossey, F., M.D., Oxford Terrace, Red Hill, Surrey.
Bowerbank, J. S., LL.D., F.R.S., 2, East Ascent, St. Leonard's-on-the-Sea.
Breese, Charles J., The Ferns, Lyonsdown Road, New Barnet, Herts.
Collingwood, Dr. C., M.A., F.L.S., &c., Pembroke Villa, Central Hill, Upper Norwood.
Jones, Sydney, St. Thomas's Hospital.
Morris, John, F.G.S., Professor of Geology at University College, Gower Street.
Newman, Edward, Memb. Imp. L.-C., Acad., F.L.S., &c., 7, York Grove, Peckham.

LIST OF MEMBERS, 1875.

Airey, W., 7, Queen Ann's Gate, Westminster. (*Council.*)
Armstrong, H. E., Ph. D., F.C.S., 8, Belmont Hill, Lee. (*Council.*)
Baker, Brackstone, 24, Belmont Hill, Lee.
Barnaby, Nathaniel, 18, Blessington Road, Lee.
Barrett, J. P., 33, Radnor Street, Peckham.
Barrow, R., Blackheath Park.
Battiscombe, Henry Ferdinand, 18, Lee Park, Lee.
Bayly, Henry, P. & O. Company, 122, Leadenhall Street.
Bidwell, Leonard, Lee Terrace, Lee.
Billinghurst, H. F., St. Alban's Villa, Granville Park, Blackheath. (*Vice-President.*
Breffet, E., The Glebe, Lee.
Borroughs, J. T. R., M.R.C.S., Manor Villa, Lee.
Brabrook, E. W., F.S.A., 11, Limes Villas, Lewisham.
Burton, J. M., F.R.C.S., Lee Park, Lee.
Busk, C., 12, Vanbrugh Park, Blackheath.
Cable, George Hughes, M.R.C.S. Eng., Royal Hill, Greenwich.
Carr, W., M.D., F.R.C.S., 6, Lee Terrace, Lee.
Chambers, W. E., Eversfield, Sutton, Surrey.
Claydon, Rev. E. A., 5, South Row, Blackheath.
Colchester, Henry S., 38, Manor Park, Lee.
Clift, Edward, 71, Granville Park. (*Council.*)
Cradock, R. W., Belvedere.
Crosland, Newton, Lynton Lodge, Vanbrugh Park Road, Blackheath.
Currey, Frederick, M.A., F.R.S., Sec. L. S., 2, Vanbrugh Park, Blackheath. (*Council.*)
Currey, Fred. Innes, Vanbrugh Park Road, Blackheath.
Davis, Robert, jun., Aberdeen Terrace, Blackheath.

Dawson, W. G., Plumstead Common.
Dewick, J., Granville Park, Lewisham.
Dewick, Rev. E. S., Granville Park, Lewisham.
Dobell, H. W., Eltham.
Donkin, Bryan, Lloyd's Place, Blackheath.
Drew, Lewis, 8, Northbrook Road, Manor Park, Lee.
Drew, Thomas, 8, Northbrook Road, Manor Park, Lee.
Duncan, Professor, P.M., M.D., Blessington Road, Lee.
Easten, John, jun., Stone House, New Cross.
Finch, F. G., B.A., D. Sc. Lond., 21, Crooms Hill, Greenwich.
Francis, H., 8, Church Terrace, Lee.
Glaisher, Jas., F.R.S., F.R.A.S., Dartmouth Place, Blackheath. (*Council.*)
Glaiser, W. R. M., 5, Grote's Buildings, Blackheath.
Gooding, R., M.D., Heath Lodge, The Grove, Blackheath.
Gordon, H. M., Courtyard, Eltham.
Graham, J. A., Stone Lodge, St. John's Road, Upper Lewisham Road. (*Hon. Sec.*)
Gray, William, Kendall House, Blackheath Park.
Groves, T., jun., Charlton.
Groves, William, 28, Manor Park, Lee. (*Council.*)
Groves, William, Grove House, Shortlands, Bromley.
Guest, B., 26, Granville Park, Lewisham.
Hasdell, H. D., 1, St. Andrew's Terrace, Dallyell Road, Stockwell.
Hay, F., Argyll Cottage, Lee Road.
Heisch, Charles, F.C.S., The Hollies, Greenhithe. (*President.*)
Hingeston, C. H., Clifford House, Lewisham.
Hitchcock, Harry Knight, M.R.C.S., St. Clare, College Park, Lewisham.
Hooper, Thos., Chilton Cottage, Southbrook Road, Lee.
Horton, B., Lewisham Bridge.
Hosking, James, 50, Granville Park, Lewisham
Hudson, Alfred, 13, Royal Place, Greenwich.
Ingall, W. T. F. M., Knockholt, Swanscombe, Kent.
Jackson, Henry Wm., M.R.C.S., F.R.A.S., F.G.S., 15, Limes Terrace, Lewisham.
Jackson, W. G., Crooms Hill, Greenwich.
Jones, Francis, Clevedon Villa, Granville Park, Blackheath.
Jordan, Charles H., 21, Circus Street, Greenwich.
Keen, P., 34, Manor Park, Lee.
Kelso, Charles, 2, Northbrook Villas, Burnt Ash Lane, Lee.
Knill, Stewart, The Crosslets, Grove, Blackheath.
Lavers, Thomas Howard, Belmont Hill, Lee. (*Council.*)
Lawrence, Hugh, Lee Terrace.
Legge, Gordon, Blackheath Park.
Lemon, W. G., LL.B., F.G.S., 20, Montpelier Row, Blackheath. (*Hon. Sec.*)
Lethbridge, J., Granville House, Blackheath.
Lindley, W. H., 10, Kidbrook Terrace, Blackheath.
Low, Edward, Aberdeen House, Blackheath.
Low, Frank Harrison, Aberdeen House, Blackheath.

Lubbock, Sir John, Bart., M.P., F.R.S., &c., High Elms, Farnborough, Kent.
MacLachlan, Robert, 39, Limes Grove, Lewisham.
MacLennan, G., Granville Park, Lewisham.
Marten, Rev. R. H., B.A., Blessington Road, Lee.
Martin, Arthur, Shooter's Hill Road.
Mills, Frederick V., 155, Fenchurch Street.
Noyes, H. G., M.D. Lond., M.R.C.P.L., Brandram Road, Lee. (*Vice-President.*)
Nursey, Rev. Claude, 12, Lillieshall Road, Clapham.
Owst, Clement, Blessington Road, Lee.
Peacock, John, Wickham Terrace, New Cross.
Pearce, Edward R., 10, Bexley Place, Greenwich.
Penn, John, F.R.S., The Cedars, Lee.
Pope, H., 5, Sydney Terrace, Lewisham.
Purser, E., 7, St. John's Park, Blackheath.
Ritchie, J. H., jun., Cedar Bank, Hyde Vale, Blackheath. (*Council.*)
Robinson, Henry, Eliot Park, Blackheath.
Rock, W. F., Hyde Cliff, Crooms Hill, Greenwich.
Roper, Arthur, M.R.C.S., 9, Granville Park, Lewisham.
Rucker, John A., Blackheath.
Sams, John S., M.R.C.S., Eltham Road, Lee.
Sharpe, Cecil, Verner's Lodge, Belmont Park, Lee.
Sharpe, Frederic, Park Villa, Bexley Heath.
Simon, L. M., Paragon, Blackheath.
Smith, F. W., Bellefield, Blackheath Park.
Smith, Samuel, 21, Granville Park, Lewisham.
Smith, W. Johnson, F.R.C.S., Seamen's Hospital, Greenwich.
Smith, Wm. Scott, 21, Granville Park, Lewisham.
Simson, Thomas, The Laurels, Courtyard, Eltham.
Slater, Robert, 8, Dartmouth Row, Blackheath.
South, John F., F.R.C.S., Blackheath Park.
Spencer, Henry, Shooter's Hill Road.
Spencer, J. B., 9, Kidbrook Terrace, Blackheath.
Spurrell, Flaxman, F.R.C.S., Belvedere. (*Vice-President.*)
Spurrell, Flaxman C. J., Belvedere.
Stainton, H. T., F.R.S., F.R.G.S., Mountsfield, Lewisham. (*Council.*)
Standring, John, Dacre House, Lee. (*Council.*)
Standring, Walter J., Dacre House, Lee.
Stuart, Charles, Verners Lodge, Belmont Park, Lee.
Swanzey, Andrew, F.L.S., F.R.G.S., The Quarry, Sevenoaks.
Sweet, George, 12, King's Bench Walk.
Tate, J. P., 32, Blessington Road, Lee.
Taylor, Francis T., M.D., Claremont Villa, Upper Lewisham Road.
Taylor, James, 26, Duke Street, St. James's.
Teede, Charles, 12, Granville Park, Lewisham.
Thorpe, R., Manor Park, Lee. (*Vice-President.*)
Tustin, J. J., 9, Paragon, Blackheath.
Tustin, J. R., Hatcham Manor Works, Old Kent Road.
Valentine, George, 9, Eliot Place, Blackheath.

Vogan, James, Granville Park, Blackheath. (*Council.*)
Vogan, Randall, Blackheath Park Terrace, Lee Road.
Wainewright, B., Belmont House, Lee. (*Council.*)
Wainewright, John, Belmont House, Lee.
Wainewright, R. Spencer, Belmont House, Lee.
Walton, William, Paragon, Blackheath.
Weir, J. Jenner, F.L.S., Haddo Villas, Blackheath. (*Treasurer.*)
Weir, Percy Jenner, 6, Haddo Villas, Blackheath.
Wigner, G. W., Roseberry House, Wickham Road, New Cross
Wilson, H., 39, Limes Grove, Lewisham.
Wire, T. B., Crooms Hill, Greenwich. (*Council.*)
Wood, Henry T., Little Bognor, Fittleworth, near Pulborough, Sussex.
Young, C. J., 55, Blessington Road, Lee.

CATALOGUE OF BOOKS.

Actinia, on the Nervous System of. *Duncan.*
Animals and Plants under Domestication. Vol. I. *Darwin.*
Ditto ditto Vol. II. ,,
Animal Kingdom, General View of. *Rymer Jones.*
Antiquity of Man. *Lyall.*
Astronomical Register for 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Botanical Works. Vol. I. *Brown.*
Ditto Vol. II. ,,
Ditto Vol. III. ,,
Botany, Reports and Papers on. *Henfrey.*
British Annelids, Monograph of. *MacIntosh.* Part I.
Ditto ditto ,, Part II.
British Birds, History of. Vol. I. *Yarrell.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
British Birds, Nests and Eggs of. Vol. I. *Morris.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
British Diatomaceæ. Vol. I. *Smith.*
Ditto ditto Vol. II. ,,
British Entomostraca. *Baird.*
British Esculent Funguses. *Badham.*
British and Exotic Ferns. Vol. I. *Lowe.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
Ditto ditto Vol. IV. ,,
Ditto ditto Vol. V. ,,
Ditto ditto Vol. VI. ,,
Ditto ditto Vol. VII. ,,
Ditto ditto Vol. VIII. ,,
British Fishes, History of. Vol. I. *Yarrell.*
Ditto ditto Vol. II. ,,
British Fungology. *Berkeley.*
British Foraminifera. *Williamson.*
British Hemiptera Heteroptera. *Douglass and Scott.*
British Land and Fresh Water-Mollusks. *Lovell Reeve.*
British Molusca. Vol. I. *Forbes and Hanley.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
Ditto ditto Vol. IV. ,,

British Sea Weeds. Vol. I. *Harvey.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
Ditto ditto Vol. IV. ,,
British Spiders, History of. Vol. I. *Blackwell.*
Ditto ditto Vol. II. ,,
British Spongiadæ. Vol. I. *Bowerbank.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
British Stalk-eyed Crustacea. *Bell.*
British Zoophytes, History of. Vol. I. *Johnston.*
Ditto ditto Vol. II. ,,
Bryologia Brittanica. *Wilson and Hooker.*
Cirripedes, Monograph of. Vol. I. *Darwin.*
Ditto ditto Vol. II. ,,
Collembola and Thysanura, Monograph of. *Lubbock.*
Descent of Man. Vol. I. *Darwin.*
Ditto ditto Vol. II. ,,
Depths of the Sea. *Thomson.*
Entomology, Handbook of. *Burmeister.*
Exotic Entomology. Vol. I. *Drury.*
Ditto ditto Vol. II. ,,
Ditto ditto Vol. III. ,,
Expression of the Emotions. *Darwin.*
Fauna of Blackheath. Part I. Vertebrata.
Foraminifera, General Introduction to the. *Carpenter.*
Fresh Water Polyzoa. *Allman.*
Garden, My. *Smee.*
Geology, Observations on. *John Hunter.*
Genesis of Species. *Mivart.*
Guide to Study of Insects. *Packard.*
Heavens, The. *Guillemin.*
Higher Cryptogamia. *Hoffmeister. Translated by F. Currey.*
Tubularian Hydroids. Part I. *Allman.*
Ditto ditto Part II.
Index Entomologicus. *Wood.*
Index Testaceologicus. *Wood.*
Infusoria, History of. Vol. I. *Pritchard.*
Ditto ditto Vol. II. ,,
Journal of Photographic Society. Vol. IV.
Ditto ditto Vol. V.
Ditto ditto Vol. VI.
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Ditto ditto Vol. VIII.
Manchester Literary and Philosophical Society, Memoirs of. Vol. I.
Ditto ditto ditto Vol. II.
Ditto ditto ditto Vol. III.
Ditto ditto ditto Vol. IV.

Man's Place in Nature. *Huxley.*
Memoirs on the Cetacea. *Eschricht, &c.*
Micrographic Dictionary. *Griffith and Henfrey.*
Microscope, The Achromatic. *Richard Beck.*
Microscope, Essays on the. *Adams.*
Microscope, How to Work with the. *Beale.*
Microscope, History and Use of the. *Hogg.*
Microscope, Half-hours with the. *Lankester.*
Microscope, The, and its Revelations. *Carpenter.*
Ditto ditto (3rd Edition) ,,
Microscopical Journal, 1859.
Ditto ditto 1860.
Ditto ditto 1861.
Ditto ditto 1862.
Ditto ditto 1863.
Ditto ditto 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Ditto ditto 1873.
Ditto ditto 1874.
Natural History Review. Vol. I.
Ditto ditto Vol. II.
Ditto ditto Vol. III.
Ditto ditto Vol. IV.
Ditto ditto Vol. V.
Oceanic Hydrozoa. *Huxley.*
Orchids, Monograph of the. *Darwin.*
Origin of Civilization. *Lubbock.*
Origin of Species. *Darwin.*
Photographic News. Vol. I.
Ditto ditto Vol. II.
Ditto ditto Vol. III.
Ditto ditto Vol. IV.
Ditto ditto Vol. V.
Ditto ditto Vol. VI.
Ditto ditto Vol. VII.
Ditto ditto Vol. VIII.
Ditto ditto Vol. IX.
Photographic Journal. Vol. VI.
Ditto ditto Vol. VII.
Ditto ditto Vol. VIII.
Ditto ditto Vol. IX.
Ditto ditto Vol. X.

Popular Science Review, 1862.
Ditto ditto 1863.
Ditto ditto 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Ditto ditto 1873.
Ditto ditto 1874.
Prehistoric Times. *Lubbock.*
Ditto (2nd Copy.)
Pterylography. *Nitzsch.*
Quarterly Journal of Science, 1864.
Ditto ditto 1865.
Ditto ditto 1866.
Ditto ditto 1867.
Ditto ditto 1868.
Ditto ditto 1869.
Ditto ditto 1870.
Ditto ditto 1871.
Ditto ditto 1872.
Ditto ditto 1873.
Ditto ditto 1874.
Rambles of a Naturalist in the China Seas. *Collingwood.*
Reptiles of British India. *Gunther.*
Shoulder Girdle, Monograph of. *Kitchen Parker.*
Tyneside Naturalists' Field Club, Transactions of.
Vegetable Teratology. *Masters.*
Voyage of the Novara. Vol. I. *Karl Scherzer.*
Ditto ditto Vol. II.
Ditto ditto Vol. III.
Zoological Record, 1864. *Gunther.*
Ditto ditto 1865. ,,

N.B.—The Books are in the custody of the Librarian, Mr. Hodgson, Post Office, Lee Bridge, Lewisham, and may be obtained daily, from 9 a.m. to 12 noon, and from 6 p.m. to 8 p.m. (Sundays excepted.).

Note.—All communications should, in future, be addressed to the Hon. Secretaries, Stone Lodge, St. John's Road, Upper Lewisham Road, and P. O. orders made payable to J. A. Graham, at the Post Office, Lewisham.

J. A. GRAHAM, } *Hon. Secs.*
W. G. LEMON, }

WEST KENT

Natural History, Microscopical, and Photographic Society.

THE

PRESIDENT'S ADDRESS

AND

Reports of the Council and Auditors

FOR 1879-80,

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

Printed by

W. H. CROCKFORD, JUN., PRINTER, BLACKHEATH ROAD, AND LEWISHAM.

1880.

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1880.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 25th, 1880.

FOR THE YEAR 1880-81.

President.

W. G. LEMON, L.L.B., F.G.S.

Vice-Presidents.

T. H. LAVERS.
R. McLACHLAN, F.R.S., F.L.S.
F. SPURRELL, F.R.C.S.
H. T. STAINTON, F.R.S., F.L.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH.
H. WILSON.

Council.

H. E. ARMSTRONG, Ph. D., F.R.S., Sec. C.S.
H. F. BILLINGHURST.
E. CLIFT.
F. CURREY, M.A., F.R.S., Sec. L.S.
T. O. DONALDSON, M. Inst. C.E.
G. H. FREAN.
W. GROVES.
H. W. JACKSON, M.R.C.S., F.R.A.S., F.G.S.
J. STANDRING.
F. T. TAYLER, M.D.
J. VOGAN.
J. JENNER WEIR, F.L.S., F.Z.S.
C. G. WOOD.

REPORT OF THE COUNCIL

FOR THE SESSION 1879-80.

The Council, in presenting the following Report for the past Session, are able to congratulate the members on the continued prosperity of the Society, the numerical strength of which is now six honorary and 118 ordinary Members.

The Council note with deep regret the loss of one who for many years took so great an interest in this Society—A Swanzy, Esq., F.L.S., F.R.G.S.

The Treasurer's Accounts up to the 31st December, 1879, have been duly audited, and shew a balance of £11 3s. in favour of the Society. Although the amount brought forward last year was considerably larger, the expenses of the Soirée have been defrayed during the present Session, as well as an item for Printing, &c., in 1878 (the account of which has only just been received), and also the cost of a new Book-case. There is a large number of Subscriptions still in arrear, and Members are reminded that Subscriptions are payable *in advance* (see Rule 2).

During the past Session the lecture by Dr. Henry Woodward, F.R.S. (as announced in the previous Report), was delivered, and another was also given by Dr. T. Spencer Cobbold, F.R.S., on the 28th January, 1880 ; both of these were well attended.

The Soirée was held at the rooms adjoining the Congregational Church, Blackheath, on Wednesday, the 14th May, 1879, and the large number then present proved its great success. The Council tender their sincere thanks to Dr. H. Woodward, F.R.S., and Mr. W. Webster, jun., who so kindly volunteered to give a series of Lecturettes during the evening; to the Members of the New Cross Microscopical and Natural History Society; and to the many Members and friends of our own Society, who exhibited such valuable and interesting collections.

The Annual Dinner took place at the "Prince of Wales" Hotel, Erith, on the 5th July, at which 20 Members and their friends were present. The subject for discussion was "Gulls."

On the 19th July a Field Meeting, to which Ladies were invited, was held at Dartford Heath, under the guidance of the President, assisted by Flaxman Spurrell, Esq., F.R.C.S. Notwithstanding the uncertainty of the weather, the numerous attendance showed that this meeting is thoroughly appreciated, and your Council believe it will become one of the institutions of the Society.

The Cryptogamic Field Meeting took place on the 4th October, when Flaxman Spurrell, Esq., F.R.C.S., with his customary kindness, met the Members at Northfleet Station, and conducted them through Swanscombe Wood to Greenhithe.

Many objects of interest have been exhibited, and the following papers read at the meetings of the Society.

On the 26th March, by Dr. H. E. Armstrong, F.R.S., &c., on "The influence of Manures on the character of Vegetation."

On the 23rd April, by E. H. Robertson, Esq., on "Flint: its Nature and Origin."

On the 28th May, by J. Jenner Weir, Esq., F.L.S., F.Z.S., on the "Physical Geography of Rivers."

On the 26th November, by H. T. Stainton, Esq., F.R.S., &c., on "Leaf-rolling Caterpillars."

On the 17th December, by the President, on "The Cosmopolitan Butterfly" (Painted Lady), and its extraordinary abundance in 1879."

On the 22nd October, J. Jenner Weir, Esq., F.L.S., F.Z.S., exhibited some Photographs of Italy; J. Standring, Esq., some Mushrooms, taken from his vaults in the City; and the President, various Lepidoptera, collected by Captain Markham, R.N., at Nova Zembla.

The Council would be glad if the Members, particularly those who have recently joined, would shew their interest in the Society by reading papers at the ordinary Meetings, and the Hon. Secs. would be pleased to receive an early intimation of the subjects. The Council would also ask the Members to bring with them any objects or specimens which they think would be likely to be of interest.

The Library has been examined, and the following new books have been purchased and added to it:—

"Microscopical Journal," 1879.

"Popular Science Review," 1879.

"The Voyage of H.M. Ship Challenger," by H. N. Mosely.

The Council have to thank Miss E. A. Ormerod and Dr. T. Spencer Cobbold for the pamphlets presented by them, and especially W. Walton, Esq., for the donation of a set of *Nature* (nearly complete) in numbers.

A new Bookcase has been purchased, and placed in the hall of the Mission School. In order to afford the Members greater facilities for availing themselves of the use of the books, the Rev. E. Waite, M.A., the Head Master of the School, has kindly consented to take charge of them, and they can now be obtained from him either by personal or written application, as well as in the ordinary way on the evening of the Society's Meetings.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

For the Year ended 31st December, 1879.

RECEIPTS.

	£	s.	d.
Balance in hand on 1st January, 1879	74	17	3½
Subscriptions, 1876	0	10	6
,, 1877	1	1	0
,, 1878	3	13	6
,, 1879	22	11	6
,, 1880 (in advance)	2	2	0
	£104	15	9½

PAYMENTS.

		£	s.	d.
Expenses of Meetings, including refreshments		3	17	6
Donation for use of Room		5	5	0
Fee to Librarian		5	5	0
Subscription to Ray Society, 1879		1	1	0
Insurance of Books, &c.		0	9	0
Cost of New Books		2	9	3
Stationery, Postage, Binding, &c.		8	15	3
Soirée Expenses		21	15	7½
Miscellaneous		4	16	8
Lecture by Dr. Woodward		5	5	0
Printer's Bill, 1878	£11 3 0			
,, 1879	11 10 6			
		22	13	6
Book-case		12	0	0
Balance in hand on 31st December, 1879		11	3	0
		£104	15	9½

Audited and found correct,

20th February, 1880.

JAMES VOGAN,
PERCY J. WEIR, } *Auditors.*

ADDRESS

DELIVERED BEFORE THE MEMBERS OF

THE WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

BY

The President, R. McLACHLAN, Esq., F.R.S., F.L.S.,

On 25th February, 1880.

GENTLEMEN,

When twelve months ago I had the pleasure of addressing you, my remarks were prefaced by a few general observations on the condition of this Society. I pointed out that our financial position was very strong. I pointed out also some means of dissipating a portion of what some might be disposed to consider superfluous wealth. As our present balance is not much more than one-sixth of that of last year, it may be well to notice some of the principal means by which it has been reduced, even although these may have been already alluded to in the Report of the Council which you have just heard read. The expenses of our Soirée naturally absorbed a considerable amount; the printer's bill for *two* years is included in the present balance-sheet; we have had two extraordinary Lectures by scientific gentlemen of high position; lastly, the urgent necessity for providing suitable accommodation for our Library has been met by the purchase of a substantial book-case; some amount has also been expended in books. Our balance ought to have been much larger; and in connection with this I regret to say our Treasurer has on his list far too great a number of members who are in arrear with their subscriptions; I hope these will take the hint thus thrown out.

Our numbers remain much in the same condition as last year; there is no increase, but, at the same time, there is no material decrease.

We have had a Paper on five of the ordinary meetings; and on one other (January 28th) we had an extraordinary lecture, so that the interest of our meetings has been well sustained. But it is still of paramount necessity that members furnish the Hon. Secretaries with the titles of Papers they propose reading during this year. We still want more exhibitions of interesting objects at our meetings, and especially more microscopes. In former years, when I occasionally had the privilege of attending the meetings of this Society as a visitor, and for some time after I became a member, I remember that the number of microscopes was the most distinctive feature. I cannot think the tastes and pursuits of our members change like the fashions, and believe that only a little judicious stimulus will restore this, to me at any rate, interesting part of the proceedings at our monthly meetings.

We have faithfully carried out the usual programme of excursions and social meetings, and have repeated the innovation of 1878—the Ladies' Field Day. All these have been well attended, and we were particularly fortunate regarding the weather, the especial cause of so much disappointment to many such gatherings in that pluvial year 1879.

In concluding these general remarks, the new arrangements with regard to giving our members more easy and frequent access to the Library, for the purpose of borrowing and returning books, should not be lost sight of. Our Library contains many really useful and valuable works, and access to it could not possibly be attended by less trouble than under the new system.

This time last year the ordinary routine of devoting the annual addresses to the consideration of some special subject connected with our studies was somewhat departed from, and I then took the opportunity of entering into an examination of our position as a factor in the general scheme for promoting the study of Natural Science. On this occasion I purpose saying nothing more about OURSELVES than you have already heard in my preliminary remarks. I shall fall back upon the system of most of the Addresses of former years; and the principal object I intend to say something about is our noisy, familiar, and impudent Common House Sparrow (*Passer domesticus*).

Some of you may feel inclined to ask why I have chosen a subject so utterly vulgar? or why I did not elect to enter into a discussion or explanation of some points of what may be termed transcendental Natural History? When I have concluded the few remarks I intend making this evening, I hope to have convinced you that I had an object in view, and dare to think you may have learned something about our little friend, for such I prefer to term him, notwithstanding the atrociously bad character some attribute to him. I am not about to tell you anything concerning his loves, his quarrels, his nesting habits, and other points with which all are familiar. But it may be well to say a few words on his geographical distribution. This may be briefly stated as comprised in the whole of Europe, the greater part of Asia, North Africa, &c.; but the authority from which I quote—"Yarrell's British Birds," 4th edition, edited by Professor Newton—states that it is still an unsettled point whether the Sparrow of India be specifically identical or not. Yet it may be news to some to learn (according to the same excellent authority) it does not appear to have shown itself in the Outer Hebrides till about 1830; that there are still isolated spots in the Scottish Highlands to which it is a stranger; and that it has only appeared in Siberia since the Russian conquest; war, trading, and exile having apparently served a purpose in the economy of Nature that was certainly never thought of. It has been imported into Australia, New Zealand, Mauritius, Réunion, Bermuda, Cuba, and the Continent of North America; and it is about its existence in the last-named that I shall presently especially direct your attention, as it formed the *raison d'être* of the choice of "The Sparrow" as a subject for my Address this evening. In a few words, it may be said that the Sparrow cannot exist without the society of civilized man. All who have visited the Alps must have been struck by the paucity or absence of Sparrows, excepting in the large towns. I remember when, in 1876, I made an excursion into the heart of the Alps of Dauphiné, the Sparrow disappeared, apparently entirely, a short distance up the Valley of the Isère, after leaving the City of Grenoble. I can recall to mind the small town in which I saw the last sparrow on a long and hot diligence ride; after leaving this place it was not seen. The poor Alpine villages, in which one wonders how man himself can exist, do not afford sufficient luxuries to accommodate both man and sparrow, and the long dreary months of snow probably destroy the latter even when it does effect a temporary settlement.

Where then, or what then, was the Sparrow in those far remote ages in the history of this earth when man had not learned to build towns and cities? Were there in the days of pre-historic Man, pre-historic Sparrows also; and have the latter so far modified their habits that they could not exist if some natural revolution should suddenly arrest the progress of civilization in man, destroy his cities, and throw him back once more into a condition parallel with that of his barbaric ancestors? You may say these questions are purely speculative; but, to my mind, they are perfectly legitimate in considering subjects in which the connection between man and a wild bird is so essentially close as is now the case with Man and the House Sparrow. Their solution appears to be impossible unless on the supposition that the Sparrow of the stone age (supposing there to have been such an almost inconceivable thing) was a very different bird to that of the present day, and that evolution in habits, if not also in structure, must have been unceasingly at work in order to produce such an undisguised little parasite as we now see.

Now, as to the vexed question as to whether the Sparrow is, or is not, useful to man. For my part I should say the conditions are about equal. No one doubts that he consumes a vast quantity of grain and seeds; but few doubt that he also consumes a multitude of noxious insects. There is one period in his annual history in which he is almost entirely insectivorous: that is when he has young in the nest, or young that have recently left the nest, but cannot cater for themselves. My study looks on to a small garden in which are a few standard roses, which, after the manner of roses, are dreadfully infested by "Green-fly" *(Aphides)*. At this period the Sparrows come, and gather beaks'-full of Green-fly, which they carry to their ever hungry progeny. At this time the Sparrow's habits are entirely changed, and he becomes a veritable mimic, assuming the character of a Titmouse by creeping back-downwards under the coping of walls in search of larvæ, spiders, &c.; and so effectually taking the *rôle* of a Fly-catcher, catching insects on the wing, that I have several times been startled by the apparent presence of the latter bird in the most unlikely places (as, for instance, in the heart of the City of London), until undeceived by discovering the true nature of the performer.

This brings me to what I have termed the *raison d'être* of the subject chosen for this Address. Probably about fifteen years ago (I am not sure of the exact date) our American cousins were clamorous for the introduction of the Sparrow into their continent as a means of destroying certain noxious insects to which the native birds paid little or no attention. This was effected, and the involuntary immigrants were treated with every care and attention. Boxes were put up for them to breed in; everything was done to ensure their comfort and increase. Now, from nearly all parts of the States, we hear loud demands for their destruction. One of the most celebrated American ornithologists, Dr. Elliott Coues, leads a band of determined Americans who see in our Sparrow nothing but what is bad. He has just published (in No. 2, Vol. v. of Hayden's Bulletin of the United States Geological and Geographical Survey) a bibliography of the Sparrow-controversy, enumerating nearly 200 articles (with references) from 1867 forwards, from the time when congratulation passed into doubt, and then into malediction; great expectations have been followed by disappointment, and now there is a wild cry for revenge. This cry is being rapidly echoed. We, here, do not see the greater part of the American journalistic literature, but enough has been seen to enable us to satisfy ourselves as to which way the wind is blowing. The very last number of the "American Naturalist" (February, 1880), has two very characteristic notes. In one of these a correspondent complains that for two years the much-dreaded European cabbage-worm (the larvæ of *Pieris rapæ*, an involuntary importation on the part of our American friends) has been infesting the cabbage in his vicinity, and "that other pest, the European Sparrow" will not—or at any rate only casually—devour them, though a native bird known as the "Chipping Sparrow" was as busy as possible in performing that duty. Dr. Coues himself heaps indignity upon our Sparrow in the second notice, by reproducing a letter from a correspondent, who says he actually found our Sparrow pulling up sprouting peas (who has *not* caught him at this in England ?), and that his only feathered associate is a very objectionable native bird, adding "It would be difficult to find a more disreputable pair." Such a decided bias as is shown in these (and many other) notices, seems to me decidedly unfair. Our American friends imported the Sparrow; they took the greatest care of him; he increased and multiplied very rapidly; he has followed American civilization almost over its footsteps, for he is now to be found in those cities that none but Americans could call into existence, even to the Far West. He was imported in the first instance without (I venture to think) sufficient knowledge of his habits. He was expected to devour, at all seasons, all kinds of noxious insects, and, as a most unpardonable sin, it is now recorded that he refuses to nourish himself even upon Colorado Beetles and Rocky-mountain Locusts. He is accused of being noisy and pugnacious to the extent of driving away all native birds from the localities in which he has established himself. As to his self-assertion and pugnacity, few will probably question these statements; yet, may it not be just possible that the advance of civilization, so distinctly favourable for the Sparrow, may have had something to do with the disappearance of native birds, which, naturally, can accommodate themselves to those changed conditions only by a modification of their original habits? He is accused of not devouring those noxious insects he was expected to attack; still, may it not be possible there is something protective in the nature of those insects, which secures them against the attacks of all birds? It has been very truly, I think, said of the Sparrow in this country, that it is still a question whether the benefit conferred (during the breeding season) is not an equivalent for the corn and seeds stolen during the rest of the year, and that any means devised for its indiscriminate destruction must be regarded with the utmost abhorrence. (See Yarrell's "British Birds," 4th edition, Vol. ii., p. 92.) If the advantages of living in a free country have not so far intensified, in America, the ultra-radical proclivities of our Sparrow, as to have eliminated from his nature those certainly good qualities he possesses here, I venture to predict our generous kinsmen on the other side of the Atlantic will end by tolerating him, and, probably, by an inward conviction that the *absence* of our Sparrow would leave with them, as with us, a blank impossible to fill up.

Gentlemen, it remains for me to thank you heartily for the courtesy and forbearance you have exercised towards me during the two years in which I have filled this Chair. I have been deeply sensible that I have been wanting in one very important point—local influence. You will remember that in my last Address I alluded to some dangers that may, in my opinion, beset a Society like ours. As one of the chief of these I hinted at the possibility that such a Society might be made use of for the purpose of securing local notoriety and advertisement. You have chosen as my successor a gentleman above suspicion in this respect—he is already one of the most notorious men in this district—and I look upon the possession by him of that local influence in which I acknowledge myself deficient, as of happy augury for our future welfare.

RULES.

1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay in advance 10s. 6d. each per annum, and of honorary members.

3.—The affairs of the Society shall be managed by a Council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione*.

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretary immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secs., Post Office, Lee Bridge, Lewisham, S.E.*

HONORARY MEMBERS.

Bell, Professor T., F.R.S., F.G.S., Selborne, Hants.

Bossey, F., M.D., Oxford Terrace, Red Hill, Surrey.

Breese, Charles J., F.L.S., 1, Marquess Road, Canonbury.

Collingwood, Dr. C., M.A., F.L.S., &c., Pembroke Villa, Central Hill, Upper Norwood, S.E.

Jones, Sydney, 16, George Street, Hanover Square, W.

Morris, John, F.G.S., Professor of Geology at University College, Gower Street.

LIST OF MEMBERS, 1880.

Allsup, W. J., F.R.A.S., 5, Eastcombe Villas, Blackheath.

Armstrong, H. E., Ph. D., F.R.S , Sec. C.S., 38, Limes Grove, Lewisham. *(Council.)*

Baker, Brackstone, 8, Belmont Park, Lee.

Barber, S., Oak Villa, Bexley Heath.

Bayly, Henry, P. and O. Company, 122, Leadenhall Street, London, E.C.

Belleroche, E., 14, Eliot Place, Blackheath.

Bidwell, Leonard, Lee Terrace, Lee.

Billinghurst, H. F., St. Alban's Villa, Granville Park, Blackheath. *(Council.)*

Bluhm, H., Lee Park, Lee.

Brabrook, E. W., F.S.A., 11, Limes Villas, Lewisham.

Breffit, E., The Glebe, Lee.

Buchanan, George Charles, Preston House, Burnt Ash Road, Lee.

Burroughs, J. T. R., M.R.C.S., Manor Villa, Lee.

Busk, C., 12, Vanbrugh Park, Blackheath.

Cable, George Hughes, M.R.C.S., Eng., Royal Hill, Greenwich.

Candler, H. B., 40, Manor Park, Lee.

Chittenden, Dr. C., Fellow of the Imp. Academy, of Medicine, Constantinople, &c., Preston House, Burnt Ash, Lee, S.E.

Clark, Reginald, M.R.C.S.E., South Lodge, Lee Park.

Claydon, Rev. E. A., Luton Rectory, near Chatham.

Clift, Edward, 71, Granville Park. *(Council.)*

Cotton, J. H., B.A., Lond., Church Terrace, Ladywell.

Cox, F. G., 12, The Grove, Blackheath

Crosland, Newton, Lynton Lodge, Vanbrugh Park Road, Blackheath.

Currey, Frederick, M.A., F.R.S., Sec. L.S., 2, Vanbrugh Park, Blackheath. *(Council.)*

Davis, Robert T., St. John's Villa, Grove Crescent Road, Kingston-on-Thames.

Dawson, W. G., Plumstead Common.

Deed, Alfred, 30, Manor Park, Lee.
Dewick, J., 9, Park Villas, Eastdown Park, Lewisham.
Dewick, Rev. E. S., M.A., F.G.S., 30, Southwick Street, Hyde Park, W.
Dobell, H. W., Eltham.
Donaldson, T. O., M. Inst. C.E., 49, Lee Terrace, Blackheath. (*Council.*)
Donkin, Bryan, Lloyd's Place, Blackheath.
Draper, J., 19, Newstead Road, Lee.
Duncan, J. M., 21, St. Ann's Villas, Royal Crescent, W.
Francis, H., 8, Church Terrace, Lee.
Frean, G. H., The Orchards, Blackheath. (*Council.*)
Frean, G. M., The Orchards, Blackheath.
Glasier, W. R. M., 5, Grote's Buildings, Blackheath.
Gooding, R., M.D., Heath Lodge, The Grove, Blackheath.
Gordon, H. M., Courtyard, Eltham.
Graham, J. A., Sherborne Lodge, Werter Road, Putney.
Groves, William, 28, Manor Park, Lee. (*Council.*)
Groves, William, Grove House, Shortlands, Bromley.
Guest, B., 26, Granville Park, Lewisham.
Hainworth, H., Pine Villa, Blackheath Hill. (*Hon. Sec.*)
Harrison, J., 4, Handen Road, Lee.
Hazard, H. T., 1, Granville Place, Blackheath.
Heisch, Charles, F.C.S., Holly Lodge, South Park Hill, Croydon.
Henderson, Ernest, 20, Handon Road, Lee.
Hingeston, C. H., Clifford House, Lewisham.
Hooper, Thos., Chilton Cottage, Southbrook Road, Lee.
Hubbard, William, The Elms, Hither Green, Lewisham.
Hudson, Alfred, 13, Royal Place, Greenwich.
Jackson, Henry Wm., M.R.C.S., F.R.A.S., F.G.S., 15, Limes Terrace, Lewisham. (*Council.*)
Jones, Herbert, Montpelier Row, Blackheath.
Jordan, Charles H., 21, Circus Street, Greenwich.
Knill, John, The Crosslets, Grove, Blackheath.
Knill, Stuart, The Crosslets, Grove, Blackheath.
Lavers, Thomas Howard, Belmont Hill, Lee. (*Vice-President.*)
Legge, Gordon, Blackheath Park.
Lemon, W. G., L.L.B., F.G.S., 20, Montpelier Row, Blackheath. (*President.*)
Lethbridge, J., Granville House, Blackheath.
Liardet, John Evelyn, 39, Evelyn Street, Deptford.
Low, Edward, Aberdeen House, Blackheath.
Lubbock, Sir John, Bart., M.P., F.R.S., &c., High Elms, Farnborough, Kent.
McLachlan, Robert, F.R S., F.L.S., 39, Limes Grove, Lewisham. (*Vice-President.*)
Martin, Rev. R. H., B.A., Blessington Road, Lee.
Mitchell, F., Kidbrook Terrace, Blackheath.
Nicolls, J. E. T., Lieut.-General, Roxeth House, The Glebe, Lee.
Nicolls, G. E., Roxeth House, The Glebe, Lee.

Nicolls, Oliver, Major, 8, Hamilton Terrace, Greenwich.
O'Donnell, W., Avoca Villa, Diamond Terrace, Greenwich.
O'Neill, W., 39, Manor Park, Lee.
Ord, C.K., M.D., R.N., F.L.S., The Limes, Lewisham.
Owst, Robert Clement, Derwent Villa, Blessington Road, Lee.
Pearce, Edward R., 10, Bexley Place, Greenwich.
Purser, E., 7, St. John's Park, Blackheath.
Ritchie, J. H., jun., Cedar Bank, Hyde Vale, Blackheath.
Robinson, Frank, L.D.S., Montpelier Row, Blackheath.
Robinson, H., Eliot Park, Blackheath.
Rock, W. F., Hyde Cliff, Crooms Hill, Greenwich.
Roper, Arthur, M.R.C.S., 17, Granville Park, Lewisham.
Rucker, John A., Blackheath.
Sams, John S., M.R.C.S., Eltham Road, Lee.
Simon, L. M., Paragon, Blackheath
Smith, F. W., Bellefield, Blackheath Park.
Smith, W. Johnson, F.R.C.S., Seamen's Hospital, Greenwich.
Simson, Thomas, Ardmore, Pond Road, Blackheath Park.
Slater, Robert, 10, Lansdowne Place, Blackheath.
Snell, E. W., Kidbrooke House, Blackheath.
South, John F., F.R.C.S., Blackheath Park.
Spurrell, Flaxman, F.R.C.S., Belvedere. (*Vice-President.*)
Spurrell, Flaxman C. J., Belvedere.
Stainton, H. T., F.R.S., F.L.S., F.G.S., Mountsfield, Lewisham. (*Vice-President.*)
Standring, John, Dacre House, Lee. (*Council.*)
Standring, Walter J., Dacre House, Lee.
Storrar, J. R., B.A. Lond., Stratheden House, Blackheath.
Sweet, George, 12, King's Bench Walk.
Tayler, Francis T., M.D., Claremont Villa, Upper Lewisham Road. (*Council.*)
Taylor, James, 26, Duke Street, St. James'
Teape, Richard, Fairlawn, Blackheath Park.
Thorp, R., Homelea, Portinscale Road, Putney.
Vogan, James, 22, Granville Park, Blackheath. (*Council.*)
Wainewright, B., Belmont House, Lee.
Wainewright, John, Belmont House, Lee.
Wainewright, R. Spencer, Belmont House, Lee.
Walton, William, Paragon, Blackheath.
Webster, W., jun., Wyberton House, Lee.
Weir, J. Jenner, F.L.S., F.Z.S., Haddo Villas, Blackheath. (*Council.*)
Weir, Percy Jenner, 6, Hadow Villas, Blackheath.
Whitworth, J., Ravensdean, Grove Park, Bromley Road.
Wilcox, H., M.D., Blackheath Road, Greenwich.
Wilson, H., 39, Limes Grove, Lewisham. (*Hon. Sec.*)
Wiltshire, Rev. Thos., M.A., F.L.S., F.R.A.S., F.G.S., 25, Granville Park, Blackheath.

Winkfield, John T. C., 10, St. John's Park, Blackheath.
Wire, T. B., Crooms Hill, Greenwich. (*Hon. Treasurer.*)
Wood, C. G., Talbot Place, Blackheath. (*Council*).
Wood, Henry T., Little Bognor, Fittleworth, near Pulborough, Sussex.

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Adams, G. .... Essays on the Microscope, 2nd ed.; 4to.; 1798.

Allman, G. J. .... Monograph of the Fresh Water *Polyzoa;* folio; 1856. (*Ray Society*).

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" On the Brain and Nervous System of *Pediculus Capitis;* 8vo.; 1873.

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,, The Microscope and its revelations; 3rd ed.; 8vo.; 1862.

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Tyneside Naturalists' Field Club, Transactions of. Vols. III.—VI.
Zoological Record. 1864-65.

N.B.—The Library is now in the Hall of the Mission School, Blackheath. Members can obtain or return Books by personal or written application to the Rev. E. WAITE, the Head Master; or on the evenings of the ordinary Meetings.

NOTE.—All communications should be addressed to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.

HENRY HAINWORTH, } *Hon. Secs.*
HUGH WILSON,

PRINTED BY W. H. CROCKFORD, JUN., GREENWICH AND LEWISHAM.

MEETINGS OF THE SOCIETY

FOR THE YEAR 1880-81.

Wednesday,	March	24
,,	April	28
,,	May	26
,,	October	27
,,	November	24
,,	December	15
,,	January (1881)	26
,,	February ,, Annual	23

—o—

The Chair will be taken at 8 o'clock.

—o—

The Meetings are held in the Hall of the Mission School, Blackheath.

W. H. CROCKFORD, JUN., PRINTER, BLACKHEATH ROAD, AND LEWISHAM.

WEST KENT
Natural History, Microscopical, and Photographic Society.

THE

PRESIDENT'S ADDRESS, PAPERS,

AND

Reports of the Council and Auditors,

FOR 1880-81.

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

PRINTED BY W. H. CROCKFORD, GREENWICH AND LEWISHAM.

1881.

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LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 23rd, 1881.

FOR THE SESSION 1881-82.

President.

W. G. LEMON, LL.B., F.G.S.

Vice-Presidents.

R. McLACHLAN, F.R.S., F.L.S.
FLAXMAN SPURRELL, F.R.C.S.
H. T. STAINTON, F.R.S., F.L.S.
J. JENNER WEIR, F.L.S., F.Z.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

E. BELLEROCHE.
H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
F. CURREY, M.A., F.R.S., F.L.S.
T. O. DONALDSON, M. Inst. C.E.
G. H. FREAN.
W. GROVES.
H. W. JACKSON, M.R.C.S., F.R.A.S., F.G.S.
E. B. PEARCE.
J. STANDRING.
F. T. TAYLER, M.D.
C. G. WOOD.

REPORT OF THE COUNCIL

FOR THE SESSION 1880-81.

The Council have much pleasure in reporting the continued prosperity of the Society, which at present consists of 5 honorary and 115 ordinary Members.

During the year we have lost by death one honorary Member—the late Professor Bell—and two ordinary Members—Messrs. Sweet and Simon. Mr. Sweet took a very active interest in the Society at its formation, and was for many years a member of the Council. Mr. Simon, who reached the advanced age of 99 years, had been for some time previously to his death precluded by physical infirmity from attending the Society's meetings. Eleven Members have resigned, and ten new Members have joined.

The accounts of the Honorary Treasurer, for the year ending 31st December, 1880, have been audited, and after paying all claims up to that date, show a balance in hand of £19 9s. 1d. A considerable number of subscriptions remained unpaid at the close of the accounts.

The Council are gratified in being able to record the fact that a Paper has been read, and objects of interest have been exhibited, by some of the Members of the Society, at every ordinary Meeting during the past Session, and they tender their hearty thanks to those gentlemen who have, by this means, contributed so largely to the interest and benefit of the Society.

The following Papers were read:—

1880.

March 24, "On Biolic Force, or what is Life," by Dr. C. Chittenden.

April 28, "On Gelatine dry plate Photography," with illustrations and experiments, by W. Webster, jun., F.C.S.

May 26, "On the state or condition in which our Butterflies pass the Winter," by H. T. Stainton, F.R.S., F.L.S., F.G.S.

October 27, "On the Chesil Beach," by the President.

November 24, "On some Useful and Noxious Fungi," by F. Currey, M.A., F.R.S., F.L.S.

December 15, "On the Natural History of Stylops, a Bee Parasite," by R. McLachlan, F.R.S., F.L.S.

1881.

January 26, "On Palæolithic Implements and the deposits yielding them in North-West Kent," by C. J. Flaxman Spurrell, F.G.S.

By the kind permission of Messrs. Stainton, Currey, and Spurrell, the papers read by them at the meetings will be printed with the Report of the Society.*

During the year two most instructive Lectures were given to the Members and their friends; the first by H. N. Mosely, Esq., M.A., F.R.S., "On Corals, especially the Deep-sea Corals dredged by H.M.S. Challenger;" the second by A. R. Wallace, Esq., F.L.S., "On the Natural History of Islands." The large attendance at these lectures conclusively shows the value which the Members attach to them.

The annual Field Meeting was held on the 15th June, and was attended by thirty-two ladies and gentlemen. By the courtesy of Sir W. Hart Dyke, Bart., M.P., the Members and their friends were permitted to visit Lullingston Castle and grounds. Thence they proceeded to Farningham, and passed some hours of pleasant social intercourse at the "Lion," the incessant rain having prevented them from exploring the neighbourhood.

On the 3rd July, the Members and their friends dined together at the "New Falcon" Hotel, Gravesend. After dinner the President introduced as a subject for discussion "The Natural

---

* Since the Report was presented to the Members, Mr. Spurrell has made further discoveries, and wishes to delay the publication of his Paper until he has communicated them to the Society.

History of Shrimps." An animated debate followed, in which several of those present, including the Rev. E. A. Claydon, and Messrs. McLachlan, Weir, and Van Voorst took part.

The annual Cryptogamic Field Meeting was held at Chislehurst, on the 9th February, when, under the guidance of Flaxman Spurrell, Esq., F.R.C.S., the Members went over the grounds of his friend Geo. B. Wollaston, Esq., and inspected his rare and magnificent collection of growing British ferns. The extremely unfavourable weather prevented many from attending; but the Council hope that, on some other occasion, the Members will be able to avail themselves of the invitation, then generously made by Mr. Wollaston, to visit him at some future time.

The following new publications have been added to the Library during the year:—

"Island Life," by A. R. Wallace.

"Flowers and their unbidden Guests," by A. Kerner.

"Microscopical Journal," 1880.

"Popular Science Review," 1880.

"Nature," 1880.

"Notes and Observations on Injurious Insects," by Miss Ormerod.

The Ray Society's vol. for 1879, "Monograph of the Copepoda of the British Isles." Vol. 2, 8vo. 1880. By G. S. Brady.

"Reports of the Manchester Literary and Philosophical Society."

"Report of the Eastbourne Natural History Society."

"Report of the Lewisham and Blackheath Scientific Association."

The usual Soirée will be held this year, of which full notice will be given to the Members.

The Council earnestly invite Members generally, especially the younger ones, to contribute papers and exhibit objects of interest at the ordinary meetings.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

For the year ending 31st December, 1880.

RECEIPTS.	£	s.	d.
Balance in hand on 1st January, 1880	11	3	0
Subscriptions, 1877	0	10	6
,, 1878	3	13	6
,, 1879	22	11	6
,, 1880	43	12	2
,, 1881 (in advance)	2	12	6
	£84	3	2

PAYMENTS.	£	s.	d.
Expenses of Meetings and Refreshments	6	14	10
Donation for use of Rooms	5	5	0
Fee to Librarian	5	5	0
Subscription to Ray Society, 1880	1	1	0
Insurance of Books, &c.	0	5	3
Cost of New Books and Binding	3	14	1
Stationery, Postage, &c.	7	15	9
Balance of Soirée Expenses, 1879	8	9	11
Miscellaneous	2	12	9
Lectures	11	0	6
Printer's Bill, 1880	12	10	0
Balance in hand on 31st December, 1880	19	9	1
	£84	3	2

Audited and certified to be correct,

17th February, 1881.

WILLIAM GROVES,
PERCY J. WEIR, } *Auditors.*

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

BY

The President, W. G. LEMON, Esq., B.A., LL.B., F.G.S.

ON THE 23RD FEBRUARY, 1881.

GENTLEMEN,

The Report presented to you this evening by the Council deals so concisely, and so fully with the work done by the Society during the past year, that nothing remains to be added by me to the particulars thus laid before you. I am deeply conscious of the honour conferred upon me by electing me your President; and when I call to mind the illustrious scientific workers who have preceded me in this chair, I know that the office is accorded me, rather by your indulgent kindness and goodwill, than on account of any merit of my own.

The year has not been without signal advances, we may say triumphs, in almost every department of science. Explorations in Thibet, in Africa, and the ice-bound polar regions—manifold improvements in mechanics, metallurgy, and electrical science—geological investigations in our own County (especially those of Mr. Flaxman C. J. Spurrell, a worthy son of one of our most honoured members, and himself a member, I may say an alumnus, of this Society); all claim attention. But when the history of 1880 is written, it will be found that "Light" has occupied very much of the time and thought of scientific observers.

The connection of light with heat, and with some forms of chemical action, has been long admitted as a fact, and some of its influences on living organisms have been carefully noted. By the scientific progress of recent years the question is forced into prominence, "What is the relation between light and electricity?" We recognize in light a form of energy or force, but of its intimate nature we know scarcely anything. We speak of it as the disturbance of some medium, such disturbance being periodic, both in space and time; and we explain many of its physical phenomena by adopting the theory of undulatory or wave-like motion. Of electricity we are still more ignorant; we cannot even assert it to be a form of energy; and yet we have had demonstrated to us during the past year some very marvellous results produced on organic life by the action of what is known popularly as the electric light. We appreciate the results, but the complete elucidation of the "how" and the "why" has yet to be attained.

The old satirist spoke with undisguised contempt of the scientific experimentalists of his day, laughing at them as essaying to extract "sunbeams from cucumbers;" but now vegetable or carbon points diffuse a light having many of the qualities possessed by sun-light. Sober men of science look upon trees and plants as incorporating within themselves the sun-light and heat of to-day; while our coal fires, with their unconsumed smoke and their fog-creative activities, represent the imperfectly liberated sunbeams of prehistoric ages, warming our houses but eclipsing our present sun.

It has been long known, that vegetable organisms are to a great extent dependent upon the direct influence of light for vigorous and healthy development. The extreme sensitiveness of some plants to the action of light has been clearly shown in a paper recently read before the Linnean Society by Mr. Francis Darwin, on "The power possessed by leaves of placing themselves at right angles to incident light." As an illustration, he took cotyledons of the seedling radish. When the plant is illuminated from above the cotyledons are extended horizontally, being thus at right angles to the light falling upon them. If the seedling is placed at a window, so that it is lighted obliquely from above, and if the stem (hypocotyl) is prevented from bending, the cotyledons will accommodate themselves to the changed conditions by movements in a vertical plane. The cotyledon which points to the light will sink, while the other will rise, until both are once more at right angles to the incident light. Two different theories have been suggested to account for this property in leaves. One by Frank, who ascribes to leaves and some other organs a specific sensitiveness to light, which, for simplicity's sake, he calls Transversal-heliotropismus; the other by De Vries, who thinks the effect is produced by the ordinary forms of heliotropism and geotropism acting in concert. Mr. Darwin inclines to the first of these explanations. I do not propose to discuss theories, but call your attention to these and similar facts; and would suggest to our younger members that they should read Mr. Darwin's book on "The Power of movement in Plants," as giving them much information presented in an agreeable form.

M. A. Pauchon has conducted a prolonged series of experiments to ascertain the influence which light has on the germination of seeds. Failing to obtain satisfactory results by the direct method, he compared the respiratory activity of seeds under different conditions of light and obscurity, measuring this activity by their absorption of oxygen. Taking identical parcels of seeds of equal number and equal weight, he arrived at the following conclusions:—

1. Light constantly accelerates the absorption of oxygen by germinating seeds. The advantage in favour of light varies from a quarter to one-third of the amount of oxygen absorbed by the seeds kept in the dark.

2. There is a relation between the degree of illumination and the amount of oxygen absorbed. The influence of light is very manifest under a clear sky and bright sun; with a cloudy sky it gradually decreases.

3. The acceleration produced by exposure to light continues for some hours after the seeds are placed in the dark.

4. The difference in quantities of oxygen absorbed in light and darkness are greater in winter than in summer. Hence it would appear that the influence of light upon this respiration is more intense at low temperatures.

Professor Pringsheim, by concentrating solar light on vegetable tissue under a microscope, finds that the absorption of oxygen increases with the intensity of light, and especially with the intensity of the chemical rays. But the increasing intensity of respiration involves danger to the vegetable tissue; and the light which is necessary for accumulating carbon becomes hurtful as soon as oxidization exceeds power of assimilation. Chlorophyll, by its luminous absorption, helps to balance these two functions; by its preference for chemical rays, it diminishes the respiratory effort, and thus acts as a protecting screen or regulator of respiratory action.

It has been stated that gardeners in the Azores have noticed the development of buds of roses to be quickened by the admission of smoke into the conservatories. If this be so, one must suppose that the smoke employed is wood smoke, consisting entirely of particles of carbon or vegetable ash, and not the impure smoke which would be found in our conservatories, heated by coke or coal.

Thus far our observations refer to sun-light; but perhaps the most remarkable observations of the year are those made in determining the effect of the electrical light upon plants. For these we are indebted to Dr. Siemens, F.R.S., who conducted his experiments in this county near Tunbridge Wells.

It is well known that chlorophyll (the green colouring matter of leaves), starch, and cellulose, are developed in plants by the dissociation of carbonic acid and water in the cells of leaves. The power in nature which sets this decomposition in motion is sunlight, and the question suggests itself, Is this power confined entirely to sun-light? Sun-light contains *actinism;* so does the electric light; and experiments show that the actinic rays in sunlight play an important part in ripening grain and fruit. Dr. Siemens proposed to try whether a similar effect would be produced by electric light, *i.e.*, whether such light might be advantageously employed in aiding or supplementing sunshine in the growth of plants, shrubs, fruits, and flowers. Our climate has not too many hours of sunshine, and it would be a boon to the gardener to find means of artificially gaining some of the benefits of sunshine.

With a two-horse power engine and a dynamo-electric machine, Dr. Siemens was able to produce a light equal to 1400 candles. By means of a reflector fixed in the open air, he directed this light upon a sunk melon house. Pits were prepared with mustard, cress, carrots, cucumbers, and melons; and were divided into four groups. 1. Was kept entirely in the dark. 2. Was heated with electric light exclusively. 3. Was exposed only to daylight. 4. Had both daylight and electric light, the latter from 5 to 11 p.m. The results were:—1. Plants yellow, soon died. 2. Plants light green, pretty strong leaves. 3. Leaves of ordinary colour and strength of daylight growth. 4. Plants had more strength, and the green was remarkably rich and dark. The next step was to place the electric lamp in the same glass house with the plants. Here they were exposed to the electric light for six successive nights, beginning when daylight failed, and continuing till sunrise. The plants had thus no rest, but they did not suffer. The experiment was next tried in the open air, with successful results, and the invigorating effect of electric light and sun-shine combined was very marked.

It still remained to be seen whether the electric light would aid in ripening fruit. Dr. Siemens therefore tried its effect upon strawberries. He took two pots of strawberries started under precisely similar conditions. One was exposed to daylight only in the usual way, and showed a bunch of green berries; while the other which, in addition to daylight, had been under the electric light during the night, bore a cluster of ripe, large, well-flavoured berries. Thus demonstrating that electric light promoted the formation of the saccharine and aromatic substances on which the ripening and flavour of fruit depend.

While we have thus spoken of light as affecting the life and growth of plants, we must not forget that there are some species of fungi which may be classed as *light-giving*. One of the best known of such species is the *Agaricus olearius*, which was some years since the subject of a monograph by Tulasne, published under the title "Sur la Phosphorescence de Champignons," (Ann. des Sci. Nat., vol. ix. p. 338). At first it was conjectured that such phosphorescence was developed *only at the time of decomposition ;* but further observations have so far changed this opinion that now some assert the fungus is phosphorescent *only during growth* ; that when it ceases to grow, it ceases to shine. This light is of a pale bluish colour resembling that emitted by phosphorus in a dark room.

Let us now turn to the animal world and briefly trace some of the influences of light upon its members.

By far the larger number of animals are conscious of light by means only of the eye. There are but few back-boned animals absolutely without eyes. Moles, the Proteus, and the blind fish, as they are called, of the American caves (*Amblyopsis Spelæus*, etc.) have all rudimentary eyes; and in most cases the condition of the eye in such animals is one of degeneration, the development of the organ being arrested at an almost embryonic stage; while, as the animal attains maturity, the eye being small, deeply imbedded in muscles, and quite covered with the external skin, is not easily detected. True eyeless fishes have been hitherto found only at great ocean depths, and we are indebted for our knowledge of them to the "Challenger" expedition. Many of these eyeless fishes have on the head peculiar and sometimes very large organs which have displaced the eyes. These may, according to Dr. Günther, be strongly developed phosphorescent organs; while the non-blind fishes of the deep ocean have exceptionally large eyes, which seem fitted to absorb pale phosphoric light. Sir Wyville Thomson thinks these large eyes have become exaggerated, to enable the fishes to catch the feeble rays of light coming from above; although he acknowledges that, so far as he can judge, direct sunlight does not penetrate to great depths. While admitting that abyssal creatures are phosphorescent in their native depths; he regards as untenable the notion that any deep sea animals see by the phosphorescent light emitted by thousands of their neighbours.

The struggle for existence goes on as well in the dark silent depths of the great ocean as in the busy whirl of civilized life, and in the shades and glens of primeval forests; and we can thence conjecture how these diverse organs, to which we have referred, are mutually related. The lights which the blind fishes carry in their two lanterns on their heads may serve at the same time to attract their prey, and possibly give help to fishes who can see. Every form having small eyes or small illuminating organs, being unable to gain food, would be exterminated; while none but the extremely developed species would hold their own in the struggle. This suggestion implies that the lantern-fishes of the deep sea being blind, must have other means of distinguishing friend from foe, and of identifying their prey. Such appears to be the case, for from their proboscis or muzzle hang long feelers, beards, and the like, at the tips or bulbous ends of which organs of sense or touch may probably be situate. This matter has yet to be more fully investigated; and such inquiry is rendered more difficult by the fact that, owing to the conditions of life at great depths, and possibly also to the mode of collecting specimens, the animals brought up were all dead before reaching the surface.

Though truly blind vertebrates are rare, eyeless invertebrates are far more numerous. In some parts of the Continent of

Europe, under huge boulders, where light can never penetrate, are found fauna specially adapted to such conditions of life; blind spiders, beetles, etc., occur in such positions. Many ento-parasites are eyeless, and this from their habitat we might expect to be the case; some have only rudimentary eyes. The number of known species of blind cave insects amounts to hundreds. Associated with these we find blind spiders, Crustacea, and Myriapoda. The so-called blind crab of the Kentucky caves is said to have rudimentary eyes; whilst other crustacea (as *Stygia*, *Titanethes albus*, etc.), seem to be totally blind. A list of these, with illustrations, is given in the work of Putnam and Packard on the Mammoth Cave of Kentucky. The "Challenger" expedition, and the literature in relation thereto, will afford additional illustration of the large number of blind invertebrates. Totally blind crustaceans were found living at a depth of over 2000 fathoms.

While darkness so complete as to prevent all use of the eye as an organ of light has led to the degradation of its structure, we should be guilty of too hasty generalization, if we should hence formulate a law that lack of light must necessarily lead to total or partial blindness. Insects having well-developed eyes are found inhabiting the same spots as blind insects. Dr. Semper says that in some caves in the Philippines and Pelew Islands, which he had personally explored, he found in spots where absolute and total darkness reigned, *only insects with eyes*. Again, it is known to most entomologists that in all species of the cave beetle *Machærites*, the females only are blind, while the males have well-developed eyes, yet they live together in absolute darkness. I have not been able to ascertain whether or not, at certain seasons, the female becomes phosphorescent; if this be so, it might help to account for the sexual difference. These facts would appear to show that total blindness in a particular species may arise from causes other than absence of light alone.

Enough, perhaps, has been said with reference to the special organs of sight. We have already intimated that in light we have something more than a luminous energy. Sun-light has its heating and its chemical powers, and these affect the animal as they do the vegetable organism. Animals in general breathe with less intensity in the dark than in the light; at all times they are burning carbon, but the activity of its consumption is greatest in the light. Light, too, as we have seen in the case of plants, accelerates the nutrition and development of animal life. If the eggs of a frog be placed in two glasses of water, one transparent and the other covered so as to be impermeable to light, it will be found that in the first the eggs will develop naturally, while those in the dark will develop very slowly, and not advance further than rudimentary embryos. Similar results will be obtained by placing the eggs of the common house fly in glasses of different degrees of transparency or colour. Placed simultaneously in various coloured glasses, insects of different degrees of development will be produced. In an experiment it was found that while all the eggs were hatched, the insects in blue glasses were by far the most developed; in green they were the smallest; whilst in the red, yellow, and white were produced insects of ordinary size. Adult animals, too, are affected by the colour of light. The effect of red light on the amount of carbonic acid during respiration is well known.

A word or two as to the effect of light in the formation of colour in the skin. Formerly it was accepted without question that all animal colouring was caused by the direct influence of light upon the skin. Now it has been clearly established by experiment that in the tadpoles of common toads and frogs, the pigment is equally well developed in total darkness, as in yellow, blue, or red light; and the development of pigment cells would seem to depend on influences other than those arising from mere luminous rays. Such developments may be more closely connected with the heat producing, or the chemical, not to add the electrical, influences associated with sun-light. The theory of natural or sexual selection which is so often used to account for differences in colour, would at first sight appear to be in antagonism to this suggestion; but a careful consideration will, I think, show that so far from this being the case, the suggestion is supplementary only to the Darwinian principle.

Man himself is conscious of the physical effect of bright sunshine; in addition to the beauty with which the sun in its glory gilds all nature, and paints the flowers, it wakens songs of joy in the birds, and causes our own blood to flow with greater activity, stimulating us to exertion and augmenting our enjoyment of life itself. It is true all animals are not affected in the same way by alternations of light and darkness. Some go to rest as night approaches, others rouse themselves and go forth to seek their prey. These diurnal and nocturnal species will be found scattered among mammals, birds, and insects; they are, however, so unimportant and few in number as not seriously to affect the truth of the general principle that *light promotes life.*

The perfecting of the electric light and the means of so dividing its current as to enable the light to be used in domestic life, is not uninteresting considered with reference to life and health. It may thus, at some future day, be possible for our descendants to obtain an illuminating agent free from the yellow glare of our ordinary artificial light; to live in well lighted rooms free from the sulphurous and poisonous vapours, now so liberally supplied by gas companies together with their gas, and to breathe during the evening working hours an unburnt and purer atmosphere.

Our Society concerns itself with Photography, and we were, in April, favoured with a very interesting Paper on "Photography," illustrated by experiments. Mr. Webster produced some examples of instantaneous photographs, and very fully described the advance made in the science of photography owing to recent improvements in the gelatine method. At our summer meeting, notwithstanding the weather was very wet and the sky leaden, he succeeded in taking a very admirable and sharp negative. The plates are now made so sensitive that the exposure is of very short duration. An express train passing at full speed through Chislehurst, on its way to Dover, has been photographed. The "Flying Dutchman" was photographed as it passed through Twyford Station at a speed of sixty miles an hour. All the details of the engine were distinctly pourtrayed, although the exposure could not have been more than a fraction of a second. The rapidity of photographic action is more marked by the photographing of a lightning flash by its own light, recently accomplished by Mr. Crosse, of Liverpool. With his camera, situate at Dingle, he succeeded in getting an excellent portrait of a long zig-zag flash, which leapt out from a cloud over St. Philemon's Church at the moment the bell tower was rent in pieces.

Experiments patiently continued have resulted in the discovery of means of obtaining positive photographs which retain, in some degree, the colour of the objects photographed. The process is yet in its infancy, and the specific materials used in the composition of the sensitive medium are not made known.

The photophone, although not strictly within the range of subjects hitherto considered by our Society, is yet so intimately connected with the topics now under notice, that a passing reference must be made to this very wonderful invention. Mr. Graham Bell has the honour of being the first to make known the remarkable effects produced by this instrument. By its means sound is conveyed, not by a string or wire, but by a beam of light. A plain bright flexible mirror is fixed on a stand, the light thrown upon it as a beam is reflected so as to strike a parabolic reflector placed at a distance. In the focus of the parabolic reflector is placed a cell of silenium connected with a galvanic battery and a telephone. If a voice speak behind the flexible mirror vibrations are produced, and these are communicated to the beam of light, and the vibrations acting along the light produce a sound which becomes audible by the telephone. It has been long known that various metals and metalloids give sounds under the action of light and heat; and, in addition to silenium, it is asserted that gold, silver, platinum, iron, steel, brass, copper, zinc, lead, and even paper, parchment, and mica are sensitive to light vibrations.

Mr. Shelford Bidwell also succeeded in constructing a photophone, differing in some respects from that of Mr. Graham Bell. The transmitter is a thin disc of microscopic glass silvered on its anterior surface, and placed in front of a tube, by which the voice is conveyed to it so as to excite vibration. The lime, or electric light, is reflected from this mirror through a convex lens so as to render the rays parallel; these being received on a second lens at some distance, and again concentrated on a silenium receiver. The voice is conveyed across a space of ten feet into a neighbouring room by this instrument. While experimenting with the photophone the thought occurred to him that an instrument might be constructed to transmit pictures of natural objects by means of the electric current. Thus he would be able to telegraph not merely symbols but actual portraits, and take a photo-picture many miles from the object. He has so far succeeded as to show that the problem is certainly not insoluble. A description of his process, and of the instrument employed, is given in *Nature*, Feb. 10, 1881. Every one reading his account of his work must very heartily wish that this pains-taking and accomplished physicist may be successful in developing to perfection what he calls "Telephotography."

As connected with light, I may remind you of the splendid manifestation of the "Aurora Borealis" on the evening of Thursday, January 31 last. Standing on Blackheath, I witnessed the pulsations of the aurora reaching to the zenith, and shedding a brilliant light over the heavens.

Leaving now matters connected with light, I pass on to notice two topics of local interest which may possibly deserve a record amongst us.

None of us, probably, have ever seen so severe a snow-storm as that which visited not only our own locality, but the whole of the eastern and central parts of Great Britain on Tuesday, January 18th, 1881. A strong wind of almost unexampled fierceness drove the snow from the north-east in such abundance, and heaped it in such drifts, as soon to render roads impassable. In some parts of Blackheath the snow was from ten to twelve feet deep, while the road between Loampit Hill to Lewisham was in parts covered with snow fourteen feet deep. The railway cutting near St. John's was so filled with snow that no train was able to get through after early in the afternoon; the next day the traffic on the Mid-Kent line continued to be suspended, and several days elapsed before matters were restored to their usual condition. The roads were with great difficulty cleared to enable communication to be maintained between the different parts of the district, a snow plough being used for the purpose. A heron is reported to have been found frozen to death in the neighbourhood of Forest Hill.

While earthquakes have disturbed other lands, and the inhabitants of Northwich, in Cheshire, have found the ground giving way beneath them, and the River Bradford, a tributary of the Don, has been lost to the inhabitants of Alport, in Derbyshire, our own usually quiet Blackheath has suffered some alarms. In the beginning of November, 1880, a small irregular shaped hole, about 18 feet in circumference, appeared near the gravel pit lying to the north of Eliot Place. The sides of this hole were perpendicular on the north and south, but on the south-west and south-east the ground retreated as if leading to some excavation or large cave. An examination made at the time showed, however, that no further opening could be traced. It was generally considered that this hole was of the same nature as one which occurred in April, 1878, near the centre of the Heath, to the west of the spot where the road from Maze Hill to Montpelier Row crosses that from Shooters' Hill to the west corner of Greenwich Park. On the 19th of November, 1880, another subsidence was observed, the spot being about 100 yards south-east of that where the subsidence occurred in 1878. This new hole was about 18 feet deep, cylindrical with vertical sides, like a well. Some of the residents desire either by sinking a shaft, or by excavating at this spot, to endeavour to find what are the causes of these subsidences. The Heath is a small table land, and it is well known that the sides of the slopes leading up to its surface at Maze Hill and Crooms Hill, contain caves which were formerly used by men, who in the good old times occupied themselves in various modes of conveyancing and transfer of property. Some persons have expressed an opinion that these industrious persons had large subterranean stables, in which they kept their horses; and extensive galleries beneath the surface, used by them for storage of the goods they held, not in trust for the former owners, and the value of which to themselves might be affected by exposure to day-light. Other persons have valuable traditional knowledge of an underground passage leading from Greenwich to Eltham, constructed in the times of King John, of Magna Charta memory. All these statements and traditions need verification, and until they are substantiated, or more probable evidence in their support adduced, those of us who reside on the borders of the Heath may sleep peacefully in our beds; not fearing that the anticipations of the newspaper writers will be fulfilled by our residences sinking bodily into mother earth.

Speaking generally, the surface of the Heath consists of a crust of "Blackheath gravel," varying in thickness, but believed to be about fifty feet thick, and thinning out towards Lewisham and Lee. Beneath this underlie beds of shelly clays, associated on the west and south-west with fine sands, probably in some parts forty feet thick; beneath these are the Thanet sands, estimated to be from forty to fifty feet thick; then we come to the chalk formation, which forms the escarpment between Woolwich and the entrance to the Ravensbourne valley, and is seen cropping up near St. John's. By some it is thought that these holes are old excavations for obtaining gravel and sand, which have been filled up but not sufficiently rammed, and that after heavy rains the earth in them has consolidated. I am inclined to think they are over the sites of pockets or pipes in the chalk, and that the cause of the subsidence is the drawing away of the subsoil by the action of water. They certainly have no resemblance to the artificial holes found so frequently in adjacent parts of the county. The water-level under Blackheath is about Ordnance datum, and it is just possible the drainage works carried on by the Metropolitan Board have disturbed the stability of the pebble beds and sand by removing the water. It appears, however, to me far more probable that the pumping up of the water by the Kent Water Works, at Deptford, is one, if not the principal cause, of the subterranean drainage, and consequently of the subsidence, by drawing away sand and chalk in mechanical suspension. I am told that about 9,000,000 gallons of water per day are lifted at the pumping station of the Kent Water Works at Deptford, which is near the base of the table land. We know that the unfiltered water sent by this Company for our consumption, free as it is from organic life, is fully charged with chalk and earthy matter. Our cisterns show a deposit of fine sand and chalk, which is frequently astounding.

The Council considered the proposal to raise special funds for the purpose of conducting explorations on the site of these subsidences; but regarding the question as one of archæological rather than scientific interest, they did not think it desirable to ask you, as a Society, to join in taking up the work.

Gentlemen, I thank you for the courteous attention with which you have listened to these observations; and I feel it is incumbent upon me, before closing this address, most distinctly to recognize the zeal and ability of our two Honorary Secretaries, to whose exertions in so many ways the Society is indebted. I would very cordially express my personal obligations to them, and at the same time I would heartily thank those members who, by the papers and observations they have contributed, as well as by their attendance at the meetings, have assisted in promoting the successful working of the past year. May the current year be even more successful than the last.

IN WHAT STATE OR CONDITION DO OUR BUTTERFLIES PASS THE WINTER?

EPITOME OF A PAPER

READ BY

H. T. STAINTON, ESQ., F.R.S., F.L.S., F.G.S.

ON 26TH MAY, 1880.

As there are four stages of butterfly life—egg, larva, pupa, and imago, or perfect insect—it is evident that our butterflies might pass the winter in any one of these stages. The question before us is the practical one, In what stage of their life's history *do* they pass the winter?

In the first place eight species pass the winter in the imago or butterfly state, and these furnish us with the earliest butterflies we see in the new year, if we should happen to have hot sunny weather in February or March. These eight species are, the

Brimstone	Peacock	Small Tortoiseshell
Painted Lady	Camberwell Beauty	Comma
Red Admiral	Large Tortoiseshell	

The Clouded Yellow, which is of constant occurrence as hybernating in Southern Europe, may, perhaps, occasionally hybernate with us, but as far as we at present know, it is not, like the eight above mentioned, one that regularly passes the winter with us in the perfect state.

In the next place, twelve species pass the winter in the pupa or chrysalis state: the earliest of these appear on the wing when warm weather sets in in April, and the sight of any of these may be looked upon as an indication of approaching summer. These twelve are—

The Swallow-tail (a local species, only to be found in the fenny districts of Cambridgeshire, &c.)
The Clouded Yellow
Six of our seven White Butterflies, including the Orange Tip
The Duke of Burgundy Fritillary (*Nemeobius Lucina*)
The Green Hair-Streak (*Thecla rubi*)
One of the Blues (*Argiolus*)
One Skipper (*Alveolus*)

But by far the greater number of our Butterflies pass the winter in the larva state, about thirty-eight doing so: some are quite small larvæ during the winter, and have to feed up in the spring; others are nearly full grown, and change to pupæ at the approach of spring, so that their appearance in the perfect state varies from May to August. The list of these includes—

The Pale Clouded Yellow. The Black-Veined White.
All the Browns, which form the sub-family *Satyridi* (one of the *Browns*, it must be borne in mind, is the Marbled *White*).
The White Admiral. The Purple Emperor.
Three of our four large Fritillaries.
Our five small Fritillaries. The Small Copper.
All our Blues, except *Argiolus* (already noticed as wintering in the pupa state) and *Ægon*, which winters in the egg state.
All our Skippers, except *Alveolus*, which passes the winter as pupa.

Lastly, we come to the six species which pass the winter in the egg state. These are—

One of the Fritillaries (*Argynnis Adippe*)
Four out of our five Hair-Streaks
One of our Blues, *Ægon*

It will thus be seen that, in direct opposition to what we might have expected, more species are in the perfect state than in the egg state during the winter, and more are in the larva state than the pupa state.

The following table shows the various states in which our Butterflies pass the winter.

BUTTERFLY.	PUPA.	LARVA.	EGG.
Gonepteryx Rhamni	Papilio Machaon	Colias Edusa (?) and Hyale	Argynnis Adippe
Colias Edusa (?)	Colias Edusa	Aporia Cratægi, small	Thecla Betulæ
Cynthia Cardui	Pieris Brassicæ	Arge Galathea	T. Pruni
Vanessa Atalanta	P. Rapæ	Lasiommata Ægeria, and Megæra	T. W-Album
V. Io	P. Napi	Hipparchia Semele, and Janira	T. Quercus
V. Antiopa	P. Daplidice	H. Tithonus, and Hyperanthus	Polyommatus Ægon
V. Polychloros	Anthocharis Cardamines	Erebia Blandina, and Cassiope	
V. Urticæ	Leucophasia Sinapis	Cœnonympha Davus, and Pamphilus	
Grapta C-Album	Nemeobius Lucina	Limenitis Sibylla, small	
	Thecla Rubi	Apatura Iris, small	
	Polyommatus Argiolus	Argynnis Paphia, small	
	Thymele Alveolus	A. Aglaia (?), and Lathonia (?)	
		A. Selene, and Euphrosyne	
		Melitæa Cinxia	
		M. Athalia	
		M. Artemis	
		Chrysophanus Phlæas (?)	
		Polyommatus Alsus, and Acis	
		P. Arion	
		P. Corydon, and Adonis	
		P. Alexis	
		P. Agestis	
		Thanaos Tages	
		Steropes Paniscus	
		Pamphila Actæon	
		P. Linea	
		P. Silvanus	
		P. Comma	

ON SOME USEFUL AND NOXIOUS FUNGI.

BY

FREDK. CURREY, ESQ., M.A., F.R.S., F.L.S.

24TH NOVEMBER, 1880.

Having been asked to furnish a short paper for this evening's meeting, I have put together a few remarks upon some different kinds of fungi, which I have thought might be interesting to the members, and perhaps not without novelty for some of them, for the study of fungi is so little pursued, that even to many experienced botanists that class of plants is a sort of unknown world. I have divided my observations into two parts, one relating to useful fungi, and the other to noxious ones. In the former I include those which are useful for food, or for medicinal purposes, or which are otherwise utilized; in the latter, those which exert a deleterious influence either on man, animals, or plants.

First, with regard to those fungi which are useful for food. The number of these is very small. Although many sorts may be eaten with impunity, I do not consider that any species is entitled to be admitted into the edible class, unless, in addition to being innocuous, it is also palatable. Although I am an ardent mycologist, I am by no means an ardent mycophagist, and those fungi which fulfil the two conditions of being wholesome and palatable may, I think, be counted on the fingers, almost on the fingers of one hand.

First amongst these, *facile princeps* amongst edible fungi, stands the common Mushroom. Every one knows it, or fancies he knows it, and I never heard of any one to whom Mushrooms were not acceptable. The extent to which they are cultivated, and the value of the crops is far beyond what would be generally supposed.

There was a trial a few years since in the Sheriff's Court, in London, for compensation from the Metropolitan Railway Company for the purchase of a Mushroom ground at Kensington. The claim was for £716, and one witness deposed that the expenditure of £50 would, in 12 months or less, produce a return of £200. In France enormous quantities are grown.

In one of the subterranean Mushroom caves at Paris, the proprietor is said to gather an average of 300 pounds weight a day, and one French house has sent to London in one year as many as 14,000 boxes of Mushrooms. In one great cave at Mery-sur-Seine M. Renandot a few years since had 21 miles of Mushroom beds, and at a cave at Frépillon there were sixteen miles of them.*

For those who wish for information as to methods of cultivation a good treatise has been written by Mr. Cuthill, and another by Mr. Robinson. To ensure success Mushrooms require as much skill and care as most other things which come within the domain of the gardener, but they can fortunately often be procured in abundance for the simple trouble of gathering them. To those who have meadows favourable for their growth, the only advice is to get up early enough, so as to anticipate the invasions of mushroom poachers, who never fail, if left alone, to clear off the crop.

Allied to the Mushroom, but belonging to a different division of the *Agaricini* is another excellent fungus *Agaricus procerus*, sometimes called the Umbrella or Parasol Agaric, from the curious ring which surrounds the stalk, and which is moveable up and down like the ring of an umbrella or parasol. This species is not uncommon, but it never appears in such large quantities as the Mushroom. It generally grows in patches of ten or a dozen plants together. It is a handsome species to look at. Unlike the Mushroom it varies very much in flavour, but good specimens when gathered just at the right time are little, if at all, inferior to the Mushroom.

It is curious that in the *Medical Gazette* for 1839 a case of poisoning by *Ag. procerus* is reported. I believe this to be a gross mistake. I am able to certify, from many years personal experience, that the plant is perfectly wholesome. There is always extreme difficulty, in cases of poisoning by fungi, in arriving at a determination of the species by which the injury has been caused. The characters of fresh fungi of the fleshy kind likely to be used for food, are so ephemeral, that a delay of a day or two in examining the specimens may make it impossible to

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* See Berkeley and Cooke on Fungi.

determine the species. M. Leveillé seems to think that the fungi inculpated by the *Medical Gazette* may very likely have been abnormally large specimens of *Ag. clypeolarius*, which might possibly have been mistaken for *Ag. procerus*. I cannot say that I think M. Leveillé's suggestion probable. *Ag. clypeolarius* differs so much in colour that it could hardly be mistaken for *Ag. procerus*. I think it not at all unlikely that large specimens of *Ag. cristatus* might be so mistaken, and the smell of this latter species is so very disagreeable, that I can quite imagine its being of a poisonous nature.

Agaricus rubescens is another species which is frequently eaten. It occurs in much larger quantities than *Ag. procerus*, but is (in my opinion at least) very inferior to *Ag. procerus* in flavour. Still it is well worth cooking, and when the mushroom or *Ag. procerus*, cannot be had it may well be used as a substitute. One objection to it is the difficulty of getting perfectly sound specimens. It is so infested with small larvæ that every specimen requires to be cut down to the stalk in order to ascertain that it is not "worm-eaten." The larvæ do not appear externally but burrow in the soft fleshy pileus and stipes.

I have spoken of *A. procerus* and *A. rubescens* in succession to the mushroom, because they are all allied in botanical classification, belonging as they do to the great division *Agaricini;* but there are two fungi both of which as esculents are equal if not superior to *A. procerus*, and far above *A. rubescens*. I allude to the Giant puff-ball and the Truffle. These two belong to the division Gasteromycetes, in which the organs of fructification are internal, not on the surface, as in the *Agaracini*. It is somewhat surprising how very few people seem to be aware of the good qualities of the Giant puff-ball (*Lycoperdon giganteum*). It is not a common plant by any means. If it were generally met with I am sure its virtues would be appreciated. It must be gathered precisely at one particular stage of growth, viz., before the spores (or seeds) have begun to ripen. At this period it consists of a large white spongy mass of tissue enveloped in a delicate outer skin, which resembles the very finest white kid. It attains an enormous size, being often considerably larger than a man's head. When gathered at the right time it should, when sliced across, exhibit a pure white colour. If there is any tinge of brown or green, it is not in a fit state for the table, and will very shortly afterwards be resolved into a mass of olive green powder, being the accumulation of ripe spores. If slices of about one inch in thickness are taken at the proper period, and fried in bread crumbs, the fungus is really good eating. My friend Dr. Badham, who wrote upon esculent fungi, and was an enthusiast as to their good qualities, has compared the flavour of these fried slices of *L. giganteum* to a light omelette. Without going so far as that in approbation, I can certify that they are exceedingly palatable.

The Truffle is a delicacy which has been known from antiquity, but the ancients were ignorant of its fungoid nature. Pliny and Dioscorides considered it to be a kind of earthy concretion, and the former tells a story of a Roman Prætor who broke his tooth in eating a Truffle in which a Roman coin had got embedded. Galen at a little later period thought that Truffles were roots, and this notion has prevailed in some ill informed quarters in quite recent times. The nature of Truffles is now as well understood as that of any other fungus, and modern microscopic investigation shews that their fructification is just the same as that of the Morel and other allied plants, differing, however, in being produced internally instead of on the outer surface. The Truffle—the "diamond of cookery," as it has been hyperbolically called by M. Brillat-Savarin—ranks as high as, perhaps higher, than the mushroom. Its good qualities come out in the turkey pies which we meet with at City dinners, in the patés de foie gras of Strasburg, and in other condiments. Mr. Berkeley says that a truffle, simply boiled like a potato, is very good eating, a statement which I can neither vouch for nor contradict. In this country truffles are found principally in the chalk downs in Wiltshire, where they are traced by the aid of truffle-dogs, a peculiar sort of animal, more like a poodle than any other kind of dog. Although not handsome, the intelligence of these dogs makes them very valuable. A well-trained truffle-dog is not to be got for less than £5. He is as fond of truffles as the gourmands for whom he collects them, and the truffle-hunter has to look sharp to see that his dog does not swallow the delicacies as he finds them.

It is not to mankind alone that truffles form acceptable food.

Several animals are said to be equally attracted by them. Wild boars, roebucks, badgers, field mice, and squirrels have all been said to have the good taste to appreciate this fungus, which is said to be also sought after by cockchafers, slugs, centipedes, millipedes, and the larvæ of the daddy-longlegs. The truffle has also been credited with medicinal properties, but probably without reason. One writer recommended the vapour of truffles soaked in wine as a remedy for gouty limbs, and a French doctor, M. Devergie, asserted that he had employed a decoction of truffles in water as a remedy for cholera, with most successful results, but experience does not seem to have confirmed these observations.

I can only hastily run over a few other species which have some claim to be looked upon as edible. I would mention *Morchella esculenta*, *Gyromitra esculenta*, *Cantharellus cibarius*, the Chantarelle of Freemasons' Hall, *Fistulina hepatica*, and *Marasmius Oreades*, called by the French, Champignon, as if par excellence.

I pass now from edible fungi to those which possess, or have been credited with the possession of medicinal qualities, and foremost among these is the so called Ergot of Rye. The history of this plant is of the greatest interest to the Botanist. Until quite a recent period its nature was entirely misunderstood. Long after the commencement of this century Ergot was not known to be a fungus at all, and the proof of its true nature is one of the greatest triumphs of patient botanical research. It used to be supposed that Ergot was a diseased state of the grains of the Rye, and this is not to be wondered at, for any one who has seen an ear of ergotized Rye would certainly *prima facie* conclude that the Ergot was nothing but an enlarged, blackened state of the grain. Its fungoid nature was at last suspected, and it got the name of *Ergotetia abortifaciens* from its medical qualities, to which I shall presently allude. A few years later the M.M. Tulasne, of Paris, established in the most conclusive way, in a beautifully illustrated paper in the "Annales des Sciences Naturelles" that Ergot is in fact the *Sclerotium* or mycelium of a Sphæriaceous fungus. For the information of those who are not conversant with mycological terms, I may say that the mycelium of a fungus is the vegetative part of the plant, the spawn, as it is called, when speaking of the Mushroom. Spawn usually consists of a mass of delicate interlaced creeping white threads, or filaments; but in the case of some fungi the filaments, instead of assuming the ordinary creeping habit, become compacted into a dense mass, and this mass is called a *Sclerotium*. The difference between ordinary spawn and *Sclerotia* may be illustrated by imagining a skein of wool or thread scattered loosely over the floor, and another skein rolled up into a tight ball. The latter would represent the *Sclerotium*. The complete fungus, which is developed from Ergot, is a curious and interesting little plant belonging to the germs Claviceps. Not rye only, but many other grasses are effected by Ergot.

Ergot is used in medicines to produce contraction of the uterus in cases of imperfect parturition, and it is interesting to note with reference to this quality that, in districts of the country in which ergotized grass abounds, it has been observed that cows, and other animals, are apt to slip their young.

Ergot may, I think, safely be said to be the only fungus which is undeniably useful in medicine. Others which are, or have been, used in pharmacy, are the Giant puff-ball, the common *Phallus*, the Jew's ear, and a few others. The puff-ball has certainly styptic, and narcotic properties. It is often used for stupifying bees, and it has been stated, I cannot say with what truth, that surgical operations have been performed under its influence.

The common *Phallus (P. impudicus)* is in many respects a remarkable plant. Its extraordinary and indelicate shape, its more than foul smell, and its curious mode of development, all combine to attract attention to it. A few years ago I ascertained from a French medical periodical that *P. impudicus* has been used in Russia as a remedy for gout. Unfortunately I made no note of reference at the time, and I have not been able to trace the passage.

Lately, however, in looking through a treatise "De fungis venenatis," written many years ago by Dr. Ascherson, of Berlin, I find mention of its use as a remedy for gout, together with some curious remarks on the supposed aphrodisiac qualities of this *Phallus*. The passage translated runs thus, "I was under the belief that the idea of this fungus producing sexual excitement had originated only from its form, in accordance with the ancient doctrine of signatures, but I have myself seen a broken down horse, 17 years old, after eating this fungus exhibit venereal excitement."

The subject of poisonous fungi I have always thought to be one of great interest. The unfounded dread with which the whole tribe is popularly regarded is a very singular fact. Most people look upon fungi generally—or toadstools, as they are irreverently called—as a family of almost exclusively poisonous plants. I believe no notion to be more erroneous. There is no ground for supposing that the proportion of poisonous species is greater amongst fungi than amongst flowering plants; and as to the nature of the poisonous principle, I am not aware of any fungus of which the poison would rival in virulence that of the Monkshood, the Water Dropwort, the Black Bryony, the wood of the common Oleander, and numerous other flowering plants which might be mentioned. Not a little of the nonsense of the ancients still clings to the subject. They (the ancients) represented as dangerous, all fungi which grew near the trail of a serpent, or near a rusty nail, a mouldy cloth, or a poisonous tree. Towards the end of the seventeenth century the subject cropped up again with a number of almost groundless suggestions as to the mode of distinguishing good species from bad ones; such as, when, in cooking, a tin or silver vessel turned brown, or the white of an egg lead-colour, or small onions black. Bulliard, who wrote in 1791, did a good deal to explode the above absurdities, but modern suggestions are not much more useful. For instance, it has been said that all fungi with very soft flesh should be avoided, as well as those which dissolve in age into a black fluid. Now, these rules would exclude many of the kinds of Boletus, which are undeniably wholesome, and which some people think palatable. No one would think of eating *Coprinus comatus* when it had began to turn into ink, but if gathered when quite fresh and young, it has a high character amongst esculent fungi. Again, it has been said that fungi having a poisonous, strong, or disagreeable smell, should be avoided, and this may be partially true; but four at least of the most dangerous species may be mentioned in which the smell would be no guide. I allude to *Agaricus bulbosus*, *Ag. pantherinus*, *Ag. muscarius*, and *Ag. nebularis*.

The presence of acrid milk, changes of colour when bruised, and a peppery flavour, have all been given as tests of insecurity. These again are quite fallacious. In many countries milky fungi (even *Lactarius acris* itself), are eaten with impunity, and *Lactarius deliciosus*, which is admittedly one of the best of edible fungi, and which is of rather a bright orange colour, turns dark green directly after it is broken or rubbed. The common Chantarelle which, in France and at the Freemasons' Tavern, is considered a delicacy, and also *Hydnum repandum*, a species which is universally eaten, both have an acrid peppery taste when raw.

At the present day it would not, I think, be denied that, as regards all fungi of which the properties are unknown, there is absolutely no test but experience, to shew whether the species is wholesome or otherwise. It may be interesting to mention a few instances of the actual effects of those fungi which have been found by experience to be poisonous. I have already alluded to Ergot of Rye and its great value as a medicine. In medical cases it is used in a powdered form, and in very small quantities; but where the Rye in any district has been affected to a great extent with Ergot, and has been ground up and made into bread, an epidemic of a serious gangrenous disease has been the result.

The Russians eat all sorts of poisonous fungi, but not without previous treatment which takes away all flavour. M. Letellier, who has paid great attention to the subject, says that it is always possible to prevent being poisoned by fungi if you deprive the plant of its noxious principle by prolonged maceration in fresh or salt water, or in a water mixed with vinegar or alcohol. These facts, M. Letellier says, the Russians have known for time out of mind (de toute l'eternité), but, he adds, the maceration deprives the fungi of the consistence and aroma which gourmands appreciate, and leaves only a viscous, insipid, nauseous substance, of use only to soothe the pangs of hunger of Muscovite stomachs.

The poison of the acrid milky fungi, belonging to the genus *Lactarius*, and of the deleterious species of the genus *Russula*, appears to act simply by contact. The observations of cases of poisoning by these fungi, both in man and in animals, have shewn the existence of *gastro-enteritis* in a more or less severe form, without absorption, and without any direct action upon the nervous system.

On the other hand the poison of the Amanites acts in some cases by contact, and in others by a combination of contact and narcotism. If the species of Amanites known as *A. muscaria*, *A. pantherina*, or *A. aspera* are treated chemically, a substance called *Amanitine* is extracted, the effect of which has been described by M. Letellier. He says that if a cat, or a rabbit, is made to eat about 15 grains of *Amanitine*, or if *Amanitine* is injected under the skin of a rabbit or a frog, the invariable results are loss of sensibility and of power of motion, difficulty of breathing, and stoppage of the action of the heart. Death results either quite quickly, or with slight convulsions, from 20 minutes to four hours after the employment of the poison. In some cases the animal revives, apparently unhurt, after a period of from six to twelve hours. Post mortem examination in these cases discloses no internal lesions of any importance, shewing that the poison acts upon the cerebro-spinal system by absorption, and not by contact.

Other Amanites, for instance, *A. phalloides* and *viperina*, besides producing the same symptoms as *Amanitine*, give rise to vomiting and a discharge of blood from the bowels, and cause serious lesions in the alimentary canal, symptoms which are attributed to the fact of these latter containing besides *Amanitine* an acrid fixed substance. The existence of this substance in addition to *Amanitine* adds materially to the poisonous power of those species which possess both. It has been said that as far as man is concerned death from the poison of *A. muscaria* is extremely rare, whilst the action of *A. phalloides* is almost always fatal.

I will conclude with a few remarks upon fungi which grow parasitically upon man and animals, or which, without being directly poisonous, exercise an injurious influence. The dusty spores of the Giant puff-ball appear to possess very irritating qualities when inhaled in large quantities. A case is mentioned by Mr. Cooke, of an Assistant in the Edinburgh Botanic Gardens who was confined to his room under medical attendance from inhaling these spores in the process of preserving a specimen for the herbarium. The spores of a species of a black rust, which infests *Arundo Phragmites*, is known in this country to produce violent headaches amongst the labourers who cut the reeds.

Several kinds of fungi are observed to accompany certain well known cutaneous disorders, and have frequently been spoken of as the actual cause of such disease as Porrigo, Psoriasis, Tinea, Plica polonica, and others of a similar kind. Cholera and Diphtheria also have been attributed by some writers to fungi. With regard to the two latter diseases the alleged proof altogether failed, and there is no trustworthy evidence that the other fungi are anything more than the concomitants of the disease in association with which they have been observed.

As far as concerns man and almost all animals, except insects, the parasitic fungi are of a very low grade; but some insects are affected by certain species of *Cordyceps* (or *Torrubia*) —genera which stand high in the scale of classification. Of the insect parasites, *Cordyceps Robertsii* (a New Zealand species) is perhaps the most remarkable. *Torrubia militaris* may often be found in this country, and attracts the eye by the bright red colour of its perithecia. I have in my herbarium, specimens of another *Cordyceps* growing upon what I understand to be the larva of a coleopterous insect of the family *Dynastidæ*. But it would require much more time than our meeting affords to discuss even partially these insecticide fungi.

I hope that enough may have been said to awaken some interest in the branch of Cryptogamic Botany which deals with the family of the Fungi.

RULES.

1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay in advance 10s. 6d. each per annum, and of honorary members.

3.—The affairs of the Society shall be managed by a Council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretary immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secs., Post Office, Lee Bridge, Lewisham, S.E.*

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Taylor, James, 26, Duke Street, St. James'
Teape, Richard, Fairlawn, Blackheath Park.
Thorp, R., Homelea, Portinscale Road, Putney.
Vaughan, Howard, 2 Lincoln's Inn Fields.
Wainewright, B., Belmont House, Lee.
Wainewright, John, Belmont House, Lee.
Wainewright, R. Spencer, Belmont House, Lee.
Walton, William, Paragon, Blackheath.
Webster, W., jun., F.C.S., Wyberton House, Lee.
Weir, J. Jenner, F.L.S., F.Z.S., 6, Haddo Villas, Blackheath. (*Vice-President.*)
Weir, Percy Jenner, 6, Haddo Villas, Blackheath.
Wilcox, H., M.D.
Wilson, H., 39, Limes Grove, Lewisham. (*Hon. Sec.*)
Wiltshire, Rev. Thos., M.A., F.L.S., F.R.A.S., F.G.S., 25, Granville Park, Blackheath.
Winkfield, John T. C., 10, St. John's Park, Blackheath.
Wire, T. B., Crooms Hill, Greenwich. (*Hon. Treasurer.*)
Wood, C. G., Talbot Place, Blackheath. (*Council*).
Wood, Henry T., Little Bognor, Fittleworth, near Pulborough, Sussex.

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ADAMS, G .... Essays on the Microscope, 2nd ed.; 4to.; 1798.

ALLMAN, G. J .... Monograph of the Fresh Water *Polyzoa;* folio; 1856. (*Ray Society*).

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,, On the organization of *Grantia Ciliata;* 8vo; 1859.

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" On the Expressions of the Emotions in Man and Animals; 8vo.; 1872.

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" Different Forms of Flowers; 8vo.; 1877.

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Popular Science Review. 1862-80.
Quarterly Journal of Science. 1864-80
Tyneside Naturalists' Field Club, Transactions of. Vols. III.—VI.
Zoological Record. 1864-65.

N.B.—The Library is now in the Hall of the Mission School, Blackheath. Members can obtain or return Books by personal or written application to the Rev. E. Waite, the Head Master; or on the evenings of the ordinary Meetings.

Note.—All communications should be addressed to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.

HENRY HAINWORTH, } *Hon. Secs.*
HUGH WILSON,

W. H. Crockford, Steam Printing Works, Greenwich and Lewisham.

MEETINGS OF THE SOCIETY

FOR THE SESSION 1881-82.

WEDNESDAY,	MARCH	23
,,	APRIL	27
,,	MAY	25
,,	OCTOBER	26
,,	NOVEMBER	23
,,	DECEMBER	21
,,	JANUARY (1882)	25
,,	FEBRUARY ,, ANNUAL	22

THE CHAIR IS TAKEN AT 8 O'CLOCK.

THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

W. H. CROCKFORD, PRINTER, BLACKHEATH ROAD, AND LEWISHAM.

WEST KENT

Natural History, Microscopical, and Photographic Society.

THE

PRESIDENT'S ADDRESS, PAPERS,

AND

Reports of the Council and Auditors,

FOR 1881-82,

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

PRINTED BY
W. H. CROCKFORD, GREENWICH, LEWISHAM, AND BLACKHEATH

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1882.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 23rd, 1881,

FOR THE SESSION 1881-82.

President.

W. G. LEMON, B.A., LL.B., F.G.S.

Vice-Presidents.

R. McLACHLAN, F.R.S., F.L.S.
FLAXMAN SPURRELL, F.R.C.S.
H. T. STAINTON, F.R.S., F.L.S.
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Council.

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H. F. BILLINGHURST.
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T. O. DONALDSON, M. Inst. C.E.
G. H. FREAN.
W. GROVES.
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E. R. PEARCE.
J. STANDRING.
F. T. TAYLER, M.B., B.A.
C. G. WOOD.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society.

Elected at the Annual Meeting, February 22nd, 1882,

FOR THE SESSION 1882-83.

—o—

President.

F. T. TAYLER, M.B., B.A.

Vice-Presidents.

T. O. DONALDSON, M.Inst. C.E.
W. GROVES (Lee).
W. G. LEMON, B.A., LL.B., F.G.S.
J. JENNER WEIR, F.L.S., F.Z.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

E BELLEROCHE.
H F. BILLINGHURST.
E. CLIFT.
F. G. COX.
G. H. FREAN.
B GUEST.
STUART KNILL.
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E R. PEARCE.
FLAXMAN SPURRELL, F.R.C.S.
H T. STAINTON, F.R.S., F.L.S.
J. STANDRING.
C G. WOOD.

REPORT OF THE COUNCIL

FOR THE SESSION, 1881-82.

The Council are pleased at the termination of another year to be able to congratulate the Society on its stability and continued prosperity. The list of Members has been carefully revised, and the names of those who, owing to removal from the neighbourhood or other causes, had practically ceased to be Members have been erased. The number at present on the register is 107, of whom 6 are Honorary Members.

During the past year, one Member only has been removed by death, but this was one who could be ill spared. F. Currey, Esq., M.A., F.R.S., &c., who to the great grief of a large circle of friends, died after a brief illness, in August, 1881. His general scientific attainments, and the high rank he held amongst botanists —especially in regard to his knowledge of Fungi—are too well known to require comment. He had been connected with this Society from its earliest days, and had filled the offices of President, Vice-President and Member of Council. He always manifested a warm interest in the Society's prosperity, and was ever ready in the kindest manner to give information on any subject with which he was familiar, and without hesitation to place at the disposal of the humblest scientific enquirer amongst us, the stores of knowledge which years of patient industry, and his naturally acute powers and retentive memory, had enabled him to amass. One of his last acts for the Society was, on November 24th, 1880, to read a Paper on "Some Useful and Noxious Fungi," which will be found printed in our last Report.

The Accounts of the Honorary Treasurer have been duly audited, and shew a balance in hand of £1 18s. 5d. The sum received during the past year for subscriptions was £55 13s. 0d.

At the commencement of the Session, it was determined by the Society that papers read at the Meetings, or abstracts thereof, should so far as practicable be published with the Annual Report. In pursuance of such determination, there will be published this

Session Papers read by Dr. F. Tayler, and R. McLachlan, Esq., F.R.S., together with abstracts of papers by Messrs. W. Groves and J. Standring.

A paper was to have been read on the 25th January, 1882, by Mr. Charles Heisch, F.C.S., Public Analyst for Lewisham, "On the working of the Adulteration of Foods and Drugs Acts," but owing to the dense fog, and the fact that Mr. Heisch was at the time suffering from a severe attack of bronchitis, he was unable to attend. A discussion took place upon the topic, which was opened by the President, and in which Dr. F. Tayler, Messrs. Belleroche, McLachlan, Stainton, Weir, and others took part. It is hoped to arrange for the delivery of Mr. Heisch's paper at an early Meeting.

At the Meeting on the 18th May, instead of the usual Paper, a Lecture was delivered by Joseph Needham, Esq., M.D., F.R.M.S., on "The preparation of Sections for the Microscope." This Lecture was well attended by an appreciative audience.

A Soirée of the Members and their friends took place on the 11th May, 1881. It was numerously attended. Many interesting objects were exhibited. Messrs. Morgan and Laing, with the kind help of W. Webster, jun., Esq., demonstrated their mode of enlarging Photographs. A bust painted with luminous paint was exhibited by Messrs. Ihlee and Horne. A change was made in the usual programme by the introduction of two short Lectures. One by R. McLachlan, Esq., F.R.S., who had selected for exhibition by the Electric Lantern, a number of slides, illustrating some branches of Natural History, and who accompanied the exhibition with short observations upon the subjects as thrown upon the disc. The other Lecture was by J. Jenner Weir, Esq., F.L.S., who gave the results of personal observations in several departments of Natural History. The thanks of the Society are due to the various Exhibitors, and to Mr. Wainewright and others, who contributed flowers and valuable objects to decorate the room.

The Field Meeting was held on June, 15th, at Westerham—a large party was made up, including the lady friends of the Members. The day was bright and passed off pleasantly. The ramble through Squeeries Park and the woods near Westerham added greatly to the enjoyment of the day.

On the 16th July, the Members and their friends dined together at the "New Falcon" Hotel, Gravesend. After dinner the President introduced as a subject for discussion "Salmon," and several Members made interesting observations upon its form, habits and culture.

The Annual Cryptogamic Meeting was held on the 8th October, when Dr. Spurrell, who has so frequently taken the lead on previous similar occasions, met the Members and their friends at Bexley Station, and conducted them through Joyden's Wood to Dartford. Owing to the incessant rain the attendance was small.

The Library has been increased by the purchase of the recent work by C. Darwin, "On Vegetable Mould and Earthworms;" and by presentation of "Nature," for 1881 by Mr. Walton; "A Vision of Creation," and two Pamphlets by Dr. Collingwood; Sir John Lubbock's "Fifty years of Science" by Mr. W. G. Lemon; and the transactions of various Societies, a List of which will be published with the Report.

The Council cannot conclude this Report without thanking those gentlemen who have read Papers at the several Meetings, and also the Members who have either exhibited objects at the ordinary Meetings, or taken part in the discussions which have ensued.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

For the Year ending 31st December, 1881.

RECEIPTS.	£	s.	d.
Balance in hand on 1st January, 1881	19	9	1
Subscriptions—1877	1	1	0
,, 1878	1	11	6
,, 1879	4	4	0
,, 1880	7	7	0
,, 1881	39	7	6
,, 1882 (in advance)	2	12	6
	£75	12	7

PAYMENTS.	£	s.	d.
Expenses of Meetings and Refreshments	2	14	9
Donation for use of Room, &c.	6	6	0
Fee to Assistant	5	5	0
Subscription to Ray Society, 1881	1	1	0
Insurance of Books, &c.		5	0
Cost of New Books and Binding	3	1	10
Stationery, Postage, &c.	6	4	5
Soirée Expenses, 1881	24	2	2
Miscellaneous	1	14	6
Lecture	5	15	6
Printer's Bill	17	4	0
Balance in hand on 31st December, 1881	1	18	5
	£75	12	7

Audited and certified to be correct,

WILLIAM GROVES, } *Auditors.*
PERCY J. WEIR, }

16th February, 1882.

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

BY

The President, W. G. LEMON, Esq., B.A., LL.B., F.G.S.,

ON THE 22ND FEBRUARY, 1882.

Gentlemen,

The Council, in accordance with the wishes of the Members, have arranged for the publication of an abstract, more or less full, of the papers read at our ordinary Meetings. This, taken in conjunction with the report already presented to you, leaves little to be said by me on the work of the Society during the past year. Every one who has attended our Meetings must have noticed that many valuable remarks were made in the course of the discussions which followed the several papers; and also that, on numerous occasions, facts and personal observations of more than local scientific interest were communicated in the conversation which preceded the reading of papers. These are deserving of a permanent record, and possibly during the current year some means may be devised for preserving them in a form accessible to the Members.

The Report of the Council refers to the loss sustained by the Society in the death of Mr. Frederick Currey, M.A., F.R.S. Of late years he had not been able to mingle so much with us as in the early days of the Society. I can well remember how, more than 20 years ago, when the Greenwich Natural History Club amalgamated with this Society, Mr. Currey, who had occasionally attended our Meetings previously, became, with the late Mr. J. Flint South and others, regular attendants; and from the fulness of his botanical knowledge, and his readiness to impart the results of personal investigations, he added greatly to the pleasure of our evenings. Mr. Currey was a master of cryptogamic botany, and his death will be felt as a great loss in this special department of science.

You will all join me in congratulating our esteemed ex-President, Mr. R. McLachlan, F.R.S., on the publication of his article on Insects in the new edition of the Encyclopædia Britannica, and on the reception which that article has met with from those entomologists who are competent to express an opinion on its merits. I can here only faintly echo the sentiments that have been expressed by others. He has produced a very effective article, marked by that clearness of expression and arrangement which is a distinguishing characteristic of his scientific expositions.

The meteorological conditions of the past five months are worthy of notice. The abnormal weather may be considered to have begun with the storm of October 14th, the wind blowing from the west and south-west. This was followed by another storm of equal severity, in which the wind acted with great force within narrow limits, blowing down chimneys and garden walls in the line of its direction, doing considerable damage to property in this immediate neighbourhood. During the last week of October, the temperature fell low enough to produce frost on the ground, but the November which followed was unusually warm—in fact, the warmest recorded in Great Britain for 118 years, or since thermometers were used to record the temperature; except only as to London itself, where the mean temperatures for November, 1818 and 1852, were very slightly in excess of that for 1881. At the same time the barometer fell very low; the lowest reading probably being that at the Butt of Lewis, where on the 27th November, the reading corrected for 32°, and sea level was 27·865, remaining at this lowest point from 4.30 to 7 a.m., and over a wide area the pressure was for a considerable time less than 28 inches. December was a month of nearly average temperature, and marked by very slight variations. Some frost occurred about the middle of the month, but so slight as to offer scarcely any serious check to the growth of grass, and it would be difficult to call to mind any season when at Christmas the fields presented such a spring-like vesture. On the morning of the 6th January, 1882, our friend Mr. McLachlan noticed the first blossom of the Coltsfoot (*Tussilago farfara*) at Lewisham; the appearance of this blossom is ordinarily considered to be an indication that winter is over. A peacock butterfly was caught on the wing near Basingstoke, on February 13th. Perhaps the most noteworthy feature of the past two months has been the extraordinary high readings of the barometer.

In January, an anticyclone of a very marked character overspread Europe. On the 10th, the centre of highest pressure was over Eastern France and Switzerland, and rose to 30·512. On the 11th, the area of high pressure increased and extended eastward, retreating next day to the position it had occupied on the 10th; it then advanced eastward, till on the 15th at Lemburg, the reading was 31·004 inches; it then retreated again a little westward. At Wilna, on the 16th the pressure rose to 31·071, unquestionably one of the highest readings recorded. On the 17th at Berne, the pressure was 31·012. On the 18th it had retreated to the westward, so that the southern parts of England and Ireland were covered by it, the pressure being all but 31·000. On the three following days the anticyclone retained very much the same position, but the pressure in the centre fell successively to 30·093 inches at Oxford, 30·079 inches at Nottingham, and 30·176 inches at Isle of Wight. From the 11th to the 17th in London, the temperature was high. Mild warm southerly winds prevailed, resembling bright September weather; the mean temperature of the Metropolis being 5·6 deg. above the average. But as the anticlyclonic centre retreated towards England, the southerly winds gave way—the temperature fell and the fogs began to prevail, so that on the 18th and 19th it was 5·8 deg. below the normal. The highest barometric reading in the British Islands noted was 30·970, at 8 a.m. on the 18th, at Oxford. Probably the highest ever recorded in the British Isles, was at Gordon Castle, Banffshire, where 31·046 was registered at 11 p.m., on January 8th, 1820. The reading yesterday was 30·75, and this morning 30·7 nearly. All must have been physically conscious of these abnormal barometric conditions, in many of us producing great disinclination to active bodily exercise, and in some mental depression of a marked character. It will be interesting to observe the effect of this unusual weather on animal life during the approaching spring.

Towards the end of the month of January, dense fogs prevailed all along the southern parts of England, and specially in the valley of the Thames and its tributaries. The fog of the afternoon and evening of February 4th, was of peculiar density—objects being invisible at the distance of only three or four feet, while the trains travelled so slowly, that in some cases it took nearly six hours to reach Blackheath from London.

The Council were desirous of having this subject of the weather of the present winter brought before you at our last meeting, by our former member James Glaisher, Esq., F.R.S., but illness prevented his acceding to their request, and I have therefore thought it desirable very briefly to note these facts.

The possibility of finding workable Coal-fields under the London area, has again engaged the attention of Geologists. The question was mooted as long ago as 1826, when Dr. Buckland and Mr. Conybeare pointed out how closely the Coal measures of the Bristol and Somerset District on the west resembled that of the Great Belgian Coal-field on the east. In 1841, MM. de Beaumont and Dufrénoy called attention to the fact that Coal existed under newer beds in the north of France, and that possibly the same ridge of old rocks with Coal-strata would be found to stretch right away under the south-eastern counties of England.

Attention was again called to the subject by Sir Henry de la Beche, in 1846, and M. Mengy, in 1852, and the matter was very fully discussed by Mr. Godwin Austen, in a paper read before the Geological Society, in 1855; while in the report of the Coal Commission in 1871, Professor Prestwich brought forward new evidence. Recently, five borings in the London basin, within a radius of 20 miles, have demonstrated the very moderate depths at which the Palæozoic rocks must lie.

No. 1.—At Kentish Town—1,300 feet deep, the London Clay passed through was 350 feet thick; the Reading Beds, 50 feet; Thanet Sands, 15 feet; Upper Chalk, 250 feet; Chalk Marl, 30 feet; Upper Greensand, 10 feet; Gault, 60 feet; then 190 feet of a new Sandy Rock, believed to be the Devonian or old Red Sandstone.

No. 2.—The only boring south of the Thames was at Crossness. Here a new well bore-hole was sunk 1,000 feet deep. It showed no London Clay proper, but alluvial clay and gravel 20 feet thick, immediately below the ordnance level, rested upon undressed Reading and Thanet Sands, about 100 feet thick; then came Chalk, 620 feet; Upper Greensand, 33 feet; Gault, 135 feet, succeeded by loose red sand having all the appearance of new Red Sandstone, and resembling the Red series found at Kentish Town.

No. 3.—This boring at Messrs. Meux's Brewery, Tottenham

Court Road, gave the most important geological results. After passing through 156 feet of the London tertiaries, the Upper Chalk was reached and found to be 440 feet thick; then came Sand, Chalk, and Chalk Marl, 215 feet; Gault and Upper Greensand, 190 feet; Neocomian of a peculiar type, 64 feet; beneath this came Upper Devonian Shales, but at a depth of 1,064 feet and containing its characteristic fossils, such as *Spirifera disjuncta, Rhynchonella cuboides, etc.* This was the first indication of the presence of rocks older than the Neocomian East of North Devon, and north of the latitude of London. It clearly showed the extension of Palæozoic rocks from the Western side of England, and extending towards Holland and Belgium.

No. 4 was a boring at Turnford, 12 miles north of London. Here the London tertiaries were 100 feet thick; Chalk, 620 feet; the Upper Greensand, 15 feet; the Gault, 135 feet; the Neocomian of the Carr-stone type, about 12 inches. At the depth of 940 feet, the characteristic fossils of the dark chocolate coloured Upper Devonian series were found.

No. 5.—This trial boring was at Ware, east of Hertford, and due north of the Turnford boring. It began in the Upper Chalk here 416 feet thick, which is followed by Chalk Marl, 125 feet; the Upper Greensand, 77 feet, and the Gault, 160 feet; then a trace only of the Neocomian of the Carr-stone type, about 8 inches, resting upon an eroded surface of Upper Silurian Limestone.

One fact worthy of notice is, that these and other borings shew that the strata lie at very high angles; the dip found at Tottenham Court Road, being 36°., and at Ware, 30°., and also that the rocks forming the old Palæozoic ridge are bent into a series of east and west folds. It is among these folds, that Coal, if it exists, will be found. It has been suggested, that a point in the southern suburbs of London, such as Sydenham, should be selected as the site for a new trial; so that even if Coal were not found, the Lower Greensand might be met with, which would in all probability afford an abundant supply of excellent water. As we now know that the Palæozoic ridge lies at depths varying from 800 to 1,200 feet below the surface, in the London district, and as Coal is worked at a depth of 2,000 feet, there would seem to be no reason on account of depth, why Coal should not be worked under London, when discovered. It would thus seem that this district in which we meet may either become a "Black Country" for the supply of London with Coal, which it is to be hoped will be of an anthracite or smokeless nature; or else may prove an unfailing source of fresh water to the great relief of the New London Municipality when formed, affording them an abundant supply of potable fluid for the south side of the Metropolis, and enabling them in part at least to deal with one of the most pressing economic problems of the day. We will not here forecast the future of London. The hypothesis of a smokeless, although undermined Metropolis, with a good supply of pure water, is at least more consolatory than the terrible astronomical forecast which has so recently been announced to us. We are told to expect that one of these troublesome menacing comets will come into collision with the sun some fifteen years hence, producing terrible consequences, and by heat and flashing flames, burning up, or liquifying the earth's surface.

In many departments of science, the year 1881 has been one of retrospect. The British Association held its fifty-first Meeting at York, in August last, and in thus celebrating the Jubilee of the Association's existence, it is to be expected that many would look back and compare the state of knowledge in 1831, with that in 1881, and ask what progress has been made. The President, Sir John Lubbock, Bart., F.R.S., in his opening address, has felicitously and in popular language mapped out the ground that has been traversed, and indicated the vantage points reached. This address is now published in a book form, and as it either has been or doubtless will be read by you all, I shall not attempt to touch upon any of the subjects he has handled with so much skill and didactic power.

There are two dogmas which have done much to mould scientific thought during the latter part of this period, upon which I would with your permission make a very few remarks. They are respectively known as the doctrine of the Conservation of Energy, and the doctrine of Evolution.

The first of these, notwithstanding its wide acceptance, can scarcely be admitted to be a demonstrated principle. It must still be regarded as a hypothesis awaiting complete verification; a convenient enough hypothesis for dealing with some of the phenomena around us, particularly those relating to inanimate matter, but yet far removed from actual proof in its assumed extension to the forces of organic life. To make this clear, we must remember, that energy in its scientific sense represents work done by a force operating during some period, and the doctrine of its conservation may be briefly stated in the formula "the sum of energy in the universe, whatever its transformation may be, is a constant quantity," or in other words "no fresh energy is born into nature or dies out of it." This energy is not the "*force*" of older philosophers, but requires for its development vehicles of matter and ether. In its nature it is classed as either *Kinetic* by virtue of its motion, or *potential* by virtue of its position. If I wind up a clock causing the mass of the weights to move through a given space, the work I do is said to be equal to the change of Kinetic energy of the weights; while the weights wound up and left at rest are said to possess potential energy, because from their position, if let free, they can restore the Kinetic energy or work expended in raising them. Now accepting this dual hypothesis of Kinetic and Potential energy, it is contended that all the forms which energy assumes in the universe may be placed under one or other of these classes, and that all the operations of nature, both organic and inorganic, are confined to the change of energy from one kind to another; motion, heat, molecular separation, chemical separation, radiant energy, elecricity, or magnetism and life. Even admitting that the universe consists of matter and ether, acting upon and with each other, the form and essence of these are an inscrutable secret, and however interchangeable some results and operations may appear, it is a long step to the assumption that the mechanism of nature was at one time set a-going, and ever since continues to act without an active superintending power, and receives no addition of energy; and further that the original energy is not merely conserved, but is able to act upon and develop organic life with its numerous functions and its added power of thought and expression. Moreover, the correlative idea suggested by Sir William Thomson, of the dissipation of energy seems to follow as a necessary consequence from this hypothesis, and hence it is by some writers maintained that so far as this earth is concerned, all the energy tends during its transformation to pass into heat, that this is then in some degree dissipated through the surrounding ether, and the universe is being thus gradually brought down to a uniform temperature.

One of the most noticeable instances of the ideas to which this theory has been adapted, and of the play of the imagination in physical science, will be found in a Lecture entitled, "A Glimpse through the corridors of Time," delivered in the Midland Institute, Birmingham, on October 24th, 1881, by Professor Robert S. Ball, of the University of Dublin and Royal Astronomer of Ireland. In such Lecture he sketches the changes that in his opinion have been brought about by time, and attempts to foreshadow the earth's destiny. He uses the well-worn illustration of a machine as applied to this question, the earth being a gigantic fly-wheel, in which a stupendous quantity of energy is stored. The tides are with him mighty agents for withdrawing the energy from this earth. He assumes that there is no new source of supply. This withdrawn energy is dissipated through the universe. The tides, he says, are increasing the length of the day, the moon recedes further and further. Some 50,000,000 years ago, or thereabouts, he is unable to chronicle the event with perfect accuracy, the moon was born, thrown off in fact from an earth then revolving on its axis, in a day equal in length to about three hours of the present day. Gradually this period has lengthened, and it will continue to lengthen; the rotation of the earth will diminish until the moon will go round the earth in 1,400 hours, while the earth will rotate on its axis in the same time. In other words, the day of the future will become as long as 57 of our present days. This epoch we are told will assuredly come, if the world lasts as long. All this and much more of the same kind is put before us as the result of the hypothesis of the conservation of energy applied merely to unorganised matter. Pondering upon such speculations, is it to be wondered at that even high sounding names and magniloquent phrases should fail to secure entire admission of the truth of an hypothesis which leads to such results, or that we should ask for more patient observations and more rigorous examination. While admitting that in relation to motion and some other manifestations of physical energy, the hypothesis is found to give satisfactory results a just appreciation of all consideration, will I think convince us that with regard to its extension into wider regions and into the domain of organic life, and its denial of the introduction into this world of any new energy, it should for the present at least be regarded as "not proven."

The other doctrine, that of Evolution and its correlative doctrine of Descent, stands in an entirely different position. At first, it was a mere hypothesis suggested in 1801 by Lamarck, who upheld the doctrine that all species, including man, are descended from other species, and that organic life was one long chain of successive development. It was next touched upon by Geoffrey Saint Hilaire in 1828, by the Hon. and Rev. W. Herbert in his work on "Amaryllidaceæ," published in 1837, and subsequently by the author of the "Vestiges of Creation," by Mr. Wallace and others. But now the laborious, extensive and painstaking observations of Darwin have raised it into a theory which has become identified with his name.

Doubtless, the views and opinions of this acute and profound observer are much misunderstood. There are many, as Sir John Lubbock suggests, who think that according to this theory, a sheep might turn into a cow, or a zebra be developed into a horse, or an ape grow into a man; there are others who regard this view as entirely opposed to the belief in the existence of a supreme intelligence, working with a beneficent design, and as distinctly contradictory to what is set forth in our sacred writings, and therefore unworthy of acceptance

I am free to confess that I have no sympathy with either of these modes of regarding the wonderful yet simple law which was formulated by this illustrious observer, to express the method and results of the working of nature in organic life. Nowhere is he found asserting that an anthropoid ape could turn into a man; only that as to their physical constitution both may be descended from a common stock, a supposition in no way contradictory to the brief account of man's origin transmitted to us from Eastern sources. On this theory variation is at all times treated as connected with or dependent upon adaptation to specific ends, which certainly appears to be a true mark of design. The axioms upon which this theory is based are stated by Sir John Lubbock as—(1). That no two animals or plants in nature are identical in all respects. (2). That the offspring tend to inherit the peculiarities of their parents. (3). That of those who come into existence only a small number reach maturity. (4). That those which are on the whole best adapted to the circumstances in which they are placed are most likely to leave descendants.

The theory of Evolution does not attempt to account for the origin of life. It starts with the fact of life as existing in germs, and through embryonic development and observation upon living adults, it traces out subsequent evolution. Here evolution is a process not a power—its factors are Heredity, Environment, and Adaptation. This last is carried on in harmony with a formulated experience known as "Natural Selection" or the "Survival of the fittest;" and although it may be doubted whether the environment of any individual organism can operate so as to produce a permanent variety, minor variations are constantly arising, and such of them as prove strong and beneficial are reproduced. Evolution thus is a process leading to progress, and is a general principle or process applicable not only to the physical growth of plants and animals, but is to be found in morals, politics, and even religion itself.

Darwin himself cannot be said to have regarded the principles he has set forth as antagonistic to the belief in a Creator. In addition to the closing words of his work on the Origin of Species, he quotes with approval words written to him by one who says, "He has gradually learned to see there is just as noble a conception of the Deity to believe that He has created a few original forms capable of self development into other and needful forms, as to believe that He required a fresh art of creation to supply the ends caused by the action of His own laws."

Evolution, or progress, as a fact must be admitted; but even then it may be conceived of either as a process advancing without an aim, or as one tending to the perfection of all animate things, adapting them so as to obtain from their surrounding conditions the greatest amount of strength and enjoyment. Such adaptation may be mainly dependent upon external conditions or, as Professor Hoffmann after 20 years of labour in modifying plants has supposed, by internal organic agencies at present unknown; or, we would add, by some agency ever watchful, ever present, ever working by fixed and defined rules to the attainment of the highest ends.

It is said that the doctrine of natural selection shocks us by striking a blow at all design in nature: for as only the fittest things survive, we live because the hostile forces of nature could not kill us. But may we not rather say that the principle of Evolution discloses one great and vast design—that the best and the noblest are ever surviving and continuing their race only by means of those possessing powers and capacities for that which is yet higher and nobler.

By some it is further objected that to trace man's pedigree to a common ancestry with that of the lower animals is degrading. But in what does this so called degradation consist? Is it in the fact that for many past ages man and his more immediate ancestors have been constantly progressing onward and upward till they have attained their present position? Do men feel themselves degraded because they are descended from a Saxon freebooter or a Norman plunderer? Is the body less to be honoured because its bones, its nerves, its muscles are nourished and formed by mineral, vegetable, or animal food, and contain phosphates derived from a fish or fibrine from a pig?

Natural science is not directly concerned with theology, but it is not a cause of surprise to any observer of the facts and phenomena which surround us in our present existence to find the same principles and same laws holding good in various departments. Has not Christianity its own story of gradual evolution, of development, or evolution of truth, and of survival of the fittest in doctrine and modes of worship. Every reader of its sacred writings and history will note the one watchword of progress; old ideas giving place to new, the spiritual attainments of one race or generation being the stepping-stone to still higher advances in the future; though even now and again in the nineteenth century we have instances of reversion to the older types of superstition and cruelty.

Acknowledging therefore in the fullest and most unqualified sense that the Doctrine of Evolution, or, as it is popularly called, Darwinism, is derived from carefully observed facts, and that its conclusions, as stated by its illustrious teacher, are based upon scientific truth, I expect to find it harmonize with all other *truths* by whomsoever taught. If our theological writers assert that its conclusions clash with their formulated dogmas or ecclesiastical systems, let them look well to their modes of interpretation; see that they have not misread their books; and if necessary let them seek to discover some more accurate exegesis or more reliable hermeneutics by which their system may be brought into harmony with the truth revealed alike to all in the book of nature as it is read in the light of science and interpreted by earnest thoughtful and true men.

It has been impossible in the short time at my disposal this evening satisfactorily to discuss the doctrines of Evolution and Descent in their relation to general truth. My remarks have been restricted within extremely narrow limits, but sufficient perhaps to indicate the lines along which the mind has moved in arriving at the conviction that these scientific doctrines are not necessarily inconsistent with belief in a revealed religion; and that we may at the same time hold fast the verities of Christian faith and honestly accept the teaching of one who, like the illustrious author of the Origin of Species and the Descent of Man, patiently observes the operations going on around him, who does not hastily jump to conclusions and will not begrudge years spent in observing the habits of so humble a creature as the earth-worm, if by so doing he can add something to the accumulated knowledge of the race and thereby benefit his fellow man.

In withdrawing from the chair I very heartily thank you for the kind support you have accorded me during my tenure of office, and for the generous forbearance you have on all occasions manifested towards me in my endeavour to fulfil the duties imposed upon me. Very heartily too do I thank our able and zealous hon. secretaries, Mr. Hainworth and Mr. Wilson for their strenuous exertions on behalf of the Society, and their cheerful readiness at all times to aid us in every way. The Society is to be congratulated on having two such hard-working Secretaries; long may they continue to serve it.

With feelings of very great pleasure I now give place to Dr. Tayler, who has been unanimously elected by you to be your President for the ensuing two years. He is well known amongst us as a gentleman of high scientific attainments, extensive reading, acute powers of observation, and of courteous bearing. His occupation of this chair cannot fail to be of very great advantage to the members. I wish him a very happy tenure of office. Under him may the Society flourish and attain greater success than even in past times.

ABSTRACT OF A PAPER

READ BY

JOHN STANDRING, Esq.,

ON

"WINE AND ITS DEVELOPMENT."

23rd MARCH, 1881.

Premising that the very wide range of the subject would require a course of Lectures to do it justice, he said he should confine his remarks to the results of his own observation, and experience during more than forty years devoted to the study of Wines.

Wine is the fermented juice of the grape, but many other vegetable juices are made into so called "Wine." "Unfermented Wine" so called, is really not Wine at all, as it is only by fermentation (of which more or less alcohol is a product) that grape juice becomes Wine. Mr. Standring read an amusing paragraph from the papers, of the result of an analysis of "Teetotal Wines."

The process of Wine-making was briefly described, in which the progress of the fermentation has to be carefully watched, that the Wine may be racked into other casks at the right moment.

By repeated rackings the Wine becomes bright and fit for use. All fermentation should have ceased before the Wine is exported in casks. Sparkling Wines in bottle are really imperfect Wines, in which some fermentation is allowed to occur after bottling, by which carbonic acid gas is generated, which escapes immediately on the removal of the cork.

The varieties of Wine are practically infinite. Of "Sherry" alone, it is probably no exaggeration to say there are 100,000 varieties, or shades of difference, in England at the present time; no two of them exactly alike; some presenting the most opposite characters, but all ranked under the generic term "Sherry." All Sherry is pale when first made, but increases in colour by age. Dark gold or brown Sherry is produced by the addition of more or less "Vino de color," which is Wine from which the watery particles have been driven off by boiling, the product being of a very dark brown colour. The addition of "Vino de color" not only improves the flavour in the estimation of some connoisseurs, but adds to the stability or keeping power of the Wine. Many of the varieties of Sherry ought to have names whereby to distinguish them (as a few of them have), but the difficulty would be to find names for such a numerous family. Montilla is a white Wine from the interior of Spain, of a light dry character.

Wine is always undergoing change, getting better or worse. Wines of a good vintage, rich in saccharine, develop strength (or alchohol) as they grow older, but Wines of a poor vintage are weak from the first, and will not keep many years. All Wines may be overkept, but the best vintages keep the longest. It follows, therefore, that increased age does not always improve Wine. Age is not equivalent to good quality, and if Wine does not possess this in its youth, it will not acquire it by being kept. Every Wine after it has reached its climax of excellence, enters upon its period of decadence, which may be slow or rapid in its progress.

Wines require occasionally to be fortified or strengthened by the addition of spirit (which should be made from grapes, and not potato or any other "evil spirit.") This should not be regarded as an adulteration, but as a preservative (as salt is to meat) since Wine is a perishable article of food, and may spoil by neglect of proper treatment. Wine is sometimes over fortified; this is injurious to the Wine Merchant, as well as to the consumer. So called "Natural" Wines are such as have no spirit (or very little) added to them; but the term is misleading, if people suppose from it that the making of Wine can be safely left to nature, as good Wine would thus become Vinegar, and all Wines require to be carefully watched and treated according to their progress.

The development of Wine is much affected by the treatment it receives, how many rackings it undergoes, but especially whether it is allowed to mature in wood or bottle. The right time for bottling a Wine is generally when it is about three years' old. Vintages light in character may be bottled earlier, whereas very full-bodied Wine may be bottled somewhat later.

The condition of Wine (by which is understood its brilliancy or the reverse) is a matter of great importance when it is to be drunk, or tasted; it may be taken as an axiom that Wine that is not bright to the eye is not right to the taste. It follows, therefore, that if a Wine tastes well when in bad condition, it will taste still better when bright. It is the object of the Wine Merchant, after he has selected a Wine, to get it into good condition by fining (sometimes re-fining) when it becomes fit to bottle. White Wines are fined with isinglass or gelatine; red Wines with white of eggs. Wines generally become "sick" or cloudy soon after bottling, but recover their brilliancy in time. Port Wine is especially subject to great changes of condition. It soon becomes turbid by exposure to cold, but a warm temperature restores its brilliancy. All Wines throw more or less deposit (lees or crust) from which they should be carefully decanted or drawn before being placed on table, or the taste is prejudicially affected. An exception, however, exists in the "bee's wing," which occurs in old bottled Port. This is a thin filmy crust which floats in brilliant Wine, and should never be destroyed by the use of a strainer. Mr. Standring exhibited a specimen of Wine showing bee's wing, and recommended the members to lose no opportunity of improving their acquaintance with this beautiful product of nature in its native element. A specimen was also shown of white Port, which is made from white grapes, on the banks of the Douro. It is largely consumed in Russia, but little known in England. Val de Penas, is a red Wine from the interior of Spain. It is of an astringent character, rather like Claret. Madeira Wine, of good quality, is now being imported in considerable quantities, and at very moderate prices, the vines in the island having recovered from the disease which for many years destroyed the produce. Mr. Standring then referred to the subject of acid in Wine. Wine Merchants are sometimes asked for Wine "perfectly free from acid." This is practically impossible, if the Wine be made from grapes, as even ripe grapes contain a slight but agreeable acid, which will exist in the Wine, and which is quite wholesome. Wine often contains an excess of acid, especially if it be made from unripe grapes. Wine becomes acid or unsound by being overkept. It is then no longer wholesome.

The flavours developed by Wine, as it becomes older, are various and interesting to the connoisseur, who cannot foretell them with certainty. He knows however, by experience, that the flavour of old Wine will be in accordance with the quality of the Wine in its youth. In judging quality, connoisseurs are guided as much by the smell as by the taste. Certain technical terms are used, which are only understood by the initiated. "Dryness" means freedom from sweetness. It is somewhat remarkable, that there is no word in English which means exactly opposite to *sweet*, as *heat* does to *cold*, or *dirty* to *clean*. The terms *bitter* and *sour*, which are commonly spoken of as opposite to sweet, are really not so, as they may both co-exist with sweetness in the same liquid. The Wine Merchant therefore uses the term *dry* for want of a better. "Bouquet" is a term applied to the combination of odours proceeding from Wine, which often reminds one of the scent of flowers. "Body" is a term implying fulness or stoutness to the taste, the opposite to thinness or poorness. It is a characteristic of all good vintages.

In selecting Wines, one set of rules cannot be applied to all. In pale Sherry, there should be softness and delicacy, with good flavour and body; dryness according to taste. In golden or brown Sherry, there should be softness with fulness of flavour, and not too much richness. In Claret or Burgundy, a full fruity flavour is desirable; dryness in these Wines is to be avoided. In Port (when young) there should be a full fruity flavour with some astringency and dryness, a softness and silkiness with no mawkish sweetness. If allowed to mature in wood, Port loses its colour, but thereby becomes a more wholesome beverage for those who do not wish to be restricted to one or two glasses.

In Champagne, good flavour, lightness and elegance with dryness are desirable. Such Wine is more wholesome than the very sweet Champagne that was in vogue ten or fifteen years ago. Different degrees of sweetness are given to this Wine by the addition of more or less liqueur (a preparation of sugar) before shipment to this country. "Brut" Champagne is free from this admixture, and is consequently extremely dry.

Sauterne, a white Wine from the south of France, is rich, with fine flavour, the lower qualities are more or less free from sweetness. The celebrated "Chateau Yquem" Sauterne, sometimes sells for more than a guinea a bottle. This should only be drunk as a liqueur.

In Hock and Moselle, fine flavour, with an agreeable bouquet and fulness should appear in good vintages.

There is one characteristic, which is a test of all good Wine, namely, a flavour of fruit in the mouth, perceived after the Wine has left the palate at an interval of a minute or more. It is like the taste of a ripe plum, and is never found in Wine of a poor vintage. Good Wine may be likened to a friend who improves upon acquaintance. If it is liked better on repeated tastings, it may be trusted, but if the reverse, it should be treated with caution in buying. In another respect Wine is like man, viz., in the usual limit of its age. Few Wines will retain their soundness up to, or beyond a hundred years.

In the relative values of Wines, the range is extremely wide. Genuine light Wines can be had of any respectable Wine Merchant, at a very moderate rate, but for choice vintages (bottled at the right time—a most essential point) very high prices are obtained.

As regards the wholesomeness of Wine, we are all the best judges for ourselves. Medical men make great mistakes in recommending one particular Wine to various patients.

Wine consumers would do well to indulge their palates with more variety than they are in the habit of doing. As we do not eat the same meat every day, so different Wines may be taken with pleasure to the taste and advantage to health. We are justified in regarding Wine as especially the drink of the "temperate man." Its moderate use enables him to steer clear of the torrid zone of intoxication, as well as the frigid zone of total abstinence. It is much to be desired, that a taste for light refreshing Wines, which are not of an intoxicating character, should increase among all classes of the community for daily consumption, while the stronger Wines may be taken (either with or without water) in moderation, to the benefit of the health of many. It is moreover desirable, that good Wine should be both abundant and cheap. Unfortunately, from the ravages of Phylloxera, in many parts of Europe, this wish is not likely to be realized at present, as the tendency is quite in the opposite direction. It is to be hoped that the evil will not be of long continuance, but that before long good vintages will again add to the health, wealth, and prosperity of the civilized world.

"TRICHINOSIS,"

BY

F. T. TAYLER, Esq., M.B., B.A.

27th APRIL, 1881.

It is quite certain that from a very remote period of time, science has known that the bodies of men and animals are liable to be invaded by other organisms; but it is equally certain that we owe to the untiring zeal of modern investigators, all the knowledge we possess of the life-history, and almost universal prevalence of these unwelcome visitors. Rymer Jones writing on the subject says, "There are probably no races of animals which are not infested with one or more species of these parasites, from the microscopic *Infusorion* up to man himself, and sometimes several different forms are met with in the same species to which they would appear to be peculiar, and even in some cases the Entozoa would seem themselves to enclose other species parasitically dwelling in their bodies."

> So, naturalists observe, a flea
> Has smaller fleas that on him prey;
> And these have smaller still to bite 'em;
> And so proceed, *ad infinitum.*

Owen, writing about thirty-five years ago, says that upwards of fifteen distinct kinds of *Entozoa* are already known to infest the human body, while Aitken in his last edition gives a list of thirty-seven *Entozoa*, eight *Ectozoa*, a dozen *Epiphytes* and *Entophytes*, besides certain ill determined *Algæ*, *Fungi*, &c., and the cry is still they come.

Dr. Cobbold would have us believe that the poor boy, who died on the "Cornwall" training ship, was the proprietor of a brand new *Entozoon*, and if the latest researches of Pasteur are confirmed, it seems likely that it will be positively dangerous to kiss our own babies, and last of all Drs. Ballard and Klein have introduced to our notice another new pork disease. A few more years and we shall be filled with astonishment that we have not all shared the fate of King Herod of old.

It is to the labours of men for the most part still living, that we are indebted for all we know about the *Trichina Spiralis*, which has excited so much interest of late.

At the present time, we are able to view our subject from a commanding elevation, but the cutting of the path has been slow and difficult; there are many steps, and it has been the work of many hands. How the task has been accomplished I propose to relate to-night.

To commence, we must go back more than half-a-century to the year 1822. Before that time nothing whatever was known of the subject. In that year Tiedemann, while making a *post-mortem* examination of the body of a gouty old toper, observed what he describes as certain stony concretions, lying in the cellular tissue between the muscles; they were from two to four lines long and roundish. A chemical examination showed them to consist largely of Phosphate of Lime. The weight of opinion now is, that these were *Trichinæ Capsules* greatly altered by earthy deposit (they are much larger). Tiedemann had no idea of their parasitic nature; he doubtless thought that he had come upon a pathological curiosity, and there was the end of it. Six years after, in 1828, when this case had no doubt been forgotten, we find that Mr. Peacock observed similar small bodies in the muscles. He preserved a portion, but made out nothing fresh. This specimen, which is in Guy's Museum, is, according to Dr. Cobbold, the oldest piece of *Trichinous* flesh in existence.

Five years more elapse before we have anything fresh to record. During the year 1833, Mr. Hilton, then Demonstrator of Anatomy, at Guy's, came again upon these bodies and made some investigation into their nature, the results of which he embodied in a paper read before the Medico-Chirurgical Society, towards the close of the year. He relates that a man named Proctor, aged 70, suffering from Cancer, was admitted into Guy's, that he died in a short time, and five days after, his body was submitted to dissection. He says his attention was arrested by a mottled appearance of the muscles. They were pale, and not so distinctly fibrous as usual, and between the fibres there were situated oval bodies, transparent in the middle and opaque at either end. He examined them with the microscope without finding any organization, probably owing to their calcification. He placed some under the skin of a rabbit, but as the animal died 72 hours afterwards, the results were negative. He allowed other portions to decompose with the same result. Dr. Addison put some portions of the flesh into a glass vessel and covered it with paper perforated with pin-holes. Some flies subsequently appeared, but he refused to attach any importance to this circumstance. Hilton came to the conclusion that they were parasitic bodies, and probably of the nature of small *Cysticerci* (the larval condition of tapeworms).

In a letter to Thomas Bell, he relates that he saw three more cases of the same kind during the following year, at Guy's.

We must now turn our attention to St. Bartholomew's. It appears that an Italian named Paolo Bianchi, aged 50, was admitted into that hospital in December, 1834, under the care of Dr. Roupell. He died apparently of Phthisis, about six weeks after, and his body was brought to the dissecting room. Mr. Paget, who is described as then being "an intelligent student," observed that the muscles presented a peculiar appearance, being beset with minute whitish specks. The same thing seems to have been noticed before by Mr. Wormald, but the only thing he observed about them was, the very practical point that they blunted the scalpels. Within a fortnight, a second case of the same kind was observed. Specimens from both were carefully examined by Mr. Paget, Mr. Owen, and Dr. Arthur Farre.

Mr. Paget having obtained the assistance of Mr. Brown and Mr. John Bennett, of the British Museum, satisfactorily proved the existence of an *Entozoon*, and first published that fact to the world. Then in February, 1835, Professor Owen wrote an important paper on the subject, which was published in the first volume of the Zoological Society's Transactions.

As this is the first scientific paper on the subject, we must stop to consider it for a few moments. I think, perhaps, Professor Owen has received more than his due meed of praise for this paper as against Dr. Arthur Farre, who was working at the same time.

After giving a good description of the cyst, he deals with the *worm* itself. He describes one end as tapering, the other thicker, and in this he discovers an orifice, which he describes as the mouth and the corresponding end as the *head*. It turns out however, to be the anus and the *tail*, if you will.* He could not detect any orifice at the other extremity, nor could he discover any alimentary canal. He says moreover, that the natural transparency of the species is such as not to admit of a doubt as to its wanting the ovarian and seminal tubes and other characteristics of the *Nematode* worms generally. He of course

* It is interesting to notice here that the same mistake had been made about a century before in the case of the *Tricocephalus dispar*, a worm inhabiting the *Cæcum*.

was wrong, as has been shown by Dr. Farre and other observers since. He then proceeds to put it in its proper position in the animal kingdom. He says that the simple structure approximates it to the lower organised groups of *Parenchymatous* worms, and further that the organic form in the natural system to which the animal under consideration is most nearly allied, is that exhibited by the lower organised *Vibriones* of Müller. He then goes on to establish the genus *Trichina*, and calls this the *Trichina Spiralis*.

The name is scarcely a happy one. I imagine he wishes to describe a hair-like animal, coiled in a spiral form, Trichinus, from the Greek τρίχινος from θρὶξ a hair seems to signify made of hair rather than hair-like.*

Speaking of symptoms—He says "it may be questioned how far they can be considered as a primary cause of debility, since an enfeebled state of the vital powers is the probable condition under which they are developed." It is one of the triumphs of modern times to have upset this theory. Cobbold, speaking on this matter, says, "Most people, not excluding even votaries of the healing art following tradition, regard the internal parasites or Entozoa, as creatures either directly resulting from certain diseased conditions of the hosts, or as organisms which would not have existed if their bearers were healthy. Nothing can be more absurd. Such a conclusion is at variance with all the logical deductions of known facts, &c." Owen goes on to say, that it is not improbable that in all cases the patient himself will be unconscious of the presence of the microscopic parasites which are enjoying their vitality at his expense. At the end of 1835, Dr. Farre published a paper, in which he describes an alimentary canal running from one end of the animal to the other, with some reservation, an orifice at the small end and also an ovary, or at any rate a genital outlet. On this, Owen writes that if Dr. Farre's observations are confirmed, which he doubts, the *Trichina* would rank higher in the scale than he had placed it, and would form a genius of *Cœlelmintha*. These observations have been confirmed, and the position of the worm has never since been disturbed.———

It is now established that the muscles of man are liable to be

* The usual pronunciation is Trichína, and it is so given by Webster, but as the word is derived from τρίχινος or *Trichinus*, in both of which the second syllable is short, I think Tríchina is better.

infested with an encapsuled worm. It is supposed to belong to man exclusively, and not to give rise to any symptoms. It may be well to stop here for a moment and describe the appearances noticed. Cobbold says—As commonly observed in the human body, the Trichinæ appear as spirally coiled worms in the interior of globular, oval or lemon-shaped cysts, which latter appear as minute specks scarcely visible to the naked eye. These specks resemble little particles of lime, being more or less calcareous, according to the degeneration which the walls have undergone. They measure on an average 1-78th in. in length by 1-130th in. in breadth. It must be understood that the capsule belongs to the host rather than the guest, and is the result partially, at any rate of the irritation set up by the worm. Before the calcareous deposit takes place the cysts cannot be seen at all by the naked eye. The number of cysts found in any one indvidual, varies in each case, but it is very large. Dr. Coupland brought a case before the Pathological Society, in 1874, in which the number was estimated at 75 millions; this, I ought to say, is an unusually large number. The Capsuled Trichinæ measure about 1-25th in. in length by 1-630 in. in breadth, and those who are fond of figures will be interested to know that it has been computed that 35 millions of them are required to weigh a drachm.

Proceeding again with our history, we have little to record for several years, beyond the fact that every little while fresh cases were observed in which these cysts existed in the muscles. Mr. Curling reported two such in the year following Owen's paper. In the year 1847, however, Leidy stated at a meeting of the Academy of Sciences of Philadelphia, that he had lately detected the existence of an Entozoon in some of the muscles of a pig. The cysts he supposes to be the same as those of the *Trichina Spiralis*, hitherto considered peculiar to the human species. Another step gained. Six years after this, Herbst stated that in dissecting a *badger*, he had found its voluntary muscles full of Trichinæ. He fed three puppies on the flesh, and they all became Trichinised. He thus first established the fact that Trichinæ could be conveyed from one animal to another by food, but he did not attempt to decide how they got into the muscles. In the following year, Bristowe and Rainey unable to divest themselves of the theory of spontaneous generation, expressed the opinion that the Trichina was generated from a change in the fat cells between the muscular fibres.

In the year 1860, which, by the way, is the most important epoch in the history of this subject, the matter was taken up in good earnest by the Germans, principally Kuchenmeister, Virchow, Leuckart, and Zenker. I will not trouble you by stopping to relate separately their individual labours, but will give at once a brief summary of their united discoveries. They showed that the Muscle Trichina was an immature form of the worm. When swallowed, the cyst soon dissolves in the stomach and the worm is set free. It then gradually straightens itself out, rapidly grows, and by the second day is sexually mature. According to Althaus, the numbers of males and females are at first about equal; the males however, rapidly diminish, and after a period of from ten to sixteen days, females only are met with. The males are from 1 mm. to 1½ mm. in length, the females about double. The young soon appear as minute coiled up threads enclosed in the ova within the bodies of the females. They escape from the shells, and after the sixth day pass out alive at the genital aperture. On exit, they are small, transparent, and devoid of special organs, and of about 1-20th mm. in length. Each mother contains from 5,000 to 15,000 eggs. Very soon after birth the young ones commence their travels, and in about 10 days after their parents have been swallowed, will have arrived in the muscles. They infest all the striped muscles, especially those nearest to the abdomen and the laryngeal muscles; the heart very rarely indeed. After arriving in the muscle, they undergo further growth and development for 14 days, when they become coiled up and assume the size and form of the muscle Trichina. They now have an intestinal tube, which extends from end to end, and the males and females are distinguishable. From the third to the fifth week they become gradually enclosed in the cyst. According to Vogel, the deposit of chalk begins at the fifth month, commencing at the ends of the cysts. In this condition, Bristowe says, they remain alive for many years, even after the death and decomposition of their hosts. The parent worms have been found in the intestine as late as seven or eight weeks after being swallowed, but usually disappear earlier. As females have been found at this late period full of ova, it is probable that they bear several broods. The exact method by which they escape from the intestine is not altogether understood. It was at one time supposed that they worked their way into the blood-vessels and lymphatics, and so permeated the system. Virchow saw them in the mesenteric glands. It seems certain, however, that they pass straight through the bowel, as they have been found in the intestinal wall, in the abdominal cavity and in the connective tissue near. In the pig, death has occurred from perforation of the bowel and subsequent Peritonitis, when a large number of the worms have passed through at one spot. The mouth being unarmed, they do not appear to be possessed of any special apparatus for the purpose Bristowe speaks of—their eating their way through. Althaus thinks that as the head can be formed into a sharp point, they can, owing to their extreme minuteness, push their way between the fibres of the intestinal wall. After their escape from the intestine, they travel along in the course of the intermuscular connective tissue to their final destination.

It was in the year 1860, that the disease *Trichinosis* was first observed; up to that time the Trichina, as I have remarked before, were supposed to be quite harmless. The discovery was made in this wise. In January, 1860, a servant girl aged about 20, was admitted into the Dresden Hospital, under the care of Professor Zenker. Her illness dated from the previous Christmas. She was suffering from depression, loss of appetite and feverishness, and the case was set down as *Typhoid*. Considerable doubt soon arose, for after a short time, the whole of her muscles became the seat of excruciating pain, and the limbs were contracted and could not be extended. Œdema of the legs followed, and she died of Pneumonia, on the twenty-eighth day. Into the details of the *post-mortem* I need not enter, except to say that the muscles contained a large number of Trichinæ, which in this case also infested the heart, a very unusual circumstance. Professor Zenker then found out that the illness came on soon after the killing of some pigs at a farmhouse, where the patient resided. He went to the house, where he was able to obtain some ham and sausages made from these pigs. The specimens were found to be full of encysted Trichinæ. He further ascertained that the housekeeper and all the farm servants had been suffering in the same way. The butcher who killed the pigs was also suffering from what was set down as Rheumatism, the result of catching cold on the day the pig was killed. He had, however, tasted some of the raw meat.

The evidence derived from this series of cases was quite conclusive, and from this time forth *Trichiniasis*, or *Trichinosis*, has become a recognised disease. The eyes of the German Physicians were now opened, and it was very soon found that the disease prevailed very extensively in Germany. Cobbold, quoting Devaine, gives a list of 26 epidemics, which were noted in Germany during the following six years, in which over 1,500 people were involved. The histories of the epidemics are much the same as the one I have just related, the source being discovered in a particular meat or a particular butcher's shop.

Although probably, Germany has had more than her share, she has by no means enjoyed a monopoly of the article. M. Mouri found Trichinous pork coming from Barcelona into France, in 1876. An epidemic also occurred in Valencia, about this time. Twenty-eight persons having dined from the meat of a particular pig, were all affected and six died. In 1879, Trichinæ were found in Barcelona and other parts of Spain. In 1870, some cases of Trichinosis were landed in Hobart Town, but as the ship sailed from Hamburg, they would more properly belong to the German series.

Our own country has fortunately experienced little of this disease, in fact, as far as I have been able to ascertain, only one unquestioned epidemic has been recorded. This occurred at Workington, in Cumberland, in 1871. Dr. Dickinson, of that place, was called to see the widow of a farmer. She was suffering from acute pains in the limbs, with difficult breathing. Her face was swollen, and her arms, legs and hands, were œdematous with dropsical effusion. His first thought was, that the case was one of Scarlatinal Dropsy. Her daughter, and subsequently a man servant were attacked in the same way. Dr. Dickinson's suspicions were then aroused, and on investigation, he found that for two or three weeks previously they had been eating daily, sausages, and roast and boiled pork, obtained from an old sow, home fed. They subsequently recovered.

In June, 1876, a death occurred in the London Hospital, which was put down to *Trichinosis*, but little of the history of the case is known.

Then at the end of 1879, an epidemic broke out on board the Reformatory Ship, Cornwall, at Purfleet. Forty-three boys were attacked, of whom one died. The illness was for some time supposed to be Typhoid Fever. Mr. W. H. Power, sent by the Local Government Board, inquired into the matter, and discovered that the illness was closely related to the consumption of some American Pork. This circumstance, naturally suggested *Trichinosis* as a possible cause. The body of the boy was exhumed ; no traces of Typhoid were found, but the muscles were infested with what were considered to be Trichinæ. Dr. Cobbold has some doubt about it, and suggests that the illness may have been due to some as yet undescribed *Nematode* worm. Most people incline to the view, however, that it was really Trichinosis.

The mention of American Pork, naturally directs our attention to that country. When the ravages of Trichinosis were first detected in Germany, the people hailed with satisfaction the idea of obtaining their pork from a foreign and presumably uncontaminated source. Their hopes have been doomed I fear to disappointment. We find Trichinæ were discovered in American Pork, imported into Europe in 1874, and in 1878, Professor Heschel, of Vienna, stated that an examination of hams from America, disclosed the fact that a large number were Trichinised. In the following year, the Swiss Local Government Board, noted that at Thionville, large numbers of Trichinæ had been detected in pork from America. In the *Lancet* of February 5th, of this year, M. Leclerc states that he found Trichinæ in pork sent to Lyons, in sufficient quantity to poison the whole town. The Americans, at any rate at first, denied all this, stating that the flesh worm was unknown in their country. A short inquiry into the matter may be therefore not uninteresting. As far back as 1842, very soon after the discovery of Trichinæ, we find Bowditch reported cases (that is of discovery of the muscle worm) in the *Boston Medical and Surgical Journal*. Then, in the Spring of 1866, the Chicago Academy of Sciences appointed a committee to examine into the facts. The result was, that out of 1,394 hogs from the various packing houses and stalls of Chicago, 28 were found to be infected, *i.e.*, 1 in 50, which they say would indicate that Trichinosis is even more common in America then in Germany. In 1878, Drs. Attwood and Belfield made a further inquiry at Chicago, with the result, that on an average 8 out of 100 were infected, a much larger percentage than on the former occasion. During 1866-67, Dr. Ude inspected 75,911 slaughtered pigs, in the Duchy of Brunswick. Eleven only were found to contain Trichinæ, a result not favourable for the Americans. The State board of health of Massachusetts, reported two outbreaks of Trichinosis, in 1870; one at Saxonville. Six persons partook of the infected meat; three were attacked, and one died. Soon after, another at Lowell, in the same State, but there was no fatality. Again, Dr. Sutton of Amora, Indiana, reports an outbreak there in 1874. Nine persons were attacked, of whom three died. He states, that a considerable portion of the pigs killed in the Western States are so affected. In several thousand examinations made in South Indiana, 3 per cent. to 16 per cent. of the pigs contained Trichinæ. The Western States, he says, send away 5,000,000 pigs each winter, and if only 4 per cent. are infected, the number would amount to 200,000. According to a recent report of the Sanitary Committee of Massachusetts, it appears that of 2,701 pigs examined, 154, or nearly 6 per cent. contained Trichinæ. Several cases of lard, imported into France from America, have been found infected.

In the *Lancet* of March 19th, of the present year, will be found a full account of one of the largest epidemics known. It occurred at Kiam, near the sources of the Jordan, and arose from eating the flesh of a Wild Boar; the writer found no less than 257 persons affected.

The symptoms in man usually appear after a few days, and may continue for a month or six weeks, and even longer in severe cases. When the worms have once become encapsuled, all further trouble ceases, and for ever. They divide themselves into classes. (1) *Fever*, which persists more or less throughout, and is not characteristic; (2) *Gastro-Intestinal irritation*, especially during the first week; (3) *Excruciating pains* in the muscles, especially on movement, due to the irritation set up by the presence and migration of the worms, and (4) *Dropsical swelling* of the face and limbs. Sometimes one set of symptoms, sometimes another has prevailed. The illness has consequently been ascribed to various causes. Sometimes diarrhœa and vomiting have predominated and even caused death. The disease has then been taken for Cholera, as was the case in one of the German epidemics, at Hedersleben. If these symptoms are less acute, the case has been put down as Typhoid Fever, as in the instance of the epidemic on board the Cornwall, and for a time in Zenker's first case. When the muscular pains have prevailed, it has been called

Rheumatic Fever, as in one of Zenker's first series, and in Wood's case, which I shall speak of in a moment. Where the Dropsy has been the predominant symptom, the illness has been reckoned as Dropsy after Scarlet Fever, as it was by Dr. Dickinson in the English Epidemic.

Is it a new disease, you will ask? I answer, no. As to whether Trichinæ accompanied Noah into the ark, I cannot form an opinion. At any rate, two cases have been traced back to a period anterior to the discovery of the disease. In 1863, Langenbeck, in operating on a man, noticed Trichinous cysts in his muscles, and a careful inquiry brought out clearly the history of an epidemic which had occurred in 1845. And in 1835, Wood, of Bristol, must have come very near to the discovery of the disease, for a case was under his care in the infirmary, which was supposed at the time to be acute Rheumatism, in which, after death, Trichinæ were discovered. This, you will observe, was at a period when the first investigations were being made.

At first, it was supposed, that the disease was necessarily fatal. This, as you may anticipate, was altogether an error, for obviously it would be bad policy on the part of the worm, when it had obtained free quarters, to destroy its host. In fact, the death rate varies very much, sometimes very high, as in the Hedersleben epidemic; 350 cases, with 100 deaths; sometimes very low, as in Magdebourg (1858-62); 300 cases, with only two deaths. This difference seems to depend almost entirely on the number of live Trichinæ swallowed. Dr. Belfield thinks that a few may be eaten with impunity, and to back his opinion he deliberately swallowed a dozen. No evil results ensued. This does not seem however, to be altogether a safe proceeding, for at a meeting in Berlin, Professor Virchow brought some specimens of Trichinous sausages. A Veterinarian made some insulting remarks to the Professor, and there were loud cries from the meeting for him to "eat, eat." After some prevarication, he bit a portion from one of the sausages and ran out of the room. A few days afterwards, he was suffering from characteristic symptoms.

It is of practical importance to consider what animals are likely to be infected.

As it is entirely a flesh worm, it is beyond all calculation most liable to be found in flesh eating animals, but not quite exclusively so. It has been pointed out by Devaine, that the debris of an animal eaten by carnivora, may become fatal to rodents, and a carcass infested with Trichinæ, decomposing near a river or marsh, may communicate the parasite to man or animals drinking the water. This would explain its occasional presence in the horse, ox and sheep, where according to his authority it is occasionally found. Birds seem almost impervious to its attacks. A Hippopotamus was found infected in France. The Pig is, however, the only animal which really concerns us. It is obvious that it must get its supply from without. Hence pigs carefully fed in styes are scarcely ever affected; but it is different when they are allowed to roam about, picking up all kinds of offal, as is frequently the case in Ireland and other places.

Pigs, like men, seem to suffer according to the number of Trichinæ present. Fleming describes symptoms very similar to those mentioned before, as belonging to the human species. On the other hand, Kuhne of Halle, in 1875, made special investigation into this point. Pigs were fed with Trichinous flesh, and daily watched by Veterinary surgeons, and their health was scarcely disturbed at all, although *post-mortem*, they were found to contain a large number of Trichinæ. Pigs are supposed to be for the most part infected by eating rats. These animals seem to acquire and tolerate the worms with remarkable facility. Belfield fed a white rat, three weeks' old, on Trichinous flesh; he grew rapidly and enjoyed the best of health, yet when killed, his muscles from the tip of his nose to the end of his tail, were literally alive with Trichinæ. Rats living near knackeries seem specially liable to be infected; thus in Boston, of 51 rats caught in a slaughter-house, 30 contained Trichinæ. In another case, 40 rats caught were all found Trichinised, whereas, 28 fowls in the same establishment were all free. Similar facts have been noticed in Saxony. As to their origin in this part of the world, Professor Gerlach thinks they have been imported from China, in the Chinese race of pigs, but upon what grounds I cannot say.

What is the remedy? Well of course, the avoidance of pork; but if we must eat pork, it should be thoroughly cooked. The most dangerous article of food seems to be sausages, especially smoked sausages, as they are liable to be eaten without ever having been exposed to a high temperature. After these, thick joints of meat. Putting science on one side, ordinary cooking seems practically a very effectual preventive, as the disease is extremely rare in countries where raw, or nearly raw food is not eaten. This is seen to be the case in our own country, and in Southern Germany, according to Niemeyer, where the people dislike raw flesh, and even pickled and smoked ham, and sausages, not a single case of acute Trichina poisoning has been reported. In the great epidemic at Kiam, the persons who partook of portions of the *body* of the Boar were largely affected, while those who ate of the *head*, which was better cooked, entirely escaped.

With regard to salting, various observations have been made and various opinions expressed. Professor Gerlach pointed out, that only the direct action of salt on the raw pork kills the worms, and that at a depth of one or two inches in pickled meat, they do not die for several weeks. Dr. Belfield says, that the addition of a little sulphurous acid to the brine, kills all the Trichinæ without damaging the pork.

M. Colin thinks, that salting always finally destroys the Trichinæ, but it is impossible to determine the lapse of time necessary. M. Chatin, on the other hand, maintains that salting does not necessarily kill the worm. Infected meat was preserved in salt and given to guinea pigs, and in several of the animals Trichinæ were found. Colin would doubtless answer that it had not been salted long enough.

As to the effect of heat, it seems quite certain that a temperature of 136° to 140° F. (the coagulating point of albumen) is fatal to them. M. Vacher recently made some experiments, to ascertain how far this temperature was attained in ordinary cooking. He took a leg of pork of moderate size and boiled it thoroughly. A Thermometer placed within it, at a depth of 2½ inches, registered after half-an-hours' boiling, 86° F.; after an hour, 118°; after one and-a-half-hours, 149°, and after two and-a-half-hours, 165°. He does not, however, tell us anything of the temperature of the more central parts of the joint. It is tolerably certain that portions of the joint which still remain red, cannot be eaten without risk.

With these facts before him, Mr. Mundella has, I think, wisely refused to interfere with the importation of pork, until it can be shown that evil consequences have actually resulted.

For examining the flesh, Dr. Parkes gives the following directions ; a power of 50 to 100 diameters is sufficient. The best plan is to take a thin slice of flesh, put it into Liquor Potassæ (one part to eight of water), and let it stand for a few minutes till the muscle becomes clear. It must not be left too long, otherwise the Trichinæ will be destroyed. The white specks come out clearly, and the worm will be seen coiled up. If the capsule is too dense to allow the worm to be seen, a drop or two of weak hydrochloric acid should be added. If the meat is very fat, a little ether or benzine may be put to it in the first place. The parts most likely to be infected, are said to be the muscular part of the diaphragm and the intercostal muscles, and the muscles of the eye and jaw. In diagnosing Trichinæ, the coiled worm should be distinctly seen.

ABSTRACT OF A PAPER

READ BY

W. GROVES, Esq.,

ON

THE PREPARATION OF SPECIMENS FOR THE MICROSCOPE,

23rd NOVEMBER, 1881.

Mr. Groves exhibited a variety of instruments, which he had found useful in the work, and recommended the ordinary turn-table to be fitted with stops, so as to facilitate the operation of laying correctly successive coats of varnish rings on the slides; and advised the use of caustic potash in cleaning Polycystina, as he had never found any injurious effects result from boiling them in a strong solution of potash.

A caution was given against putting chlorate of potash into sulphuric acid, and then applying heat to the mixture when cleaning Diatomaceæ, &c., as an explosion was in that case inevitable, but he stated that he had never found any danger arise from dropping small quantities of that salt into boiling acid. He also pointed out the danger of diluting the acid while hot.

He cautioned Microscopists against explosions caused by retarded ebullition ; this occurred under certain conditions, when boiling (in a glass tube for instance) was stopped and heat again applied to the vessel containing the liquid ; the heat often accumulated in such cases without ebullition re-commencing for some time, the accumulated heat causing the explosions.

He described the process of getting rid of air bubbles in objects mounted in Canada Balsam, the method adopted being to mount in rather fluid Balsam, and to allow the slides to remain covered, so as to exclude dust until the bubbles disappeared, which usually took place in a few days.

Many other items of information were given of importance to those desirous of preparing specimens for the Microscope.

ON CADDIS-WORMS AND CADDIS-FLIES,

BY

R. McLACHLAN, Esq., F.R.S., F.L.S. (Vice-President.)

21st December, 1881.

Up to somewhat more than 20 years ago, my entomological pursuits were mainly (as is often the case with beginners) devoted to *Lepidoptera* ; but when in pursuit of moths, other insects of a different order, though much like them, were often captured ; these were Caddis-flies (or *Trichoptera*). About that time there appeared in my friend and colleague Mr. Stainton's Entomologists' Annual, a series of articles by Dr. H. A. Hagen, then of Königsberg, East Prussia (now of Cambridge, Mass., U.S.A.), on the British species of these insects. Feeling probably that the *Lepidoptera* had a full share of devotees, and scarcely offered sufficient scope for (let me confess it) an ambitious young man, I resolved to devote myself especially to *Trichoptera*, and entered into correspondence with Dr. Hagen, my friendship with whom continues to the present day. By degrees, the whole Linnæan order *Neuroptera* (of which the *Trichoptera* form a portion, according to some) attracted my attention ; but even now the Caddis-flies probably receive most favour in my eyes.

Most of us are acquainted with Caddis-worms as tempting baits for fishes, and of the curious habitations constructed by them, but probably only few of my audience have more than a faint idea of the insects produced from these Caddis-worms. The five drawers before you, represent a tolerably complete collection of the British species (which now number about 150). I propose to briefly call your attention to some of these, with passing remarks on some curious forms that do not occur in this country.

The eggs of Caddis-flies are excluded by the female in a mass enveloped in a gelatinous secretion, and are usually deposited on water-plants, or dropped into the water to take their chance. So soon as the larvæ are hatched, they commence to make houses for themselves, in which they pass the rest of their aquatic existence. These houses may be mainly divided into two classes. Firstly, those which are portable, and only become fixed when the larva is about to assume the pupal condition. Secondly, those which are constantly fixed to stones or other substances.

In the first class, the forms and conditions are very varied. Speaking generally, these houses (or cases) consist of an inner silken tube, to the exterior of which various extraneous substances are attached. Some species (*Phryganea*, *Neuronia*, *&c.*) form perfectly cylindrical straight tubes of morsels of leaves and other vegetable substances, beautifully arranged in a spiral manner (these are not uncommon in the ponds of our district), and of nearly equal diameter throughout; and the inmate is able to present its head at either end indiscriminately by turning itself in its case. Of course, it is apparent that the case of a young larva must be much smaller and narrower than that of a full-grown one. Now, with us, when we outgrow our clothes, the tailor is usually applied to for a fresh suit, and the old ones are discarded: but with Caddis-worms it is ordinarily different; the creature does not come out of its case and thus expose itself to danger while manufacturing a new house, but it ingeniously cuts off from time to time the end portion that has become too small, and goes on adding simultaneously to the other end. This will apply to all the tubular cases. A very common form (*Anabolia*) still occurring abundantly in our little river Ravensbourne, is a tube of fragments of gravel and sand, and as the larva lives in running water, and might be in danger of being swept away by the current, there are attached to this tube long fragments of small twigs which serve probably as balancers. Some of the most interesting forms are those in which the exterior of the case is ornamented with shells (often containing their living inmates), seeds of water-plants, fragments of water-beetles, and even the cases of the smaller species of the same group. These are mostly constructed by species of *Limnophilus*, and the same species will often use a variety of materials according to the conditions in which the larvæ are placed. Sometimes comparatively large shells are used, sometimes myriads of minute shells to the number of several hundreds, beautifully arranged in mosaic, are wholly employed, sometimes wholly the seeds of some particular water plant, sometimes portions of the case wholly of one material and the other portion of another, and finally, all these substances, combined with sand, gravel, and vegetable matters, are sometimes arranged indiscriminately on one and the same case. These shell cases are especially interesting to the Conchologist, because by collecting such cases he may occasionally procure species of fresh-water shells that he has searched for in vain; the Caddis-worm is a better collector than he! It has occurred to me that the cases formed of *seeds* may play a part in the distribution of water plants hitherto unsuspected. Caddis-worms no doubt form part of the food of many aquatic birds, as also of those of the snipe family, &c.; it would be impossible for these to pick the larvæ out of their cases, and these latter are commonly swallowed with the inmates; the hard seeds and other substances would probably be passed in an undigested condition by the birds, when perhaps many miles from the locality where they were swallowed; hence plants may be thus distributed. This suggestion requires working up from actual observation, but at present I think there is some force in it. A very common form of these tubular cases is that in which stoney fragments or sand is exclusively used; these are usually curved, and taper a good deal to the tail-end, resembling shells of the genus *Dentalium* in form. Such cases differing only in size, amount of curvature, coarseness or fineness of materials, &c., are constructed by a vast number of different species and even of genera. Very rarely (*Setodes, &c.*) the case is formed wholly of hardened silky secretion, with no covering of extraneous matters. One of the most wonderful of British forms of case is that constructed by the genus *Molanna*. It may be found in parts of the Ravensbourne, where the bottom is sandy, and in ponds on Hayes Common, &c. These cases are wholly made of fine sand; internally there is the usual tube, but the sides are broadly expanded, so that the form is long-oval, the upper side slightly convex, the lower slightly concave; the larva lives on the sandy bottom, from which the case is scarcely distinguishable unless the inmate move, and an additional peculiarity is that the upper or convex side is produced at the mouth-end far beyond the lower side, so as to form a covering for the larva when feeding at the sandy bottom. A still more remarkable instance occurs in a small case from Ceylon, in which the actual case is merely an ordinary straight tube, but to the mouth-end is affixed a circular shield, concave beneath, and equally protecting the inmate when its anterior segments are extended in search of food. Some cases (*Goëra, &c.*) are nearly oblong in shape, consisting of a tube formed of fine gravel, to the sides of which are fixed, much larger, stoney fragments; such are common in the Ravensbourne. Very extraordinary cases are those of *Helicopsyche*, spread over nearly the whole world, but not occurring in Britain. These are for all the world like small spiral shells formed of sand or gravel, and such is their deceptive resemblance to shells that they were originally described as such, and even a new genus (*Thelidomus*) was formed for their reception by Conchologists. Their true nature has long been known, but it is only recently that the perfect insects of the species that construct them have been satisfactorily determined.

Were I to only briefly allude to the many marvellous forms that exist, I should have to occupy your attention for several evenings. Hitherto I have alluded to Caddis-worms as peculiarly aquatic. But there is no rule without an exception, and there exists at least one instance of a species that lives out of the water amongst moss, at the roots of trees (*Enoicyla*); it constructs an ordinary slightly curved tube of sand, and has occurred in one or two localities in this country; an additional peculiarity in this species, is that the female of the perfect insect has only the slightest rudiments of wings. Mention should also be made of the cases formed by minute insects of the family (*Hydroptilidæ*); these are usually like flattened or kidney-shaped seeds, often without any extraneous materials, or with only a coating of very fine sand, opening by a slit at either end; recent researches have discovered some extraordinary forms, which time will not permit me to allude to here.

The constantly fixed cases need little more than passing allusion. They are formed by the families *Hydropsychidæ* and *Rhyacophilidæ*.

If we take up a large stone from the bottom of a clear stream, and examine its surfaces, we are pretty certain to find what appear to be little oval masses of agglutinated gravelly fragments, and upon opening them we find Caddis-worms. But many of the larvæ of this class live almost free beneath stones, or with the lightest possible covering, and the firm cases are only constructed when the inmates are about to assume the pupal condition. Some of them construct long serpentine mud galleries on stones, &c., in which they live, but a more solid case is formed before metamorphosis. Some insects of this class are extremely abundant, and it has even been suspected that certain curious sculpturings seen on limestone pebbles, on the shores of Swiss lakes, may in part owe their production to the action of these larvæ. The *Rhyacophilidæ* are so far exceptional, that in them the pupa is enclosed in a special cocoon lying free inside the case, whereas in all others there is no such cocoon.

A few words as to the form and structure of Caddis-worms. You will observe from the examples I exhibit, preserved in alcohol, that there is a certain vague resemblance to the caterpillar of a moth. But all Lepidopterous larvæ possess in addition to the six true thoracic legs (which are very strongly developed in Caddis-worms), a varying number of prominences along either side of the ventral surface, termed pro-legs; these are never present in Caddis-worms. But the latter have two strong hooks at the tail-end, by means of which they resist attempts to drag them from their case, certain humps at the base of the abdomen also assisting in this; the consistence of the body is soft, excepting the head and thoracic segments, which are horny in texture, and which alone are extended from the case when the larvæ are travelling or feeding. Respiration is mostly effected by means of variously arranged filaments on either side of the body, forming a kind of external gills or branchiæ, which absorb air from the water and convey it to the internal tracheal tubes.

Those Caddis-worms that live in standing waters are not difficult to rear in an ordinary aquarium, and they may be forced to form cases of all kinds of odd materials by depriving them of their original dwellings; but to my mind, this result is not equivalent to the trouble it occasions. Those that live only in swiftly-running, strongly-aërated waters, are far more difficult to rear in confinement, unless a special apparatus be provided for the purpose.

The greater part of this paper has been devoted to consideration of "Caddis-worms," or of the cases formed by them. Now, as to "Caddis-flies," or the insects produced from these "worms." To many of you these are far less familiar. If you examine the contents of the drawers before you, it will be seen that although not possessing any great amount of striking colours, the forms are very varied. You will also, I think, notice a vague resemblance to moths pervading the whole, but I would remark that true "scales," the colours and arrangement of which produce those beautiful designs on the wings of moths, are not present in Caddis-flies; the normal clothing is composed of hairs only, and from this they acquired the scientific name *Trichoptera*. Were I to attempt a disquisition here on the actual position in Nature of these *Trichoptera*, I should not only require an entire evening, but tire you by the necessary use of technical terms. Whether they should form an order apart, or be considered only a section of that ill-assorted order *Neuroptera*, is a matter on which much difference of opinion exists. I rather incline to the former idea; as I do also to a conviction that their relationship to *Lepidoptera* is close, but not sufficiently so to warrant their absorption into that order.

It remains for me to thank you for the attention with which you have listened to the few remarks I have had occasion to make this evening. When I consented to "read a paper" at this meeting, I had no idea on what subject that paper was likely to be; other occupations caused me to put off this consideration until the last moment, and in that case I naturally chose the subject most familiar to me. I can only hope that, under the circumstances, some of my remarks may have proved not altogether uninteresting.*

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* The author would remark that the "paper" was "spoken," not "read;" and that which appears above has been written from memory only.

RULES.

(As amended at the Annual Meeting, 22nd February, 1882.)

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1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s. in one sum. All subscriptions shall be due on 1st January in each year.

3.—The affairs of the Society shall be managed by a Council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February, for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secs., Post Office, Lee Bridge, Lewisham, S.E.*

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Eastbourne Natural History Society. 1870-81.
East Kent Natural History Society. 1876-80.
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Lambeth Field Club and Scientific Society. 1881-82.
Lewisham and Blackheath Scientific Association. 1879-80.
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The following have been received during the session 1881-82:—

REPORTS, &c.

Croydon Microscopical and Natural History Club. 1878-81.
Dulwich College Science Society. 1880-81.
Eastbourne Natural History Society. 1881.
East Kent Natural History Society. 1880.
Epping Forest and County of Essex Naturalists' Field Club. Parts I.—V.
Erith and Belvedere Natural History and Scientific Society. 1881.
Lambeth Field Club and Scientific Society. 1881-82.
Lewisham and Blackheath Scientific Association. Exploration of the Subsidences on Blackheath. 1881.
Manchester Literary and Philosophical Society. Memoirs. Vol. VI.
Postal Microscopical Society. 1881.
The Scientific Roll. Parts I.—VI.

N.B.—The Library is now in the Hall of the Mission School, Blackheath. Members can obtain or return Books by personal or written application to the Rev. E. Waite, the Head Master; or on the evenings of the ordinary Meetings.

Note.—All communications should be addressed to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.

HENRY HAINWORTH, }
HUGH WILSON, } *Hon. Secs.*

Crockford, Steam Printing Works, Greenwich, Lewisham, and Blackheath.

MEETINGS OF THE SOCIETY

FOR THE SESSION 1882-83.

Wednesday,	March	22
,,	April	26
,,	May	24
,,	October	25
,,	November	22
,,	December	20
,,	January (1883)	24
,,	February ,, Annual	28

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THE CHAIR IS TAKEN AT 8 O'CLOCK.

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THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

W. H. CROCKFORD, GREENWICH, LEWISHAM, AND BLACKHEATH.

WEST KENT

Natural History, Microscopical, and Photographic Society.

THE

PRESIDENT'S ADDRESS, PAPERS,

AND

Reports of the Council and Auditors,

FOR 1882-83,

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

PRINTED BY
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1883.

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1883.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 22nd, 1882,

FOR THE SESSION 1882-83.

President.

F. T. TAYLER, M.B., B.A.

Vice Presidents.

T. O. DONALDSON, M.Inst. C.E.
W. GROVES (Lee).
W. G. LEMON, B.A., LL.B., F.G.S.
J. JENNER WEIR, F.L.S., F.Z.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

E. BELLEROCHE.
H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
G. H. FREAN.
B. GUEST.
STUART KNILL.
R. McLACHLAN, F.R.S., F.L.S.
E. R. PEARCE.
FLAXMAN SPURRELL, F.R.C.S.
H. T. STAINTON, F.R.S., F.L.S.
J. STANDRING.
C. G. WOOD.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 28th, 1883,

FOR THE SESSION 1883-84.

President.

F. T. TAYLER, M.B., B.A.

Vice-Presidents.

T. O. DONALDSON, M.Inst. C.E.
W. GROVES (Lee).
W. G. LEMON, B.A., LL.B., F.G.S.
J. JENNER WEIR, F.L.S., F.Z.S.

Hon. Treasurer.

MAJOR TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

E. BELLEROCHE.
H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
G. H. FREAN.
B. GUEST.
THOS. HAZARD.
STUART KNILL.
R. McLACHLAN, F.R.S., F.L.S.
E. R. PEARCE.
H. T. STAINTON, F.R.S., F.L.S.,
J. MORRIS STONE, B.A.
J. JENNER WEIR, F.L.S., F.Z.S.

REPORT OF THE COUNCIL

For the Session, 1882-83.

The Council report with much gratification that the Society still continues in a prosperous state. The number of Members at present on the list is 104, viz.—7 Honorary, 5 Life, and 92, Ordinary Members.

During the past Session James Glaisher, Esq., F.R.S., F.R.A.S., &c., who has been connected with the Society since its commencement, has been elected an Honorary Member.

The accounts of the Honorary Treasurer have been duly audited, and shew a balance in hand on the 31st December, 1882, of £27 7s. 11d. This balance includes £21 for Life Subscriptions; but the sum of £22 11s. 6d. is still due on account of subscriptions outstanding at that date.

Papers have been read or objects of interest exhibited at all the ordinary Meetings during the past Session; the Papers or Abstracts thereof will be published with this Report. At many of the Meetings interesting and valuable observations are made by the Members, an epitome of which the Council hope in future to be able to print with the Report.

The Annual Field Meeting was held at Sevenoaks, on the 14th June, 1882, and was well attended by the Members and their friends. The Council note with pleasure the presence of so many ladies on such occasions.

Twenty-three Members and their friends attended the annual Dinner at the "New Falcon" Hotel, Gravesend, on the 8th July. The subject for discussion was "Vegetarianism," introduced by the President.

At the annual Cryptogamic Field Meeting on the 7th October, which was well attended, Dr. Spurrell kindly met the Members and their friends at Abbey Wood Station, and conducted them through the grounds of Messrs. Chillingworth and Mitchell, and thence through Belvedere Park to Erith.

The Library has been examined, and various additions have been made. The Council are pleased to notice the increasing use of the Books by the Members.

In concluding this Report the Council desire to impress upon the Members that the vigour and usefulness of the Society must greatly depend upon their individual exertions ; and trust that in the ensuing Session they will bring forward, and make reports upon, any objects of interest which may come before their notice.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

For the Year ending 31st December, 1882.

RECEIPTS.		£ s. d.
Balance in hand on 1st January, 1882		1 18 5
Life Subscriptions		21 0 0
ANNUAL SUBSCRIPTIONS.		
For the year 1879	£0 10 6	
,, 1880	1 11 6	
,, 1881	5 5 0	
,, 1882	35 14 0	
,, 1883 (in advance)	3 3 0	
		46 4 0
		£69 2 5

PAYMENTS.	£ s. d.
Expenses of Meetings and Refreshments	4 1 7
Donation for use of Room, &c.	6 6 0
Fee to Assistant	5 5 0
Subscription to Ray Society	1 1 0
Insurance of Books, &c.	5 0
Cost of Journals, &c.	1 1 1
Stationery, Postage, &c.	3 3 10
Printer's Bill	18 10 6
Miscellaneous	2 0 6
Balance in hand on 31st December, 1882	27 7 11
	£69 2 5

Audited and certified to be correct,

J. JENNER WEIR,
J. H. RITCHIE, } *Auditors.*

February, 1883.

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

BY

The President, F. T. TAYLER, M.B., B.A.,

ON THE 28TH FEBRUARY, 1883.

GENTLEMEN,

To night our Society arrives at the commencement of another term in its existence, and so it becomes my privilege to address to you some words from the Chair.

It has been well remarked that in youth we are accustomed to direct our thoughts principally to the future, and in old age we are occupied largely in reviewing the past. Our Society has now arrived at a period of vigorous manhood, when I think we may do both with equal satisfaction.

To the report of your Council I have little to add. During the past season we have had presented to us papers of great value and interest, which, on many occasions, have given rise to observations of scarcely less importance. In reference to this matter, acting upon a suggestion thrown out by our late President, I think we have contrived a net of such a mesh that, while it will allow the smaller specimens to escape, possibly to undergo further development, it will yet enable us to retain some of the more choice examples, to be afterwards submitted to the compressorium of the printer, and so be preserved for future examination.

Instead of occupying the time remaining at my disposal with a general account of the various advances made in science during the past year, a subject which would doubtless afford topics of the greatest interest, I have chosen, on this occasion, to ask your attention to a single line of investigation. I have selected it, first, because it is intimately connected with one of our special subjects—the microscope; and secondly, because we are coming to see more and more every day that it is concerned with matters not only of the greatest importance to us, but which involve our very existence. The subject to which I refer is the part played by certain micro-organisms in the economy of nature.

The question covers such an extent of ground that I should have preferred to have plunged at once *in medias res*, but I must ask the forgiveness of the more learned among my audience if I begin at the beginning, for otherwise I fear that I should be unable to make myself intelligible to those who have not paid any special attention to the subject.

An animal stricken, say with splenic fever, falls dead upon the plain. In a short time certain alterations will be observed in its condition. The tissues will soften, and give off offensive odours; in other words, will rot. At the same time the carcass will be attacked by nature's scavengers in various forms—mammalia, birds, insects, &c., and ultimately nothing but its bleaching bones will be left to tell the tale. Now these changes have been brought about by a series of causes which graduate from the most obvious to the most obscure. The coarser and more evident phenomena have been known to men without doubt from time immemorial. When Hamlet is asked as to the whereabouts of Polonius he replies "at supper. Not where he eats, but where he is eaten—a certain convocation of politic worms are e'en at him . . . If you find him not out within the month you shall nose him as you go up stairs into the lobby." But they knew more than this. They knew that these changes were influenced by conditions of heat, cold, moisture, and dryness, Savage tribes have long used the heat of the sun for drying and preserving flesh. They knew also that the contact of a substance in a state of decomposition greatly accelerates a similar change in another previously unaltered. The use of leaven in bread making is an instance of this. Whether they troubled themselves to think about, or inquire into, the causes of these phenomena, is quite another matter. If they did they were, no doubt, content to adopt the views of Dr. Watts with regard to the combative propensities of the genus Canis that "'tis their nature to."

With the advance of Science naturally came an increased desire for more knowledge of these and similar matters. The chemists came first on the scene. They explained that the vital force having been removed, the animal tissues were left a prey to the ordinary physical forces, and that the complex organic compounds were broken up by the oxygen of the atmosphere into others of a simpler constitution. The late Professor Miller speaks of "the readiness with which the albuminoid bodies putrefy and undergo *spontaneous* chemical changes, when moist," as being "one of their most striking characters." I hope to be able to show you presently that not only albuminoid principles, but all other organic substances, have no such spontaneous tendency at all.

The Microscopists then took up the question. The discovery in 1835 of the Yeast plant gave a great impetus to this inquiry. It was readily demonstrated that if two portions of wort or other saccharine liquid are separated by some porous material, such as filtering paper, and yeast is added to one, fermentation occurs only in that portion which actually comes in contact with the Yeast plant, and not at all in the other; thus showing, at any rate, that the presence of the Yeast plant is something more than an accidental circumstance, as of course all the liquid portions of the wort can readily pass from one side of the paper to the other.

With the increased perfection of our microscopes came the discovery that the presence of the Yeast plant in fermenting beer is only a small part of a greater and more general truth, for it was soon ascertained that decomposing organic matter, under all ordinary circumstances, contains large numbers of minute living organisms.

For the sake of convenience these investigations were conducted for the most part by studying the changes manifested in the filtered infusions of various animal and vegetable substances. Turnip, for instance, has been much used, as it yields an infusion nearly as bright and clear as water. Broths made from pork, fowl, and Liebig's extract of beef, have also furnished suitable animal fluids.

If such an infusion is exposed to ordinary conditions it soon becomes cloudy, and teems with minute organisms, the number of which increases *pari passu* with the decomposition. The first question which excited the curiosity of scientific men was, from whence come these organisms? Do they arise *de novo* from the contents of the infusion, or are they derived from germs introduced from without? In other words, does their presence support or not the theory of spontaneous generation? Many years ago Spallanzani, and after him Pasteur, conducted experiments to determine this point, but the matter was then allowed to rest in abeyance until about ten years ago, when Dr. Charlton Bastian recommenced hostilities, declaring for their spontaneous origin. The opposing forces were led on the one side by Bastian, and on the other principally by Pasteur, Burdon Sanderson, and Tyndall. I need not enter into the details of the campaign; but a description of some of their experiments is necessary for my purpose.

First, it was shown that a temperature below that of boiling water is sufficient to destroy all the visible living organisms. Unfortunately a fallacy occurred at this point which was the cause of much contention, and some loss of time, before it was discovered. Bastian performed the following experiment:—He partly filled a number of small long-necked flasks with an organic infusion. He then heated the necks and drew them out into capillary tubes. This being done he boiled the contents, and during the ebullition he closed the flasks by melting the minute necks in a blow-pipe flame. Notwithstanding these precautions, in many instances, after a short time, organisms appeared in the infusions. Bastian then came forward with his flasks and said if spontaneous generation is not true, how is this to be explained? He even went so far as to throw down the gauntlet to Pasteur, and offered to go to Paris and perform these experiments there in Pasteur's own laboratory.

Dallinger, of Liverpool, after this pushed the inquiry further. He said, although you kill all the living organisms which are visible, yet the germs, which are invisible, may still remain, and these are probably more resistant to high temperatures. He showed that brisk ebullition for fifteen minutes was required to completely destroy these germs, and that the temperature necessary to kill varies with the nature of the medium to which the heat is applied. Klein has shown that even these precautions will occasionally fail, and that absolute certainty of success can only be ensured by at least a second boiling after about 24 hours.

If the development of organisms is to be prevented, it is not only necessary that the germs in the liquid itself be destroyed but the vessels, with their stoppers, &c., must also be purified. This is best done by exposing them for some time to a high temperature. Such prepared infusions are usually spoken of as being sterilized. As I shall have to use this word frequently, I will express the meaning at once. When I speak of a sterilized infusion, I mean one which has been thoroughly boiled, and is enclosed in a vessel which has been perfectly purified in all its parts. If all these precautions are properly observed, an organic infusion may be certainly kept free from the presence of organisms or of decomposition for an indefinite period. At present we are of course supposing that the air is absolutely excluded.

I shall ask you now to leave the infusions for a time while we deal with the other half of the question, viz., the part played by the atmosphere. For our knowedge of this portion of the subject we are largely indebted to the researches of Professor Tyndall. His first question was, is decomposition caused by the mere contact of air, from whatever locality it may be obtained? To determine this point he prepared fifty flasks of sterilized infusions. Twenty-five of these he opened in a hay loft, and the remaining twenty-five on the edge of an Alpine cliff, afterwards closing them and placing the whole in a warm chamber. After a few days he found the whole of the hay-loft series in a state of decomposition, and full of organisms, while the whole of the Alpine series remained pure as before. Now we know that the chemical composition of the atmosphere is remarkably constant, therefore, to what is this strange variation due? Tyndall's experiments with the electric ray, by which he showed that the air, in most situations, is full of solid particles, are, no doubt, familiar to you all. He also demonstrated that the same method is applicable to liquids, and so delicate is the test that he was able to show the presence in water of minute portions of mastic, which eluded a magnifying power of 1200 diameters, and also by a comparative experiment that the particles contained in a highly infecting liquid were even smaller still. By means of the electric ray, you will also recollect, that he showed that cotton wool had the property of filtering out all these minute particles from air drawn through it. He next proceeded to apply these results to the investigation of the question before us. He constructed an air-tight box, with glass sides and ends, and after coating the whole of the interior with glycerine, he closely fitted into the bottom a number of glass tubes, containing organic infusions, the tubes opening freely into the interior of the box. On first passing the electric ray through this arrangement, he found the air in the box, as usual, full of particles. After waiting two or three days he examined it again, when the electric ray showed the air to be quite pure, all the suspended particles having subsided and been retained by the glycerine. He then boiled all the infusions, and found that they remained perfectly pure after a lengthened period. Dallinger repeated these experiments under more trying conditions, and was able to confirm his results.

From these experiments we are able, I think, to conclude—First, that organic infusions have no inherent tendency to decompose. Secondly, that the decomposition is not set up by the contact of pure air, that is air free from floating particles; and Thirdly, that decomposition is associated with the presence of organisms which derive their origin from the atmosphere, or, at any rate, from without.

In the stand before me are three test tubes. Two of them are closed with plugs of cotton wool, and contain sterilized infusions. They have been kept for fourteen days at a temperature varying between 65° and 90° F.; but notwithstanding that the air can pass through the plugs, and has actually done so, owing to the variations of temperature, the liquids remain as clear and bright as at first. The third tube contains a vegetable infusion, not sterilized, and although it has been exposed to the same conditions for only three days it is already turbid and full of organisms.

Our next step is to inquire into the nature of these minute particles. First of all Tyndall, by passing air through red hot platinum tubes, showed that they were largely organic. In order to collect them for microscopical examination, various devices have been adopted. Pasteur passed large volumes of air through cotton wool or gun cotton, and then dissolved it. Pouchet used what he called an aeroscope, which was a contrivance by which he caught the particles on a glass slip covered with glycerine. Cohn passed the air through a saline solution. Various substances were found. Miguel gives the following:—spores of algæ, fungi, pollen grains, fragments of tissue, starch grains, and particles of silex, but all agree that nothing was found relating to Bacteria germs. Cohn accounts for this by supposing that they passed through his saline solution in the bottles and escaped without being wetted. That Bacteria, or their germs, are not present in every sample of air is shown by the experiments before mentioned of Tyndall opening sterilized flasks on the Alps. They are related to dust. How long the adult forms may survive in dry dust is not known, but the spores are much more enduring, hence in cultivations from old dust we are not surprised to hear that only spore-forming species are found (fungi, bacilli). In warm moist rooms, according to Horsley, all forms are seen. The largest numbers are found in the air in the neighbourhood of decomposing substances. The atmosphere is also much purer in this respect in rainy than in hot dry weather. Klein, and others, tell us that the trouble in conducting sterilizing and cultivation experiments, varies very greatly according to the state of the weather, and the locality where the experiment is made. Recent investigations show that these organisms are found in the soil, but not below the depth of one metre. They have probably been washed in by water. Their presence or absence in water depends upon the existence or otherwise of proper nutritive material in a suitable state of concentration. In view of these facts Burdon Sanderson has come to the conclusion that decomposing substances owe their contamination more frequently to water than to air, but this question is not yet settled.

Gentlemen, the history of this subject reminds me somewhat of the account of an arctic expedition. The journey down the river is easy enough, and the various odours there encountered might serve to link the two subjects together. The sea voyage at first is extremely pleasant, but after a time our difficulties begin, and unfortunately they increase as we go on. I fear we are nearing the ice.

I will now ask you to turn your attention once more to the infusions. If we place a drop from one of these decomposing liquids under the microscope we shall observe a number of living forms scattered through it, such as torulæ cells, fungus mycelium, &c., but, besides these, some other very minute organisms, with which we are at present specially concerned. First of all we shall notice a number of extremely minute spherical bodies, which sometimes appear singly, more usually in pairs, looking somewhat like a figure 8, and sometimes connected together in chains, or branched forms, or aggregated into masses (zooglœa). These are known as micro-cocci (little beads). Then there will be seen short rod-like forms, sometimes single and sometimes two or more connected by their ends. These have received the name of Bacteria (*βακτηρία*, a wand). Thirdly there are longer slender rods, sometimes connected in chains, known as Bacilli (*Bacillum*, a staff); and lastly, occasionally, screw shaped bodies (*Spirillum*). These forms have been used as a basis for classification. Their exact biological position is perhaps uncertain. Haechel placed them in his *Regnum Protisticum*, but they are now usually classified with the *algæ*. They consist structually of a protoplasmic body, enclosed in a cellular envelope. Chemical analysis, so far as it has gone, shows about 6 per cent. of fat and 50 per cent. of an albuminoid substance, which has received the name of Micro-Protein.

We have now to consider what are their relations to each other, and to the liquid in which they are found.

Much difference of opinion has existed as to whether they are essentially different organisms or merely variations of one protean form. The latter opinion was held, especially by Naegeli, but the former view is now gaining ground. Dr. Horsley observes "Where direct observation has been applied to any given form, there has been found a definite cycle of changes, resulting in the reproduction of the original shape."

Dr. Greenfield carefully cultivated micro-cocci through many generations, and never found them give rise to rod-shaped forms. Where this has been supposed to have occurred, the error seems to have arisen from mistaking the spores of Bacilli for true micro-cocci.

Next as to Bacteria *inter se*. In various liquids undergoing different varieties of decomposition Bacterial forms are found which closely resemble each other. Are these Bacteria all alike, or are there different species? Secondly, are these organisms the true cause of the fermentation process? Professor Lister has made a series of experiments which throw some light upon this question. He carefully studied the changes which take place during the souring and decomposition of milk. If you put milk aside in a warm place it shortly becomes sour, the Sugar of Milk being converted into Lactic Acid. Lister says that if you place some of this milk under the microscope, you will as usual observe the presence of Bacteria; but he maintains that this is a special Bacterium, for the following reasons:—First, it is motionless, whereas the ordinary putrefactive Bacterium—the Bacterium termo as it is called—passes a considerable portion of its life in active movement. Secondly, it differs from it somewhat in form, the segments being more oval and less rod-like. Thirdly, it refuses to live in liquids in which ordinary putrefactive Bacteria thrive perfectly well. Fourthly, if you boil a number of flasks of milk so as to sterilize them, and subsequently introduce a drop of ordinary water, or expose them to the air, the milk will still undergo decomposition, but the lactic fermentation does not take place, nor is the special Bacterium found. He has given it the name of *Bacterium Lactis*, and believes it to be found in dairies, and usually nowhere else.

This is really a very important experiment, as of course so far as it goes it supports the view that there are special forms of Bacteria, associated with special kinds of fermentation, and probably with these only; but is the Bacterium really the cause of the fermentation?

Lister conceived the idea that if he could by any means count the number of Bacteria in any given sample of souring milk, he would by suitable dilution, be able to prepare a liquid of such a strength that each drop would *on an average* contain one Bacterium. Then he says, as it is practically certain that these Bacteria would not be uniformly distributed through the liquid; the result would be that some of these drops would contain Bacteira and some would not. I am now speaking of course of his Bacterium Lactis, the special Bacterium of the souring milk. He succeeded in counting these Bacteria by a method similar to that now adopted for counting the blood corpuscles, and he found that it was necessary to add to the milk no less than a million parts of boiled water to get the liquid of the dilution before mentioned. Of this he added one drop to each of five glasses of boiled milk. After a short time he found that one only out of the five had soured, and in this one only were Bacteria discovered. He repeated his experiments in various ways, but the result was always the same. With fermention Bacteria; without fermentation no Bacteria. Then he says, if the Bacterium is not the ferment, what is it? Is it a solid or a liquid? If it were a liquid it would be uniformly diffused through the inoculating fluid, and therefore fermentation would occur in all the glasses or in none.

Is it, then, a solid? If so we must suppose that there are exactly the same number of particles of ferment as there are of Bacteria, and not only so, but each Bacterium must be accompanied by its own special portion. This experiment brings fermentation home to the Bacteria as nearly as can be. But it has been objected that it is not possible to introduce into a liquid a chemically clear organism, and until you can do so the absolute proof cannot be established. The results of these investigations may be thus summarised:—

(1). Organic substances show no *inherent* tendency to decomposition, even when exposed to the action of air or water previously purified.

(2). Organic substances exposed to impure air or water, under suitable conditions of warmth and moisture, undergo fermentation or decomposition.

(3). This fermentation is associated with the presence of certain organisms.

(4). There is very strong evidence, although perhaps not absolute proof, that these organisms are the cause of the fermentation, and probably there are special organisms, each associated with a special process.

These discoveries have already borne abundant fruit, not only in the improved methods of preserving articles of food in a condition more or less allied to freshness, but also in rendering possible a scientific study of antiseptics and disinfectants.

Thus far I have dealt with these micro-organisms, in their relation only to dead organic matter. When I fixed upon this subject for my address, my intention was to lay before you, as far as I could, what is known of their relation to certain important and very fatal diseases; but, as I said at first, I felt that I should not make myself understood unless I commenced my subject from the beginning. I regret to find that my time is now exhausted, and that I must defer to another occasion the second, and perhaps the more important part of my subject.

Under the microscopes on the table will be seen specimens of some of the organisms to which I have referred.

ABSTRACT OF A PAPER

READ BY

CHARLES HEISCH, Esq., F.C.S,

CALLED

A CHAT ABOUT THE SALE OF FOOD AND DRUGS ACT,

22ND MARCH, 1883.

The author began by saying that, at first, he did not quite see how his subject came within the scope of the Society, but having been bred in habits of obedience to the powers that be, when the President asked for a paper on this subject, he decided to give it.

He first drew attention to some statistics concerning the working of the Act, drawn from the yearly reports of the analysts throughout the country. It appears that the number of samples analysed in 1879 was 16,772, and in 1880, 17,919. The per centages of adulteration in various articles were then given, from which it appeared that

In milk, it had decreased between 1877 & 1880 from			26·07 to 22
In butter, it had increased	,,	,,	12·48 to 20·08
In groceries, it had decreased	,,	,,	13·00 to 10·43
In drugs, ,,	,,	,,	23·82 to 20·26
In wine and spirits, ,,	,,	,,	47 to 21·31
In bread and flour, ,,	,,	,,	6·8 to 6·3

After having been as low as 2·9 in 1878.

The great difference in wine and spirits was partly due to the fact that the Goverment had authorized gin of 35 under proof being sold as gin, while formerly it would have been called gin and water.

The increase of adulteration in butter was partly due to improved methods of manufacturing butterine, and partly due to improved methods of detection.

A comparison was then made between the per centage of adulteration in different articles in London, the other large towns, and in the country, from which it appeared that milk was most adulterated in London and least in the country. Butter most in large towns, less in London, least in country.

Groceries, in London,	8·48 %; large towns,	6·78; country,	13·15
Drugs ,,	6·9 ,,	21·7 ,,	33
Wine and spirits ,,	6·09 ,,	23·97 ,,	22·1
Bread and flour ,,	2·55 ,,	6·97 ,,	7·5

Another point to which attention was particularly called was that, in any particular district, the per centage of adulteration varied according to the activity with which the law was put in motion. Thus, if in any quarter a large number of samples was analysed, in the next quarter the per centage of adulteration very much decreased, while, if but few samples were taken, the next quarter always showed an increased per centage of adulteration, proving that adulteration could not be really stamped out, but only kept down by a vigorous working of the law. The author also expressed his regret that the public were so little inclined to help themselves in the matter. Inspectors were such well known people it was often difficult for them to obtain samples of any but pure articles, but the public, though willing enough to complain of bad articles, shrank from the trouble of summoning a tradesman who had sold them any such.

He then briefly touched on one or two of the principal adulterations, many of which were most easily detected by the microscope, and, of course, required, on the part of the analyst, a good knowledge of the articles employed as adulterants. One thing which involved an application of a very scientific process, he wished particularly to show them. Great difficulty had been for years experienced in determining if red wines were coloured by the juice of the grape or by logwood, magenta, &c., &c.

Dr. Dupré pointed out that almost all the articles usually used to colour red wines were of a crystaline character, and that, therefore, dialysis might be employed to detect their presence. Without going into a regular process of dialysis, which would require the use of large quantities of wine to be satisfactory, he found that immersing in the wine a cube of about one inch in the side (made by dissolving gelatine in hot water, letting it set, and cutting it into cubes with a sharp wet knife), if any crystaline body were present, in about 12 hours the cube would be coloured to the middle, while, if only grape colour were present, it would only be just stained on the outside. It must, however, be remarked that, unless the wine were a regular made up stuff, the occurrence of these substances was not probable, as the amount of grape colour to be met with in wine-making countries, greatly exceeded what was required for the red wine manufactured.

Several other adulterations were briefly touched on, but none the detection of which involved any principal of great interest.

ABSTRACT OF A PAPER

READ BY

J. MORRIS STONE, Esq., B.A.,

ON

THE HABITS AND ECONOMY OF WASPS

(From observations by the late Stephen Stone, Esq., F.S.A., Hon. Member of the Ashmolean Society).

ON APRIL 26TH, 1882.

Wasps belong to the class of insects termed Hymenoptera. Like the common honey bee, which also belongs to this class, they form themselves into colonies, living and working in society. These colonies, as is also the case with the honey bee, consist of males, females, and neuters, which last are imperfectly developed females, and upon them devolves the principal part of the work connected with the nest. They are furnished, by way of defence, with stings; while the males, whose avocations do not call them much from home, and who, consequently, are not much exposed to danger, and therefore do not require a defence against it, are unprovided with these weapons. The females have not only more formidable stings than the neuters, but are also endowed with superior strength; an all-wise provision, because on their safety depends the rise and fall of the colony, and consequently the perpetuation of the species. The males are to be distinguished from the neuters by their longer and more slender bodies, and longer antennae, and the females by their larger size, they being more than double the size of either males or neuters.

The only individuals who survive the winter are the females produced the previous autumn. Both males and neuters, at the close of that season, dwindle away and die, while the young females proceed to lay themselves up in secure places, and pass the winter in a torpid state. We thus see that, like the honey bee, these insects do not require a supply of food for the winter; on the approach of that season the nest becomes entirely deserted, not a single wasp remaining in it.

The warmth of the returning spring having aroused the females from their winter's sleep, they may be seen in search of proper receptacles for the nest they are about to form. Having discovered a suitable cavity, the deserted burrow of a field mouse being, perhaps, more generally selected than any other, it proceeds to attach its work to the centre of the roof of the chamber. This consists, in the first instance, of what may be termed a pedicle or footstalk, something like half an inch in length, at the extremity of which an hexagonal cell is formed, and around it six others. Simultaneously with the formation of the cells an umbrella-shaped covering is being prepared above them, and, at the same time, an egg is deposited in each cell. More cells are gradually added, an egg being deposited in each as soon as formed, while constant additions are made to the covering till it has assumed a somewhat spherical form, with only an aperture sufficient for the ingress or egress of the builder. This work is carried on with great rapidity, eight or ten cells, with a covering over them, being finished in some thirty-six hours from the commencement.

No sooner has one covering been completed than a second, a trifle larger, is begun, and, when this is completed, a third, larger, and so on. In from four to eight days, the period varying according to the temperature, the eggs are hatched, when the parent wasp has to perform the duty of supplying the young larvæ with food in addition to the task of enlarging the nest. The larvæ require to be fed for 12 or 15 days, when, having become full grown, they change into nymphæ, in which state they continue some 10 days longer, and then undergo their final change into perfect wasps. In the course of a few hours after their appearance in the winged state they may be seen actively employed in the work of enlarging the nest, or ministering to the wants of their larval brethren.

When a sufficient number of the young wasps have emerged from the cells, the parent does not again quit the nest, but occupies herself in the task of producing eggs as fast as receptacles for them can be formed. Those only from which neuters or workers proceed are laid during the earlier part of the season; later on those which produce males are also laid, and towards the close of the season those which produce females.

The combs formed by wasps differ from those formed by the honey bee, the former being placed horizontally, and the cells occupying only the underside, with the mouth of each cell downwards, while those of the latter insect are placed in a vertical position with the cells opening on either side.

As the work of the nest progresses it is obvious that the cavity it occupies must be proportionately enlarged, accordingly each wasp, as it emerges from the aperture, for the purpose of collecting building material or food, wherewith to supply the larvæ, will be observed to bring out with it a small lump of earth, which it has scraped from the walls of the chamber. In this way the excavation is gradually increased in size exactly in proportion to the increased side of the nest; care being taken to keep a clear space of a quarter of an inch between its outer covering and the walls of the chamber in which it is situate. About the same space occurs between the combs; supporting pillars or columns being placed at proper intervals between the several tiers. Supporting columns are also placed, at short intervals, between the roof of the chamber and the crown of the nest, connecting the one with the other; and these supports are constantly strengthened, as the increased weight of the nest renders such a precaution necessary. The material employed in building is a sort of paper manufactured by the insects themselves.

A fact illustrative of their habits, and one which shows them to be rigid economists, wasting nothing, but making the most of everything, is shown by the manner in which they deal with larvæ which chance to get injured, or to fall sick. These, as soon as their unhealthy state is discovered, are dragged from their cells, and at once cut up and made to serve as food for the rest.

They are not only economists in the article of food, but in material also; for as the inner portions of the shell or covering of the nest are removed in order to make room for the combs as they increase in size, the material is not thrown by as useless, but is worked up afresh; indeed this is effected in the very act of removing it. It is then applied to the purpose of enlarging the combs, or else used in making additions to the outside. The basis of the material used is wood; this they scrape, by means of their jaws, from off posts, rails, &c., in which act it becomes mixed with some peculiar fluid with which nature has provided them. It then possesses nearly the same properties as the pulp from which paper is made, but is of firmer consistence. This is gathered in a small lump under the chin, to which it adheres, and in that way is brought to the nest, where they apply it to some unfinished part of the shell or combs, and then leave it to dry before building upon it.

The foundress of a colony of wasps is constantly moving about in search of empty cells wherein to deposit her eggs; and so intent is she upon the performance of this duty, that scarcely any amount of disturbance will cause her to desist, or divert her attention from the one single object to the accomplishment of which all her powers are directed, and every moment of the remaining portion of her life is devoted. Long before the walls of a fresh cell are completed, indeed almost as soon as the base is formed, an egg will be deposited therein; and no sooner has a previously-tenanted cell become vacant, than it is at once made the receptacle for a fresh egg. When the larvæ become full grown, they spin a covering of immaculate whiteness over the mouth of the cell; in about an hour after commencing to spin they succeed in enclosing themselves, but several hours more are employed in thickening the covering. In due time they assume the winged state; when they gnaw their way out through the covering, swallowing the pieces as they proceed, and which no doubt they afterwards turn to some account in their economy.

One singular feature in the character of these insects deserves a passing notice. A piece of raw meat having been placed near a nest, which had been dug out and placed in a room (an aperture being made to allow of the egress and ingress of the wasps) the meat was presently surrounded by carvers, each of whom carried off a piece; but, instead of going straight to the nest with it, as they might have done, the passage being easy, and, moreover, the one by which they had come, they thought proper to pass through the casement, which chanced to be left open, make an entire circuit of the garden, and then return through the aperture by which they commonly entered and went out. As every individual was observed to act in this extraordinary manner, they must have had some common object in view or cause for doing it. What the cause of this proceeding was I am unable to say, but it would almost seem as if they were seeking to obtain credit for a greater amount of diligence than they were really entitled to.

Another remarkable feature is presented by the fact that wasps, which have been born and bred in one nest, sometimes desert and join another. Mr. Stephen Stone thus describes the manner in which this fact was first brought to his knowledge.

After explaining how two nests of Vespa Germanica were placed in a room on the first floor of an unoccupied house, which he used as a vespiary, he proceeds:—"It soon became apparent that the nest near the window had more than its fair share of workers, while those in the opposite one had fallen off very considerably. Surprised at this, I proceeded to reverse the position of the nests, when that which had previously become almost deserted, now suddenly became thriving and populous, while the other, in its turn, retained but a few faithful and staunch adherents, the whole number being barely sufficient languidly to carry on the 'business of the state.'" "Finding, as above stated, that members of one community were allowed, without opposition to join themselves to another, I determined to try whether advantage could not be taken of this fact to cause the work of a nest on the ground floor, which had at this date (the middle of August,) aided by a constant supply of sugar, with which the workers were regaled, attained a very considerable size, to be carried on with increased rapidity; I therefore began gradually to stint, and ultimately to stop, the supplies altogether of the lodgers occupying the first floor, upon which, as I anticipated, they began to desert in vast numbers, and join the more favoured community below, life members of which they at once became. This vast addition to the ordinary number of workers had, of necessity, the effect I intended, that of contributing to swell the work far beyond its ordinary limits."

This nest was placed in the Ashmolean Museum at Oxford. It has recently been removed to the New Museums, where it may still be seen. It measures upwards of five feet in circumference the shortest way.

Throughout the summer a most singular noise may be heard to proceed from the nests both of Vespa Germanica and Vespa Vulgaris. The power of producing it seems to be restricted to these two species. The sound is not exactly like the purring of a cat, nor the croaking of a frog, but very much resembles what one can imagine a mixture of the two sounds would produce. It is louder and sharper than the purring of a cat, and it is not continuous, but occurs at intervals of two or three seconds. It goes on thus for a few seconds at a time, and then ceases probably for half an hour or more, when it may again be heard. It occurs by night as well as by day; indeed, in the evening, and for some hours after nightfall, its occurrence is more frequent than in the daytime. So loud and sonorous was the sound which proceeded from the large nest now in the Oxford Museum, that at night, when all around was still, it could be heard most distinctly at a distance of 50 yards from the house though the doors and windows were all closed. It appeared to be given off by hundreds of individuals in concert, all keeping the most exact time. The purpose of this noise, and the means by which it is made, seem to be mysteries which science has yet to unravel for us.

Rain appears to cause these insects but little annoyance, and the indifference they manifest towards it is really surprising, venturing out to pursue their ordinary avocations with little apparent concern when it is pouring in torrents.

Though wasps consume animal as well as vegetable food, yet, as a general rule, the substance which contains the greatest amount of saccharine matter is that most eagerly sought after by them; nor is any chemical analysis required to show them what the substance is which is richest in that article; guided by instinct, they are enabled unerringly to make proper selection. When honey dew abounds, as it sometimes does, it supplies them, as well as the bees, with a plentiful feast.

In 1854 these insects were exceedingly numerous throughout all parts of the country. Before the close of the summer, and many weeks before the usual period at which their labours cease, nests were found which had become deserted. It seemed strange that these nests, which, in their situation, were everything that could be desired, should be deserted at such a time. They mostly appeared to have been left when in full work, being about eight inches in diameter, or something like two-thirds of their usual full size. At the same time thousands of these insects were found dead, scattered under fruit trees and elsewhere. This circumstance would sufficiently account for the desertion of the nests just mentioned, but what could be the cause of this mortality? The weather was magnificent! Just such as one would imagine wasps would rejoice in. Could this fatality be in any way connected with that dread epidemic which was raging in ill-drained, smoky, and populous towns amongst the human species? An atmosphere which engenders cholera among mankind is said to be fatal to certain Dipterous insects, it may therefore be so to Hymenopterous ones; whether it be so or not, it is a fact that, in the height of summer, in weather the most splendid and enjoyable, the career of thousands of wasps was suddenly stopped in death at the very time the cholera was raging in various parts of the country.

The following are the species of Social Vespidæ at present known to inhabit Britain, viz.:—Vespa Vulgaris, Germanica, Rufa, Arborea, Sylvestris, Norvegica, and Crabro; the first three are the most common, and almost invariably choose an underground situation for their nests; V. Arborea occasionally constructs its nest in holes in the thatched roofs of buildings, but more frequently perhaps attaches it to the branches of fir trees. V. Sylvestris sometimes builds underground and at other times among the branches of a tree or in a bush; while V. Norvegica confines itself to trees or bushes, suspending its nest from the branches. The nest of V. Crabro is to be looked for in hollow trees or under the roofs of houses, &c.

Although public feeling is very strong against these insects, some fearing them for their stings, others disliking them on account of their voracity, it must be admitted that they seldom, or never, use their weapons except in self-defence, and that their voracity proceeds not from any wish to satisfy their own appetites but from a desire to provide for their younger brethren, who are unable to help themselves. It should therefore excite rather our admiration than our disgust. As a pattern of industry they surpass the "busy bee," rising even earlier in the morning and working later in the evening than the little creature we have all been taught to imitate; and, though they do consume a portion of the produce of our orchards, yet, it must be confessed, that their share is well earned, since in the earlier part of the year they have destroyed vast numbers of the Aphides and other creatures whose ravages upon the leaves, buds, and blossoms of our fruit trees are of a much more serious nature, involving as they do, not only the destruction of the crop, but also the sacrifice, to a great extent, of the health of the tree. For the removal of these destructive creatures, and thus rendering comparatively light the evils they would inevitably cause, we are largely indebted to the wasp.

ABSTRACT OF A PAPER

READ BY

JAS. GLAISHER, Esq., F.R.S., F.R.A.S., &c.

ON THE

EXTRAORDINARY VARIATIONS IN THE WEATHER BETWEEN OCTOBER, 1881, AND MAY, 1882.

24th MAY, 1882.

Temperature, 1881, October, to 1882, May.

October, 1881.

The weather in October was cold, and at times painfully so, with winds for the most part from S.E., E., and N.E. The month proved to be the coldest October about London for 64 years, although the October of the year 1842 was nearly as cold. On the 13th the barometer reading decreased rapidly, and the wind blew heavily from the north-west, increasing in strength during the night, to a very violent gale on the morning of the 14th. On this day great damage was done. About London, slates, tiles, buildings in course of construction, were blown down in great numbers. Large trees were uprooted, and during the morning locomotion was difficult and dangerous. The gale extended all over the country, many thousands of large trees being blown down; there was loss of life at many places, and great damage to property everywhere both on land and sea. The month was almost free from thunderstorms, and but little lightning was seen; snow fell on the 15th at Wrottesley, and at this time the mountains in Wales were white with snow, as also were those in Cumberland at the end of the month.

The mean temperature of the air for October was 45°·3, being 3°·5 and 4°·8 below the average of 110 years and 40 years respectively; it was 0°·9 and 3°·8 lower than in 1880 and 1879 respectively.

Back to 1771 there have been but five Octobers so cold as this, viz. :—

YEAR.		DEGREES.
In 1782	the mean temperature was	45·2
1784	”	43·9
1786	”	44·7
1817	”	45·0
1842	”	45·1
1881	”	45·3

November, 1881.

The month of November was fine and warm, being a great contrast to that of October; the prevalent winds were from the W., S.W., and S., and there was almost a total absence of north and north-west winds. The mean temperature of the month at Greenwich was 48°·7, being 3°·4 warmer than in October, and warmer than in any November back to 1852, which was 48°·9. In the year 1881 the mean temperature of November was 49°·2, being the warmest November on record, and there was no other instance back to 1771 of so warm a November as this.

The mean temperature of the air for November was 48°·7, being 6°·4 and 5°·3 above the average of 110 years and 40 years respectively; it was 6°·2 and 10°·4 higher than in 1880 and 1879 respectively.

Back to the year 1771 there have been but three Novembers whose mean temperature exceeded 48°, the instances are:—

YEAR.		DEGREES.
1818	when it was	49·2
1822	”	48·2
1852	”	48·9
1881	”	48·7

December, 1881.

The weather in December for the first week was cloudy and generally warm; from the 8th to the 25th it was cold, with frequent fog, at times dense; on the 26th it became warmer, and continued so to the end of the year. The weather throughout the month was open. The range of readings of the barometer was great, being as large as 1°·5 at southern stations, increasing to 1°·8 and 1°·9 at northern stations. There was a good deal of fog at stations in the Midland counties.

The mean temperature of the air for December was 39°·8, being 0°·8 above the average and 0°·1 below the average of 110 years and 40 years respectively; it was 3°·4 lower than in 1880 and 7°·4 higher than in 1879.

January, 1882.

The weather in January was remarkable for very high readings of the barometer and high mean atmospheric pressure for the month; total absence of snow, the very few nights on which the temperature on grass was below 32°, and consequently very few and slight frosts, and almost total absence of north and north-east winds. It was a mild pleasant month, being very warm during the first fortnight, and the last five days, with a rainfall below the average; at the end of the month all agriculture was a month in advance, and many flowers were in blossom in addition to the usual January flowers.

The mean temperature of the air for January was 40°·4, being 3°·9 and 2°·1 above the average of 111 years and 41 years respectively; it was 8°·8, 7°·2, and 8°·5 higher than in 1881, 1880, and 1879 respectively, and of the same value, viz., 40°·4, in the year 1878.

Back to 1771 there have been 18 Januarys as warm as this, viz. :—

YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.
1775	40·4	1846	43·7	1866	42·6	1875	43·4
1796	45·3	1851	42·9	1869	41·1	1877	42·7
1804	43·2	1852	42·0	1872	41·3	1878	40·4
1806	40·6	1853	42·4	1873	42·1		
1834	44·4	1863	41·8	1874	41·7		

February, 1882.

The weather in February was mild and pleasant, with a high barometer continuing till near the end of the month, and a high temperature from the 11th day, vegetation was very forward at the end of the month.

The mean temperature of the air for February was 41°·8, being 3°·1 and 2°·4 above the average of 111 years and 41 years respectively; it was 4°·1 higher than in 1881, corresponded with the mean in the year 1880, and 3°·6 higher than in 1879.

Back to the year 1771 there have been but 23 Februarys as warm, viz. :—

YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.
1775	41·9	1826	42·2	1856	42·0	1871	42·4
1779	45·3	1833	42·4	1861	42·1	1872	44·8
1794	44·7	1846	43·9	1863	42·1	1877	43·5
1809	44·1	1848	43·4	1867	44·7	1878	42·2
1817	42·6	1849	43·2	1868	43·0	1880	41·8
1822	43·3	1850	44·7	1869	45·3		

March, 1882.

The weather in March was singularly mild and pleasant, being exceptionally warm during the first 20 days, and quite genial; on the 21st and 22nd, a little snow was general over the country, and the temperature on the 21st, 22nd, and 23rd was slightly below the average, but it became warm again on 24th. The weather from November to this time was most favourable for farming work, and at the end of the quarter vegetation was very forward.

The mean temperature of the air for March was 46°, being 4°·9 and 4°·3 above the average of 111 years and 41 years respectively; it was 3°·4, 1°·7, and 3°·8 higher than in the year 1881, 1880, and 1879 respectively.

Back to 1771 there have been but four instances of a mean temperature in March being as high as 46°, viz:—

YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.	YEAR.	DEG.
1779	47	1780	49·2	1822	47·3	1841	46·2

April, 1882.

The weather in April was generally warm till towards the end of the month, with frequent rain, the total being in excess of the average, but not more than was needed, the three preceding months having been drier than usual. The atmospheric pressure was in excess of the average till the 10th, and generally in defect afterwards. The prevailing winds were from the S., S.W., and W.

On the 28th, there were violent gales of wind and squalls passing over Jersey and Guernsey, and on the 29th a severe gale passed over the South of Wales and the South of England, which proved to be very injurious to fruit trees and the foliage of trees throughout its course. This gale was thought to be in some places as severe as that of October 14th, 1881. The observer at

Osborne says, twelve large trees were overturned; the observer at Southbourne says, houses were unroofed. At all places the leaves of trees on the S.W. or windward side was spoken of as blackened, as if by frost, or as if scorched by fire; this effect was attributed by several observers to saline matter carried by the wind. The gale entirely changed the appearance of the country over which it passed, but it did not extend far north. At Cambridge there was a gale after 3 p.m.; at Oxford a storm from 5 p.m. to 9 p.m.; at Lowestoft a gale after 4 p.m.; at Hull the day was fine with showers; at Bradford the day was fine throughout; at Stonyhurst there was a snow storm, and snow fell at Liverpool and Bolton. The instances of rain exceeding an inch in one day, were on the 1st at Plymouth, on the 12th at Totnes, on the 13th at Stonyhurst, on the 25th at Caterham and London, on the 29th at Wrottesley, Bolton, Bradford, and on the 30th at Halifax.

The mean temperature of the air for April was 47°·9, being 1°·8 above the average of 111 years, and 0°·8 above the average of the preceding 42 years, and of nearly the same value as on the two or three preceding Aprils.

The mean temperature of the quarter ending with December, 1881, was 44°·6, being 1°·2 above the average of 110 years, and 0°·1 above the average of 40 years.

The mean temperature for the quarter ending March 31st, was 42°·7, being 4° and 2°·9 above the average of 111 years, and 41 years respectively.

Back to 1771 there have been six instances of the mean temperature of the quarter ending March exceeding 42°, viz:—

1779 it was 42°·4	1834 it was 42°·9	1863 it was 42°·6
1822 it was 44°·5	1846 it was 43°·6	1872 it was 43°.6

of these four of higher temperature than in this quarter, viz., in 1822, 1834, 1846, and in 1872.

Mean High Day and Low Night Temperature.

The mean high day temperature of the air in October was 52°·4, being 5°·8 below the average of 40 years; in November it was 54°·0, being 5°·3 higher than the average, and in December was 43°·9, being 0°·8 below the average.

The mean low night temperature of the air in October was 39°·0, being 4°·5 below the average of 40 years; in November it

Plate *every day from*

day from the

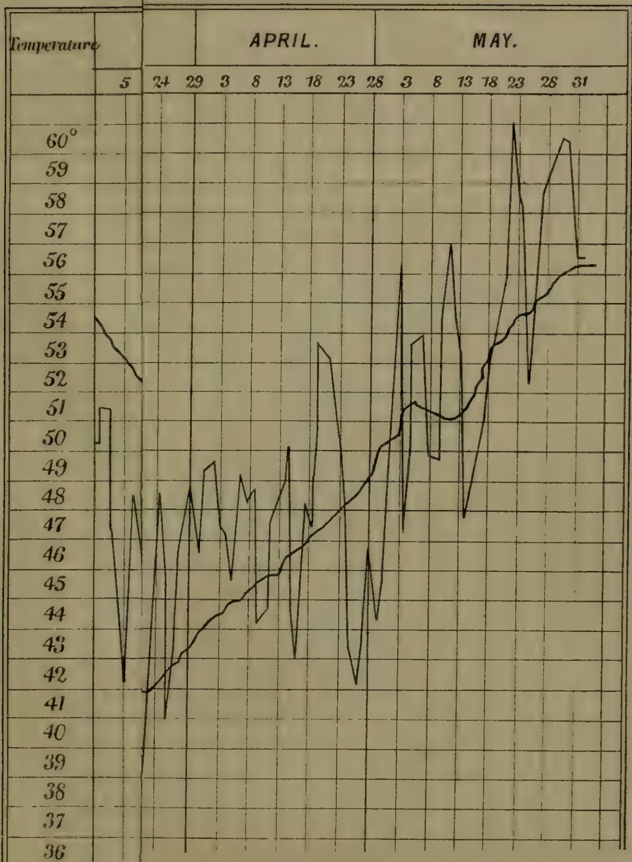
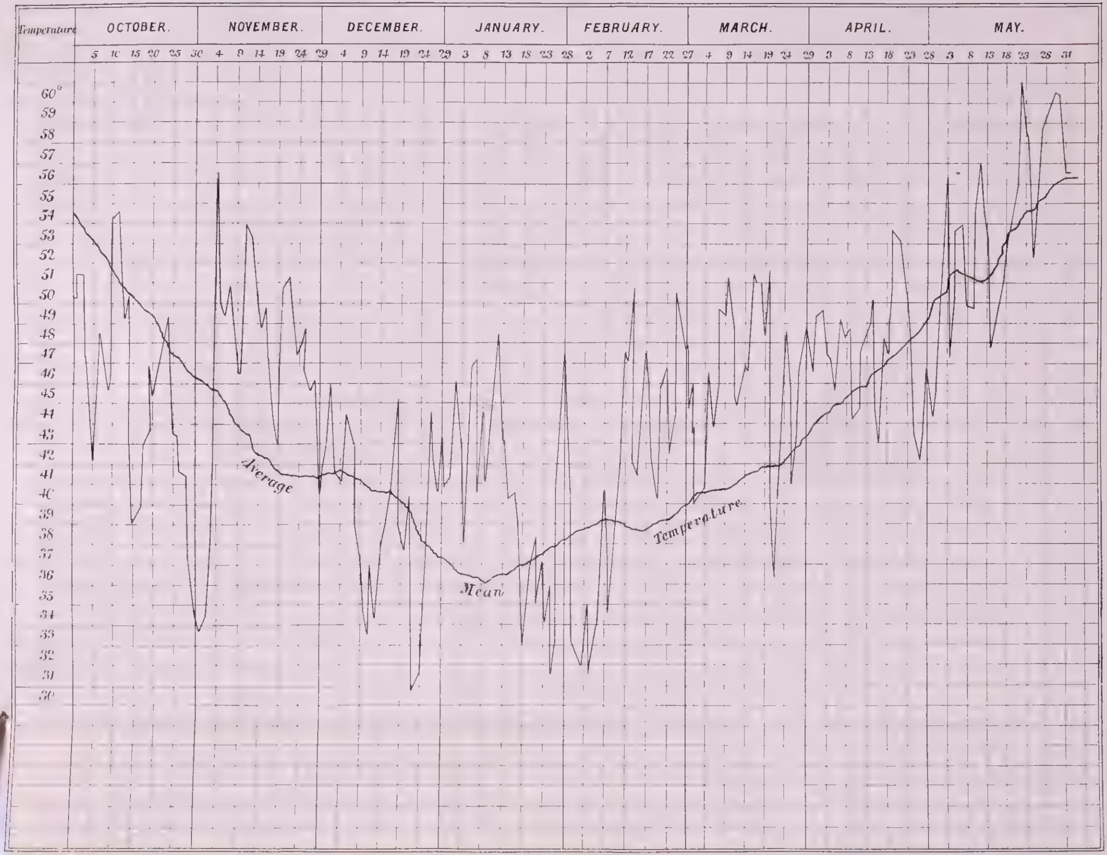


Plate 1. *Diagram shewing the Mean Temperature at Blackheath on every day from October 1, 1881 to May 31, 1882, and the departure on every day from the Average Mean Temperature.*



was 42°·8, being 5°·6 above the average, and in December was was 34°·9, being 0°·3 below the average; therefore both days and nights were cold in October and December, and were very warm in November.

The mean high day temperature of the air in January was 44°·4, being 1°·6 above the average of 41 years; in February it was 47°·7, being 2°·3 above the average, and in March it was 55°·1, being 5°·1 above the average.

The mean low night temperature of the air was in January 35°·3, being 1°·8 above its average; in February it was 36°·2, being 1°·9 above its average, and in March it was 37°·6, being 2°·3 above the average; therefore the high day temperatures and low night temperatures were both very warm, particularly the high day temperatures in March.

Diagram (Plate 1) *showing the mean temperature of the air at Blackheath on every day from October 1, 1881, to May 31, 1882, and the departure on every day from the average mean temperature.*

The diagram shews that the mean daily temperature of the air, with very slight exceptions, was below its average from October 1st till November 3rd; the mean daily defect of temperature for these 34 days was 4°·8, the very cold days being October 5th, with a temperature 11° below its average, October 16th with 11°·1 below its average, and October 30th, 31st, and November 1st, with 11°·8, 12°·6, and 11°·9 respectively below their averages. On November 4th a warm period set in and continued to December 7th, a period like the preceding, of 34 days in length, whose mean excess of daily temperature was 5°·4; of these, November 5th, 11th, 12th, 13th were 11°·4, 10°, 11°·1, and 10°·7 above their averages. From December 8th to December 25th the temperature was mostly cold; the average daily deficiency of these 18 days was 2°·6, and the average daily excess of temperature from December 26th to January 16th was 6°. It was generally below its average from January 17th to the 26th, the average daily deficiency being 2°·6; from the 27th it was warm, the mean daily excess of these five days being 4°·4. The first 10 days in February were cold, the average daily deficiency of mean temperature was 3°·3; a warm period set in on the 11th of February, which continued with very slight exceptions to the present time (May 24) the average daily excess of temperature for these 103 consecutive days being 3°·1.

Atmospheric Pressure.

The mean reading of the barometer for the month of October at the height of 160 feet above the sea, was 29·827 in., it being ·121 in. above the average of 40 years, and ·121 in. above that of 1880, and ·125 in. below that of 1879.

The mean reading for November was 29·785 in., being ·037 in. above the average of 40 years, and ·008 below that of 1880, and ·249 in. below that of 1879.

The mean reading for December was 29·821 in., being ·027 in. above the average of 40 years, and ·072 in. above that of 1880, and ·318 in. below that of 1789.

The mean reading of the barometer for the month of January at the height of 160 feet above the sea was 30·185 in., being 0·419 in. above the average of 41 years, and 0·475 in. above that of 1881, and 0·019 in. below that of 1880.

Back to 1840 there have only been six instances of a mean atmospheric pressure so high as this, viz. :—

1858	30·171 in.	1861	30·011 in.	1876	30·095 in.
1859	30·037 in.	1864	30·044 in.	1880	30·204 in.

The mean reading of the barometer in February was 30·051 in. being 0·268 in. above the average of 41 years, 0·390 in. above that of 1881, and 0·417 in. above that of 1880.

Back to 1840 there have been but four instances of readings as high in February, viz. :—

1863 30·141 in. 1878 30·101 in. 1849 30·106 in 1854 30·041

The mean reading of the barometer in March was 29·843 in., being 0·097 in. above the average of 41 years, and 0·115 in. above that of 1881, and 0·094 in. below that of 1880.

Back to 1840 there have been 11 instances of readings in March exceeding 29·84 in., viz. :—

1850	30·039 in.	1856	30·011 in.	1874	30,013 in.	1880	29·937 in.
1852	30·007 in.	1870	29·865 in.	1875	29·954 in.	1882	29·843 in.
1854	30·186 in.	1871	29·876 in.	1878	29·890 in.		

The mean reading of the barometer for the quarter ending March 31 was 30·026 in.

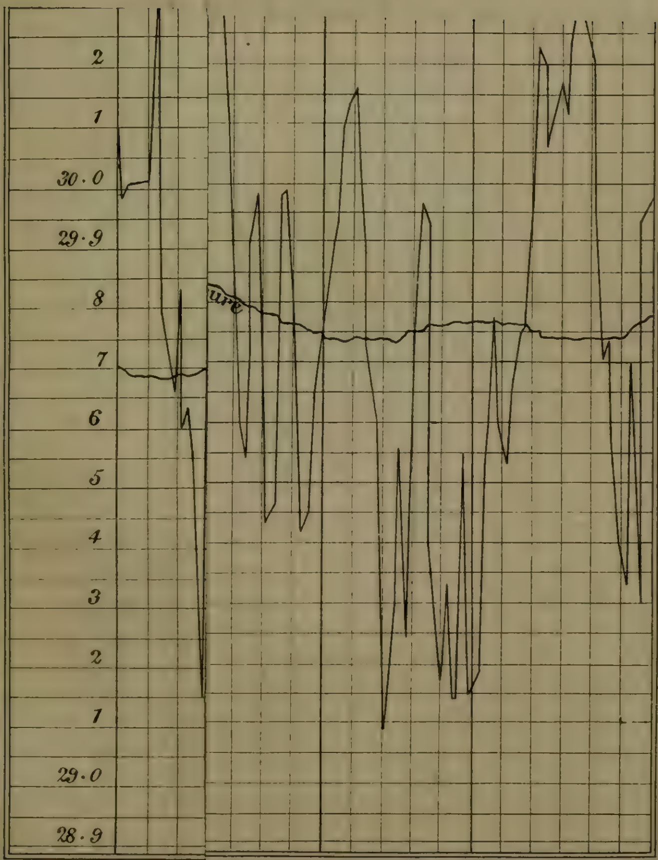

2
1
30·0
29·9
8
7
6
5
4
3
2
1
29·0
28·9

Plate II. *Diagram shewing the Average Mean daily pressure of the atmosphere at Blackheath at the height of 150 ft above the level of the sea, from October 1, 1881 to May 31, 1882, and the departure on every day from the Average Mean Pressure.*

Back to 1840 the highest mean readings have been in the years—

1854 when it was	29·984 in.	1874 when it was	29·919 in.
1858 „	29·926 in.	1878 „	29·990 in.
1859 „	29·890 in.	1880 „	29·925 in.

So that there has been no instance, back to 1840, of so high mean readings for the three months ending March, the nearest approach was in 1878, when it was 29·90.

Diagram (Plate 2) *showing the average mean daily pressure of the atmosphere at Blackheath, at the height of* 150 *feet above the level of the sea, on every day from October* 1, 1881, *to May* 31, 1882.

The diagram shows that the mean daily pressure of the atmosphere till October 8th was above the average by 0·4 in.; from the 9th to the 14th it was below by 0·12 in. daily; then for five days it was above by 0·15 in. daily; from the 20th to the 25th it was below by 0·26 in. daily; and it was 0·26 in. daily above till the end of the month. On the first four days in November it was below by 0·06 in. daily; from November 5th to the 24th it was mostly above, the mean averaging for these 20 days 0·16 in. in excess of daily average; then for four days it was below by 0·49 in. daily; from November 29th to December 6th, it was upon the average 0·22 in. above; then for six days 0·2 in. below; then for three days 0·22 in. above; from December 16th to 22nd it was daily 0·46 in. below; then for seven days 0·41 in. above, and on the last two days of the year it was slightly below the average.

They were below their average till the 6th day of January; on the 3rd day it exceeded 0·5 in.; the lowest reading throughout the month at nearly every station took place on this day. The average daily deficiency of pressure till the 6th was 0·23 in. On the 7th day of January the reading was above its average, and continued so till February 24th; with the exception of the 11th and 15th days of February, on which days it was 0·07 in. below its average on both days. The readings in January were very remarkable, the average daily pressure from the 16th to the 19th, both inclusive, was nearly one inch in excess over the average. On the 18th the reading all over the country was remarkably high, being such that on being reduced to the level of the sea, it was about 30·95 in. The average excess of pressure, both on the 17th and 18th exceeded one inch, and the average excess daily for the 49 days ending with February 24th was 0·51 in. From February 25th to March 6th—there was a deficiency of pressure, of nearly one inch on March 1st, and averaging of 0·55 in. for the 10 days ending March 6th; from March 7th to 19th there was an excess of 0·33 in. daily, and from March 20th to April 2nd there was a deficit of 0·1 in. daily; from April 3 to 10 there was an average daily excess of 0·25 inch; from April 11 to the 18th, it was 0·32 in. daily below its average; then for three days it was above, by 0·17 inch; from April 22 to May 5 it was below its average by 0.34 daily; from May 6 to 19, the average daily excess of pressure was 0·33 in.; then for seven days, May 20 to May 26, it was below, and was above the average to the end of the month.

Natural History Notes.

Full flower.

White Nettle,
Red Nettle,
Dandelion,
Veronica,
Groundsell,
Primroses,
} at the beginning of December, 1881.

January, 1882.

Lilac in bud,
Honeysuckle in leaf,
Yellow Gorse in full flower,
Laurel, inflorescence well formed,
Fuchsia in leaf,
Elderberry in leaf, 14th,
Blackberry in leaf, 25th,
English Clary or Salvia Verbenica,
Red Dead Nettle,
Dog Mercury,
Violets,
Primroses in great numbers,
} Ventnor.

Bees out, 22nd,
Snowdrops in flower on the 22nd,
} Lancaster.

In the middle of the month, in addition to the usual January flowers, the following could be gathered:—

In a sheltered place Geranium still survived, and also some Mignonette, Aconite, Primrose, Anemone, Periwinkle, Snowdrop, Crocus, Polyanthus, Hepatica,	Boston.

Plants in flower on January 1st.

Yellow Primrose, Cowslip, Polyanthus, Pansy, Carnation, Christmas Rose, Wallflower, White Rock Cress, Double Daisy, Chrysanthemum, Yellow Jessamine, Auricula, Heath,	North Shields.

Snowdrops in flower on the 19th.

February, 1882.

Sycamore,	first appearance	of leaf-buds on	26th	Ventnor.
Horse Chesnut	,,	,,	26th	Ventnor.
Hawthorn	,,	,,	4th	Ventnor.
Yellow Broom	,,	,,	25th	Ventnor.

Apricots in blossom on the 27th; Gooseberry in full leaf on the 18th — Bath.

Hawthorn first appearance of leaf-buds on the 27th. Rugby.

Crocus and many other early spring flowers in bloom; Ribes sanguineum; Narcissus pseudo narcissus in bloom — Silloth.

March, 1882.

Horse Chesnut in leaf on the 23rd; Hawthorn ,, 7th — Torquay.

Apples, Pear, Cherry, Peach, Plum,	All in blossom before the end of the month.	Ventnor.

Dog Violet on the 2nd; Anemone in flower, 13th; Wild Hyacinth, 24th.

Horse Chesnut in leaf on the	16th	Strathfield Turgiss.
Pear in blossom on the	27th	
Cherry ,,	24th	
Plum ,,	11th	

Horse Chesnut in leaf on the	16th	Downside, Bath.
Hawthorn ,,	5th	

Horse Chesnut in leaf-buds on the 4th, at Rugby.

Horse Chesnut,	15th	Llandudno.
Hawthorn, leaf-bud 9th, and leaf,	15th	
Pear in blossom,	20th	
Cherry ,,	10th	
Plum ,,	17th	
Cuckoo arrived on the	17th	

Horse Chesnut in leaf-bud on the	23rd.	Hull.
Hawthorn ,,	15th	

Lime in leaf-bud	on the 31st	Stonyhurst.
Horse Chesnut in leaf	,, 31st	
Occidental Plane in leaf-bud	,, 30th	

Plum in blossom on the 19th, at Silloth.

Horse Chesnut in leaf-buds on the	24th	Carlisle.
Occidental Plane ,,	18th	
Hawthorn in leaf-buds	4th	
Balsam Poplar in leaf	28th	
Laburnum in leaf-buds	11th	

Blackbirds, Thrushes, and Rooks building nests January 1st, 2nd, and 3rd.

Thrushes' nest, with eggs, seen on the 7th March, at Strathfield Turgiss.

April, 1882.

Nightingale first heard on the	10th	Strathfield Turgiss.
Cuckoo ,, ,,	12th	
Wryneck ,, ,,	20th	

Martins seen on the 21st at Banbury.

Cuckoo first heard on the 20th	Woolstaston.
Swallows seen on the 22nd	

Cuckoo first heard on the 21st	Orleton.
Whitethroats seen ,, 24th	
Willow Wrens seen ,, 24th	

Swallows seen on the 19th	Grimsby.
Cuckoo heard on the 29th	

General Notes.

January.

All agricultural products very forward at Strathfield Turgiss.

Fruit trees forward at Culford.

February.

All nature about one month in advance, most favourable, at Strathfield Turgiss.

March.

The season, as a whole, from November up to the present time has been most favourable for many years, at Strathfield Turgiss.

Weather very favourable for farming operations at Orleton.

Vegetation very forward and farm work going on rapidly at Grimsby.

April.

The pastures have made rapid progress at Strathfield Turgiss.

VARIATIONS IN THE COLOR OF LEPIDOPTERA.

BY

J. JENNER WEIR, Esq., F.L S., F.Z.S.,

22nd NOVEMBER, 1882.

In no order of insects has so much importance been attached by entomologists to the mere coloring of the species as in the Lepidoptera.

The reason of this is not far to seek, for the wings of Butterflies and Moths are as a rule larger in proportion to the size of the body than is the case in any other order of insects, and further the markings of the great majority are singularly invariable specifically, and the same character of markings obtains often over the whole of the genus and even family to which the species belongs.

Many of the species of butterflies are so constant in their markings and coloration that a variety or even slight aberration is rarely to be found. The common peacock butterfly, *Vanessa Io*, is remarkably invariable in color and markings; thousands might be taken before the most trifling deviation from the normal type could be found. This is true also of the Red Admiral, *Pyrameis Atalanta*, the Painted Lady, *Pyrameis Cardui*, and numerous other species.

On the other hand, particularly amongst the moths, some species are so truly polymorphic that it would be difficult to decide which coloration was the typical or normal one, scarcely two specimens being found to be absolutely similar.

Two of the *Cidariæ*, for instance, viz., *C. russata*, and *C. immanata*, are very unstable in their colors, and *Peronea cristana* has even a wider range of variation.

Within the limits of the word variety, as used amongst lepidopterists, several widely different conditions of variations of color are embraced, and it is the object of this paper to classify these conditions, and to give greater precision to the use of the word.

Variations in the color of lepidoptera either from the normal type, or in the case of polymorphic species, from each other, may be placed under at least twelve different classes, and this diagram will show the divisions under which I propose to deal with the subject.

TABLE OF VARIATIONS IN THE COLOR OF LEPIDOPTERA.

Aberrations or Heteromorphism.

White.	Pallid.	Black.	Sports.	Females colored as Males.	Both sexes in one individual.
Albinism.	Xanthism.	Melanism.	Heteropœcilism.	Gynandrochromism.	Hermaphroditism.

Constant Variations or Orthopœcilism.

Variable species.	Local variations.	Reversion.	Two static conditions.	Three static conditions.	Seasonal variation.
Polymorphism.	Topomorphism.	Atavism.	Dimorphism.	Trimorphism.	Horeomorphism.

It will be seen from the diagram that I divide the twelve classes into two sections, six classes in each. The first includes mere aberrations, and the second variations of constant occurrence. To the first section I give the name of Heteromorphism and to the second that of Orthopœcilism.

The six heteromorphic variations are more of the nature of what gardeners call "sports," and in the natural state do not, as a rule, form permanent varieties or races, although by careful selection in confinement some of them may be perpetuated.

The six orthopœcilic variations are of constant occurrence, and in a state of nature form permanent variations either of a local, seasonal, or other character.

I do not contend that these twelve classes are sharply separated from each other, but, on the contrary, there are some variations to be met with that might with equal propriety be placed in more than one of the classes.

I shall now consider the twelve classes separately.

Albinism.—A pure albino amongst the lepidoptera is very rare, and my cabinet contains but one specimen, viz., *Eusebia bipunctaria.* This remarkable specimen I took myself at Lewes. The only other albinos I have seen were captured in the Island of Lewis, in the Outer Hebrides. They were so frequently met with there, in the case of *Emmelesia albulata*, that I proposed for them the subspecific name of *Hebudium*. Partial albinism occurs not infrequently in *Satyrus janira*, the color being absent from one or more of the wings, producing white patches.

Xanthism.—In this class I place all those aberrations of color which assume a pallid appearance over the whole extent of the wings. I illustrate this condition by three remarkably light yellow varieties of *Cænonympha pamphilus*, one of *Satyrus semele*, one of *Cænonympha davus*, and one of *Polyommatus phlœas*, and on the under side of *Satyrus hyperanthus*. Xanthism is also found occasionally in the genus *Anthrocera* especially in *A filipendulæ*, the spots on the wings being sometimes yellow instead of red. Many more instances of Xanthism might be given. The most remarkable case I ever saw was that of *Pyrameis cardui*, where the two wings on one side were normal, on the other xanthic.

Melanism.—Pure melanism is rare amongst lepidoptera, and I think it is found only in those species where black obtains in the markings, and it really consists in the diffusion of the black over the whole of the wings. I illustrate this condition by melanic specimens of *Biston betularia*. This, commonly called the peppered moth, has usually a white ground color to the wings with small black spots; but it has been found in the North of England entirely black, and I believe this melanic variety has been perpetuated in confinement by careful selection. I have seen almost melanic varieties of Abraxas grossulariata, and partial melanism is common in that species. Several of the Geometridæ and Noctuidæ are found more or less melanic in the northern parts of England and in Scotland. *Dianthœcia conspersa* is a good illustration of this darkening of color in northern specimens, many, more or less suffused with black, have been captured.

Heteropœcilism.—In this class I place mere sports, which may occur once or twice and perhaps never be found again. I illustrate this by two specimens of *Satyrus hyperanthus* from the New Forest—one captured by myself. In these two insects the ordinary round spots on the underside of the wings are changed into lanceolate markings. I have also two specimens of *Cænonympha davus*, with similar lanceolate instead of round markings both on the upper and underside of the wings. The aberration in the case of *S. hyperanthus* would probably be a disadvantage to the insect, as the usual round spots on the underside of the wings resemble very closely the oak spangles, so that the imago, when at rest with closed wings, would more easily escape being detected by birds.

Gynandrochromism.—In this class I place those aberrations in which the two sexes being generally of different colors, the female is more or less of the color of the male.

Odonestis potatoria is usually of a buff color in the female and dark brown in the male. I have a specimen in which the female is precisely of the color of the male. This was taken in the New Forest, and I have seen many others.

In the genus Lycæna the males of several species are blue, and the females brown or blackish. In specimens of the female of *Lycæna icarus*, of which I have a score or more in my cabinet, the females have the wings more or less of the blue color usual in the male. This occurs also occasionally in *L. Adonis* and *L. Corydon*. This assumption by the female of the color of the male is found in several species of Lepidoptera.

Hermaphroditism.—I have found this a very rare condition of lepidoptera, and have never taken one myself. When it does occur, the wings and antennæ on one side are often colored and formed exactly as in the male, and on the other side as in the female. It has been found in *Lycæna icarus*, in which case the peculiarity is very marked, as the wings on one side are blue and on the other brown. The insect indeed appears equally divided down the middle of the head, thorax, and body into the two sexes. Hermaphroditism occurs also in varying proportions. I have observed it in *Satyrus semele*, and in some moths. It is found more frequently amongst hybrids, and has been observed in those between *Smerinthus populi* and *S. ocellatus*.

Occasionally the wings of hermaphrodites appear as if quartered, the upper right wing and the lower left being of one sex and the left upper and lower right *vice versâ*.

I now pass on to the Orthopœcilic sections.

Polymorphism.—The most remarkable species amongst the British Geometridæ illustrating this condition are the two allied

Cidariæ, C. russata and *C. immanata.* The variation is, I think, greatest in the former species.

Cidaria russata has the broad central bar of the upper wings either black, brown, red, or gray, and in some cases nearly white. Specimens are occasionally found suffused almost entirely with black, and the relative proportions of the colors varies considerably. It would be impossible to say what is the normal color in this species. I find that in the outer Hebrides and in the island of Arran that the coloration is much more uniform, the general appearance of all the specimens being grayish.

Cidaria immanata varies in a similar manner, except that only in the Shetlandic specimens have I seen any tendency to red in the centre of the wing.

Peronea cristana varies from almost black to nearly white, and the tufts in the wings vary in color from black, red, yellow, or white. The same difference also obtains in the shoulder markings and in the dashes on the inner edges of the wings. Several others of the *Peronea* differ in an equally remarkable manner amongst themselves, whilst one species, on the other hand, is very constant in color in this country.

Topomorphism.—I place under this class all local variations. These may be sufficiently constant as to admit of being considered subspecific or racial; and in certain districts the variation appears to take place in response to the geological environment. In the British Isles the most remarkable topomorphic variation is that of *Hepialus humuli.* This species which, so far as I am aware of, in England and Scotland has a silvery colored male, and a buff female with a few reddish markings; but in the Shetland Isles it appears to be subject to many variations, the coloring of the sexes being reversed both in the case of males and females; and some varieties being more melanic, so that the *Hepialus humuli* of those islands has been raised to a subspecific rank, *Hethlandica* by Staudinger, and as well as being topomorphic is also truly polymorphic. In the Outer Hebrides *Boarmia repandaria* departs from the normal coloration of that species as found in England, viz., various shades of brown, to a prevailing slaty gray, with darker markings. To this well-defined topomorphic variation I have ventured to give the name of *Sodorensium.* As an instance of a topomorphic variety dependent apparently on the geological environment, I know of no better example than that of *Gnophos obscuraria.* This insect on the chalk downs near Lewes is found almost white with dark markings, and of a light gray ground color, with darker markings; but on the peaty soil of the New Forest I have taken it in plenty of a very dark gray color, in some instances nearly black. Specimens obtained in limestone districts are of a brownish gray color.

Atavism.—In this class I place all variations which show a tendency to reversion to what I conceive to be a common ancestor. Of this I have a few illustrations in my cabinet, and singularly in that usually remarkably invariable species *Vanessa Io.* Several of the Vanessidæ have a row of blue spots on the margin of the wings, these are well seen in *Vanessa urticæ, V. polychloros, V. Antiopa,* and several foreign species. In *V. Io.* the blue marginal spots appear to be concentrated in the under wings into two large circular patches; but by careful examination of specimens, taken by myself in the New Forest, I find some have on the lower wings small blue spots in the dark color beyond these patches which, to my mind, are evidently traces of the row of blue spots which in *Vanessa Io.* have become differently arranged. In the Larentidæ, a family commonly known as carpet moths, the bulk of the species have a well-defined broad central bar; but this is more or less broken in some species, yet amongst them it is not unusual to find one with the central bar well defined. This I take to be a case of reversion to the markings of a common ancestor. *Cidaria corylata* in the normal form has the bar interrupted; but I have a specimen in which it is as complete as is typical of the genus. In *Melanippe hastata* the bar is usually interrupted, but I have one in which the bar is complete. *Melanthia rubiginata* has usually only the commencement of the bar at the costal edge of the wings, but frequently traces of the obliterated bar are found on the inner edges of the wings.

Dimorphism.—In this class I place all those insects which have two well defined types of color, generally without intermediate variations being found. The best type of this class found in the British Isles is *Argynnis paphia* and its dimorphic female form *Valezina.* In this case the normal coloration has red for the ground color of all the wings, but in *Valezina* the ground color is green. Although I have spent many days in the New

Forest in the observation of this species, I have never found a female of this insect which is other than either *A. paphia* or *A. valezina*, yet I have found a green shade somewhat pervading the female of the former to greater or less extent.

In *Clisiocampa neustria* dimorphism is well pronounced. I have both males and females of a yellowish buff and of a dark brown color.

Colias edusa and *Colias hyale* are both dimorphic in the female sex. Some of the females of the former are red and some yellow, and of the latter some are yellow and others white or nearly so.

Trimorphism in butterflies is not found in England, but attention has been drawn to it by Mr. A. Russell Wallace in the case of certain species of Papilio inhabiting the Austro and Indo Malayan Archipelago.

Papilio pammon, *Papilio theseus* and *Papilio ormenus* are all trimorphic in the female sex.

Horeomorphism.—In this class I place all those lepidoptera which appear twice a year, and with such a difference in their coloration that in many cases they have been held to be distinct species. The best illustration of this, found in Great Britain, is *Pieris Napi;* this insect appears in May and June and again in July and August. The males of the Spring emergence are almost white on the upper side, and the undersides of the secondary wings have their venations densely irrorated with dark grey. The Females on the upper side have the venations of the wings densely irrorated with gray on a whitish ground, and the undersides strongly suffused with the same color, denser at the sides of each venation. The males of the summer emergence have well-defined larger or smaller subapical black spots on the upper wings on a pure white ground, the sprinkling of gray near each venation on the underside being much less than in those of the spring emergence. The females have a pure white ground color to all the wings on the upper side, and the venations are well defined with black edgings; on the underside the irrorations on the edges of the venations are very much less pronounced. It appears from the researches of Dr. Weisman, that whether the insect presents the coloration of the spring or summer emergence, depends entirely on the time it remains in the chrysalis. The butterflies which appear in spring, have spent the winter in the chrysalis state; these lay eggs in June, which pass through all the stages of egg, caterpillar, and chrysalis states in a few weeks, appearing as perfect insects in the summer, but in the form of the summer emergence. Now Dr. Weisman has found that if the chrysalis, which in ordinary course would produce the summer emergence form, are prevented from developing, by being placed for a sufficient time in a cold place, say in an ice safe, they appear with the coloration of those of the usual spring emergence, or, in other words, in nature, A produces B, B A, and so on, but when thus retarded, A produces A entirely skipping B.

The hypothesis of the learned Doctor was that both forms were descended from *Pieris bryoniæ*, an Alpine single brooded form which perhaps existed over Europe during the glacial period, this species is very much darker than even the British spring form of the insect; that, as the climate became ameliorated, the insect gradually acquired the double brooded habit, and at the same time became seasonably Dimorphic, or, as I term it, Horeomorphic; he then proceeded to test the truth of this hypothesis, by forcing the insect back to its old condition of single broodedness, and with the result that the form, that of the summer emergence, least like *Pieris bryoniæ*, was eliminated. All this is well set forth in Mr. Raphael Meldolas' translation of the Doctor's work on this very interesting subject.

Some of the British species of *Ephyra* and *Ennomos* amongst the moths, and of *Lycæna* and *Polyommatus* amongst the butterflies are horeomorphic.

Ennomas illustraria is Horeomorphic, and it has been observed that out of one brood some of them will appear in the summer in the form of the summer emergence, whilst others remain in the pupa state all through the winter, and appear the next spring with the characteristics of those of the spring emergence. Other species of the genus *Ennomas* are equally marked in their Horeomorphism. This is perhaps the most interesting of all the forms of variation to which I have adverted. It is known to occur in several European butterflies. *Araschnia prorsa* has its Horeomorphic form *levana*, and its intermediate form *porima*, In America it occurs in a true papilio. Mr. Edwards, in his North American butterflies, gives an account of exceedingly interesting results he had obtained in breeding this insect, known under the names of *Papilio Ajax*, *Telemonides*, and *Marcellus*. This is a very complicated case, Dimorphism and Horeomorphism existing in the same species Mr. Edwards uses the old name of Ajax to include all the variations; *walshii*, and its sub-variety *abbottii*, for the spring emergence, and retains the name of *telemonides* for the intermediate form, and that of *marcellus* for those of summer emergence.

In conclusion I have to add that in each of the classes I could have given many more instances of the different conditions of variation, but I have restricted myself to a few cases only, which I deem sufficiently marked to illustrate the subject.

ABSTRACT OF A PAPER

READ BY

FRANCIS T. TAYLER, M.B., B.A., President,

ON

THE VIVISECTION QUESTION,

On DECEMBER 20th, 1882.

We cannot properly discuss this question without first inquiring into the amount of suffering inflicted by man on animals in other ways and for other purposes. A very slight investigation will show that animals endure sufferings at the hands of man, which pass in a descending scale from what may be designated the simply unnecessary to the most cruel and unjustifiable. Here are a few examples.

Assuming that the killing of animals is necessary to provide food, the amount of needless cruelty inflicted on them in the streets, on board steam-boats, and in slaughter-houses, is probably known only to few.

Thousands of animals are sacrificed every year in order to provide materials for personal adornment.

A countless number of animals suffer severely by the cropping of ears, docking of tails, and other mutilations inflicted for mere convenience or caprice.

The pursuit of sport causes an amount of suffering which can scarcely be estimated. We have examples in the use of live bait by fishermen, the maiming of animals in shooting, and especially trapping game. As far as we can judge the suffering endured by a hunted fox or hare is horrible in the extreme.

When we put all this against the pain inflicted by vivisection the latter becomes almost lost to view. Professor Lister considers that more suffering is inflicted in one day's battue shooting than in a year's vivisection.

The horse-breeder, the stock farmer, the sportsman, may do all these things to their heart's content; but the Scientist cannot move without the risk of instant prosecution.

The opinion is held by many that all animals are equally sensitive to pain. This view is supported only by conjecture. There is the strongest evidence to the contrary. Polyps when cut to pieces do not die, but each piece is developed into a new creature: this is only one out of scores of examples which could be quoted.

Because animals usually manifest suffering by certain sounds or movements, it must not be assumed too hastily that the manifestation of these movements or sounds necessarily indicates pain. A paralysed and insensible limb is often drawn forcibly away when touched. We are told that a recently-decapitated horse will, when skinned, kick out with sufficient force to cause severe injury, if the spinal cord has not been previously destroyed. Such facts must not be forgotten in trying to distinguish the *real* from the *apparent* suffering during a vivisectional experiment.

We are very apt to form exaggerated notions as to the amount of suffering caused by cutting operations. We mostly estimate it from the pain of a scratch or other injury of the skin, which is known to be more severe than that of a deep cut by a sharp knife. Cutting operations are frequently performed on the eye, which is usually considered an extremely sensitive organ, without chloroform, and without the production of severe suffering.

People who know nothing of vivisection—probably forming their ideas on this subject from certain horrible pictures which were to be seen a short time ago stuck on the walls in various parts of London—seem to think that usually animals are nailed down to boards and hacked to pieces in the most horrible fashion, while the whole neighbourhood is aroused by their hideous cries. As a matter of fact, the experiments of many investigators have scarcely ever exceeded the injection of certain materials under the skin—an operation performed many times every day by individuals upon themselves—or the feeding of animals upon noxious materials.

When painful experiments are performed, we have the word of all the English Physiologists, that anæsthetics are always used when possible, and that there is not one case in five hundred in which their use is not possible. Experiments are most frequently made on decapitated frogs. The Secretary of the Society for the Prevention of Cruelty to Animals, after investigation, bears testimony to the absence of cruelty in any form.

According to Burdon Sanderson, not more than sixteen people in England practise vivisection. Nothing, or next to nothing, is done outside the great schools, and only in some of these. These experiments can only be performed in special laboratories owing to the expense and complexity of the instruments required.

Painful experiments are regarded with aversion by both Professors and pupils. All the Lecturers in London agree that public opinion among students is such that they would not dare to perform a painful experiment before a class. There appears to be less sensitiveness in this respect on the Continent, but of this there is no actual proof. Acts of Parliament passed here cannot influence doings abroad, and to punish Englishmen for the sins committed by foreigners is useless and absurd.

The next question is, has any good been derived from these experiments? Such competent authorities as Burdon Sanderson and Humphry say that the practice of vivisection and the advance of physiological science go hand in hand, and consequently we owe nine-tenths of our physiological knowledge to continental observers. The importance of the discovery of the Circulation of the Blood cannot be doubted. It has been gradually made out principally through vivisectural experiments commenced 1700 years ago by Galen. Harvey distinctly states that it was by vivisections practised almost daily that he was able to make out the functions of the heart and the circulation through the lungs. The completion of the scheme was made by Malphigi, who discovered the capillaries in vivisected frogs.

It was by vivisection, Sir Charles Bell tells us, that he made his important discoveries as to the functions of the spinal cord and nerves. He showed that the facial nerve was a motor and not a sensory nerve, and so put an end to the useless practice of dividing it for facial Tic. He also showed how to distinguish one form of facial paralysis of little or no consequence from another which portends the greatest danger. This was done by an experiment scarcely more painful than the prick of a pin. He showed also that a man was not necessarily an imposter who moved his legs when they were touched, although he said they were paralysed. The discovery by Bernard and Pavy of the glycogenic function of the liver would have been absolutely impossible without experiments which necessitated the death—though without pain—of certain animals. Upon its importance in relation to diabetes I need not dilate.

Surgery owes much to vivisection. Soon after the discovery of the circulation of the blood it was demonstrated that Transfusion was a feasible and often a life-saving operation. Further vivisectional experiments have shown that if air or clots are allowed to enter with the blood the death of the patient will rapidly ensue. The establishment of facts such as these is surely worth the sacrifice of a few dogs.

In the arrest of hæmorrhage our advance from the use of hot irons and such like barbarous practices to the employment of the antiseptic animal ligature, could only have been accomplished by one method, viz., the study of the changes which occur in the occluded arteries at different periods, and this could of course only be done on animals. Lister, while strongly averse to the performance of vivisectional experiments, expressly states that, but for the knowledge he obtained from them, he could never have worked out his antiseptic method, a system which has quite revolutionised modern surgical practice.

Although before the time of Dr. Hope it was known that the beating of the heart gave rise to certain sounds, and that these sounds were altered by disease, everything beyond this was in a state of chaos and uncertainty. By vivisectional experiments he was able to explain the causes of these sounds, and so enable us to determine by the stethoscope the presence or absence of most forms of disease in that organ. Every holder of a policy of life insurance benefits by this discovery in the way of diminished premiums.

It has been said that drugs act differently upon men and animals. This is no doubt true in a certain number of instances, but it is by no means the general rule. We have derived important information as to the effects of drugs from experiments on animals. Chloral hydrate, nitrite of amyl, and digitalis afford examples.

The same may be said with regard to poisons. As the late Dr. A. S. Taylor—a most competent observer—remarks, the quantities of poisons which will kill a dog or a human being, as well as the symptoms produced, are much the same. As to the practical utility of experiments on animals in this direction the following instance must suffice:—

Dr. A. S. Taylor relates the case of a child who died of arsenical poisoning, and arsenic was found in the stomach. The mother was tried for murder. She pleaded that she had merely applied arsenic to the head for ring-worm. The question was, could this explain the case. No one could tell. Was a murder to go unavenged, or an innocent woman to be sacrificed, or was a rabbit to be killed? I am glad to say the last course was adopted, and the woman's statement was justified.

Murder was brought home to Dr. Pritchard of Glasgow, and more recently to Lampson, by experiments on animals.

In another department, Pasteur has recently shown that the poisons of chicken cholera and splenic fever may be so dealt with that a so-called "vaccine" can be produced, which has the power of rendering animals impervious to those diseases. The importance of this discovery can be estimated from the fact that France loses every year by Splenic Fever animals to the value of of not less than a million sterling. Obviously the discovery could not have been made without the sacrifice of a few animals.

Much time has been wasted in trying to show that in some discoveries vivisection has not been our sole source of information. We often pass from ignorance to knowledge by bridges constructed of many arches, but the absence of any one of these would render the passage impossible.

Surely if it is justifiable to kill animals in large numbers for the mere pleasure of killing, or to obtain ornaments for the person, or even for food, and if it is justifiable to mutilate them for our mere caprice, surely it cannot be wrong to sacrifice a few when the problem to be solved is the saving of life or the prevention of disease. Gentlemen, picture yourselves by the sick bed of a loving wife or child, dearer to you perhaps than your own existence. The question of life or death turns upon the correct appreciation of some Pathological fact or the proper employment of a potent drug. Would you think it too much to sacrifice a mouse, a rabbit or two, or even all the horses in your stable, to acquire the information? It is too late now. These experiments must be carefully conceived and skilfully executed in the cool leisure of the laboratory, and then they are available, not for one but for all; and I have the highest authority for saying that "Ye are of more value than many sparrows."

ABSTRACT OF A PAPER

READ ON

JANUARY 24TH, 1883,

BY

J. MORRIS STONE, Esq., B.A.

(Being a continuation of a paper read before the Society, April, 26th, 1882),

ON WASPS

(From observations by the late Stephen Stone, Esq., F.S.A., Hon. Member of the Ashmolean Society).

In my former paper I made a few remarks of the habits and social economy of Wasps, to night I propose to turn your attention more especially to what may be looked upon rather as their misfortune than their habits.

One of the greatest misfortunes that can happen to a family of wasps, and is one to which, by reason of the uncertainty of life, they must now and then become subject, is the loss of their queen. She is the originator of the nest, and seemingly the director of all that goes on within it. The question naturally arises what becomes of the nest if, from any cause, it is deprived of her presence? In the case of the honey bee it is well known that, if such a catastrophe overtake the hive, the workers proceed to feed one of the newly hatched larvæ with the royal food, which differs in some marvellous way from that on which the larvæ of the workers and neuters are fed, and this has the effect of changing the status of the favoured one from that of a common worker to that of a fully developed queen. Kirby and Spence tell us that it takes only 13 days for this wonderful transformation to take place. Within a couple of days she may begin to lay eggs, so that, in little more than a fortnight, the *status quo* is restored, and all goes on well.

This, however, is not the case with wasps. Nature has provided for them a different means by which, on the loss of their queen, the cells may for a time be replenished with eggs, and the workers may indulge their propensity for the work of feeding and tending larvæ and of enlarging the nest, which the increase of their numbers entails.

The workers, that is the hitherto *abortive* females, become in a marvellous manner, indued with the power to lay eggs. It has been found, according to Dr. Ormerod, that the eggs laid by the workers, produce only male brood. The nest is continued for a time, though with the queen all order and regularity vanish; cells are built crowded together in the most disorderly style, and numbers of eggs are laid in the same cell, so that it is impossible for the larvæ, when they emerge, to grow to their proper size.

Two nests of V. Rufa, in which the queen had perished on account of the wetness of the season, were taken from their natural cavity. Each contained a single comb, that in the one about an inch and a half in diameter and that of the other about an inch. The cells in each contained a profusion of eggs, as well as larvæ of various sizes. In many of the cells the larvæ had become full-fed and had spun themselves up, in which case, as well as where they had attained to anything like their full size, they occupied each a separate cell, while each of the remaining cells contained either a group ot eggs or a number of larvæ. Both these colonies consisted of workers of the ordinary size, the whole of which were carefully secured, and in both instances fresh eggs continued to be deposited by them after the nests had been removed and had been placed in a favourable situation for work.

In order to ascertain what proportion of the workers possessed the power of producing eggs, the whole number were chloroformed so as to cause them to

"Sleep the sleep that knows no waking,"

and then a post mortem examination of the bodies was made, the result of which was that in each case one in every five or six was found to contain a mass of eggs, some ready for extrusion, others in a less advanced state. A number of these eggs preserved in spirits, and also the insects from whose bodies they were extracted, were placed in the hands of Mr. F. Smith of the British Museum.

Wasps, like different kinds of birds, seem to affect particular localities; for in some districts, even in the most favourable seasons, you will have great difficulty in meeting with a single nest, while in others you will rarely fail to find several even in unfavourable seasons. Nor does the employment of artificial means appear to be more effectual in inducing these insects permanently to establish themselves in new localities, than it does to induce the nightingale to extend its visits and take up its residence beyond the geographical range assigned to it by nature; for although many nests have been transplanted from a neighbourhood where they abound to one where they were comparatively scarce, there did not in a following season appear on that account to be one nest the more in the place to which they were brought.

What then became of the host of young females that issued out of these nests? They could not all have perished! They were doubtless led instinctively far away from their birthplace into localities more accordant with their habits, or more favourable to the perpetuation of their kind.

What becomes of all the young queens, which in the Autumn leave the nest in which they were reared, can only be a matter of conjecture, but it does appear strange that so few should succeed in founding colonies in the ensuing spring.

Their destruction may be accounted for in many ways, from the effects of weather and the like; but numbers are known to meet their fate in deadly affrays with each other, for the ownership of some building site to which both have taken a fancy. Many contests of this kind are on record. Observation also goes to shew that a large number are destroyed by toads which artfully conceal themselves in holes likely to be selected as receptacles for nests.

Wasps appear to be very liable to the attacks of parasitic insects, which lay their eggs in the nest to the injury and destruction of the legitimate occupants of the cells.

It seems almost incredible that various species of small Diptera should be allowed with impunity to enter a densely populated wasps' nest, and to deposit their eggs therein, when, in all probability these same flies, if met with outside the nest, would be pounced upon as legitimate quarry, and made to serve as food for those very larvæ which are destined to become food for their progeny; the more wonderful does this appear when we consider the reception, warm enough in all conscience, but by no means hospitable, which is accorded to *wasps* which happen to be of a different species from the legitimate occupants of the nest.

They are further subject to the attacks of a parasite beetle —Rhipiphorus Paradoxus—which deposits its eggs in large numbers in their nests. For some time, though this insect was found in large numbers in the pupa and perfect state, the larva could not be found and the method of attack on the unfortunate embryo wasp who happened to occupy the same compartment as the assailant was unknown. On the 19th of August, 1864, Mr. S. Stone was fortunate enough to discover one in a nest of V. Vulgaris, and on proceeding to open the cell containing it he found the parasite firmly attached to a full-grown larva of a wasp; the mouth of the former buried in the body of the latter just below the head, its neck bent over that of its victim, whose body appeared to be tightly compressed by that of its destroyer, showing the latter to be possessed of a considerable amount of muscular power. It was of minute size when discovered, and appeared to have only very recently fastened upon the body of its victim; but so rapid was its growth, and so voracious was its appetite, that, in the course of the following 48 hours, it obtained its full size, having consumed every particle of its prey with the exception of the skin and mandibles, which from observations made it appears these creatures retain in their grasp even after they have passed into the pupa state. They appear to scarcely cease eating, except now and then for a minute or so, from the time they first begin to feed till they have become full-grown.

In another nest, taken out on the 2nd September, was found on opening some closed up cells appropriated to queens, one larvæ and one pupa which differed in nothing that could be discovered from those of Rhipiphorus found in the cells of workers except that they were something like double the size, in fact, about as much larger as the larvæ and pupæ of Queen wasps are larger than those of workers.

It appears, like some of our butterflies, such *e.g.* as C. Edusa and V. Antiopa, to disappear altogether during some seasons and then to reappear in more or less considerable numbers.

In the year 1859 Rhipiphorus was found in Cokethorpe Park, Oxfordshire, but, though diligent search was made for it in the following years, not a single specimen was discovered there till the year 1864, when those I have described were found. What had become of them during the intervening summers is a question more easily asked than answered. Like many other insects, P. Machaon and P. Actaeon, for example, these parasites appear to be very local. In the neighbourhood where the above were found it was never known to exist beyond a space of ground measuring about four furlongs in length and two in breadth.

In my former Paper I mentioned the fact that workers from one nest of V. Germanica had been observed to desert and join another nest of the same species. In 1864 a nest was formed under the management of Mr. S. Stone, in the formation of which V. Vulgaris and V. Germanica both took part. This is believed to be the first instance observed of two species living and working harmoniously. The same season, however, another instance was observed in which the two nests were situate in their natural positions.

The species were, as before, V. Germanica and V. Vulgaris, the latter being as before the intruder on the former. These two nests were situate in a drain with the entrances near together, and the explanation seems to be that the one nest was mistaken for the other. It is a remarkable fact, and one worth noticing, that in both cases it was only V. Vulgaris that made the mistake, if such it was, for no specimen of Germanica was found in the nest of Vulgaris,—unless, indeed, mistakes having been made, they were in every case at once rectified by the exclusion or punishment of the intruder.

Whether any further research has been made in this direction I am unable to say, but I believe that the two instances recorded above of one species of wasp being allowed to enter and work in a nest of another species are quite unique, though in the case of bees such a thing is by no means uncommon.

RULES.

(As amended at the Annual Meeting, 22nd February, 1882.)

—o—

1.—The Society shall be called The West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research, and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s. in one sum. All subscriptions shall be due on 1st January in each year.

3. The affairs of the Society shall be managed by a Council consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the menbers present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceeding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20 —The Council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.*

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Wood, Henry T., Little Bognor, Fittleworth, near Pulborough, Sussex.

CATALOGUE OF THE LIBRARY.

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" On the *Pterodactyles* of the Chalk Formation; 8vo.; 1851.

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" On the Expressions of the Emotions in Man and Animals; 8vo.; 1872.

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Huxley, T. H.	The Oceanic *Hydrozoa;* 4to.; 1859. (*Ray Society*).
"	Evidence as to Man's Place in Nature; 8vo.; 1863.
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Lankester, E.......... .	Half Hours with the Microscope; 8vo.
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Newman, E...............	Is the Mud-fish a Fish or an Amphibian? 8vo.; 1859.
"	An Essay on the Employment of Physiological Characters in the Classification of Animals; 8vo.; 1856.
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Eastbourne Natural History Society. 1870-82.
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The following have been received during the session 1882-83 :—

REPORTS, &c.

Croydon Microscopic Club. 2nd Report. 1872.
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Ealing Microscopical and Natural History Club. 5th Annual Report. 1882.
Eastbourne Natural History Society. 1882.
East Kent Natural History Society. 24th Annual Report. 1881.
Epping Forest and County of Essex Naturalists' Field Club. Part VI.
Erith and Belvedere Natural History and Scientific Society. 4th Annual Report. 1882.
Hackney Microscopical and Natural History Society. 5th Annual Report. 1882.
Lewisham and Blackheath Scientific Association. 3rd and 4th Annual Reports. 1881-82.
Postal Microscopical Society Journal. No. 1. 1882.
The Scientific Roll. Parts VII.—X.

N.B.—The Library is in the Hall of the Mission School, Blackheath. Members can obtain or return Books by personal or written application to the Rev. E. Waite, the Head Master; or on the evenings of the ordinary Meetings.

Note.—All communications should be addressed to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E., and Post Office Orders should be made payable to Henry Hainworth, at the Post Office, Blackheath Hill.

HENRY HAINWORTH, } *Hon. Secs.*
HUGH WILSON, }

Crockford, Steam Printing Works, Greenwich, Lewisham, and Blackheath.

MEETINGS OF THE SOCIETY

FOR THE SESSION 1883-84.

WEDNESDAY,	MARCH	28
,,	APRIL	25
,,	MAY	23
,,	OCTOBER	24
,,	NOVEMBER	28
,,	DECEMBER	19
,,	JANUARY (1883)	23
,,	FEBRUARY ,, ANNUAL	27

THE CHAIR IS TAKEN AT 8 O'CLOCK.

THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

W. H. CROCKFORD, GREENWICH, LEWISHAM, AND BLACKHEATH.

WEST KENT

Natural History, Microscopical and Photographic Society.

THE

PRESIDENT'S ADDRESS, PAPERS,

AND

Reports of the Council & Auditors,

FOR 1883-84.

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

1884.

PRINTED BY E. G. BERRYMAN, 84, BLACKHEATH ROAD, GREENWICH.

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LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 28th, 1883,

FOR THE SESSION 1883-84.

President.

F. T. TAYLER, M.B., B.A.

Vice-Presidents.

T. O. DONALDSON, M.Inst. C.E.
W. GROVES (Lee).
W. G. LEMON, B.A., LL.B., F.G.S.
FLAXMAN SPURRELL, F.R.C.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

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H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
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B. GUEST.
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STUART KNILL.
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E. R. PEARCE.
H. T. STAINTON, F.R.S., F.L.S.
J. MORRIS STONE, B.A.
J. JENNER WEIR, F.L.S., F.Z.S

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 27th, 1884,

FOR THE SESSION, 1884-85.

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President.

REV. A. JOHNSON, M.A., F.L.S.

Vice-Presidents.

R. MCLACHLAN, F.R.S., F.L.S., &c.
FLAXMAN SPURRELL, F.R.C.S.
H. T. STAINTON, F.R S., F.L.S., &c.
F. T. TAYLER, M.B., B.A., &c.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
J. DEWICK.
T. O. DONALDSON, M. Inst. C.E.
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W. G. LEMON, B.A., LL.B., F.G.S.
E. R. PEARCE.
FRED. W. SMITH.
J. MORRIS STONE, M.A.
J. JENNER WEIR, F.L.S., F.Z.S.

REPORT OF THE COUNCIL,

For the Session, 1883-84.

The Council have much pleasure in reporting that the Society now numbers 112, viz.—7 Honorary, 6 Life, and 99 Ordinary Members, an increase of 8 during the past Session.

The accounts of the Honorary Treasurer have been audited, and shew a balance in hand on the 31st December, 1883, of £7 14s. 3d., on which date there was due to the Society the large sum of about £40 on account of subscriptions still outstanding.

Members are reminded that subscriptions are payable *in advance* on the 1st January in each year.

At all the Ordinary Meetings during the past Session, Papers have been read, and objects exhibited which have afforded material for interesting discussion.

The Soirée was held on Wednesday, the 9th May, 1883, in the Rooms adjoining the Blackheath Congregational Church, which were kindly placed at the disposal of the Society for that occasion. The Soirée proved in every way a success. The number of ladies and gentlemen present was larger than usual.

The Council tender their hearty thanks to Mr. Wainewright for the loan of his plants and flowers, and to the Members of this and other Societies for their interesting and valuable contributions.

The Ladies' Field Meeting was held on the 22nd June. As on every former occasion the Meeting was attended by 32 Ladies and Gentlemen. The party proceeded by rail to Maidstone, and thence drove to Leeds Castle, the grounds of which they were allowed to inspect by the kind permission of Mrs. Wykeham Martin.

On the 14th July, the Members and their friends dined together at the "New Falcon" Hotel, Gravesend. The President made some remarks on "The Natural History of Eels," which gave rise to an animated discussion.

On the occasion of the Annual Cryptogamic Field Meeting, held on the 6th October, Messrs. Collingwood, Mitchell and Stapley courteously invited the Members to visit their grounds at Abbeywood. Dr. Spurrell kindly conducted the party. The Fungi collected were named by the Rev. A. Johnson, M.A., F.L.S., and a list is given below.

The Library has been examined, and the catalogue will be published with the Report. Members desirous of obtaining Books are referred to the note appended thereto.

In conclusion the Council earnestly invite the co-operation of the individual Members in promoting the welfare of the Society, both in bringing forward matters of interest at the Ordinary Meetings, and by introducing New Members.

LIST OF FUNGI FOUND AT ABBEYWOOD, 6th OCT., 1883.

Amanita rubescens.
Armillaria melleus.
Clitocybe laccatus.
Russula alutacea.
Lactarius quietus.
Hypholoma sublateritius.
            fascicularis.
Psalliota campestris (variety nortensis).
Boletus chrysenteron.
            subtomentosus.
            bovinus?
Lenzites betulina.
Scleroderma vulgare.

AT THE INN.—Lycoperdon giganteus. Coprinus comatus.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY,

For the Year ending 31st December, 1883.

RECEIPTS.				£	s.	d.
Balance in hand on 31st December, 1882 ...				27	7	11
Life Subscriptions received in 1883				10	10	0
ANNUAL SUBSCRIPTIONS.						
For the year 1881	£1	1	0			
" 1882	3	13	6			
" 1883	26	15	6			
" 1884 (in advance) ...	0	10	6			
				32	0	6
				£69	18	5

PAYMENTS.				£	s.	d.
Expenses of Meetings and Refreshments	£3	6	5			
Donation for use of Room, &c. ...	6	5	0			
Insurance of Books, &c.	0	5	0			
Cost of Journals, &c.	1	2	11			
Stationery, Postage, &c.	6	14	6			
Printer's Bill and Diagrams	25	6	6			
Fee to Assistant	5	5	0			
Expenses of Soirée	13	18	10			
				62	4	2
Balance in hand on 31st Dec., 1883 ...	7	14	3	7	14	3
				£69	18	5

Audited and found correct,

J. JENNER WEIR, }
J. H. RITCHIE, } *Auditors.*

22nd February, 1884.

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, & PHOTOGRAPHIC SOCIETY,

BY

The President, F. T. TAYLER, Esq., M.B., B.A.,

On the 28th FEBRUARY, 1884.

Gentlemen,

We have met to-night to celebrate again the Anniversary of our Society. If these now oft-repeated commemorations tell us that our Institution is growing rather old we are not ashamed to confess the fact, we are on the other hand rather proud of it. Our Annual Report, which will shortly be in your hands, is in its present form so complete that little is left for me to add. Our progress, if not rapid, has been steady, as is shown by the increase in the number of our members. There is one matter, however, about which I should like to say a word, and that is the Balance-sheet, which you have just heard read. Our financial position is not altogether such as we should wish it to be. This has arisen, no doubt in some degree, from increased expenditure, which has been unavoidable, but principally from the fact that a very considerable number of members have allowed their subscriptions to fall in arrear. I trust that the mention of this matter will remove a source of trouble and anxiety to the Executive Officers of the Society.

Gentlemen, when I last had the privilege of addressing you, I dealt, as fully as time permitted, with the various facts and questions concerning *Bacteria* in their relation to dead organic matter. To-night I propose to complete my subject by laying before you some of the more important points concerning the part played by these organisms when present in the bodies of living animals, in other words concerning their relationship to certain diseases. I must ask your pardon if I fail to make the subject as clear as could be wished; for our knowledge is at present only fragmentary, and the investigation of the question is beset with difficulties, not only in conducting experiments, but also in reasoning correctly from their results.

To the outsider it may possibly appear that the theory of the production of certain ailments, and their communication from one individual to another by means of living organisms is altogether a new departure in the study of disease. It is not so; on the contrary the enquiries of scientific observers have gone on step by step until the minds of Pathologists were in a condition at once to accept such a discovery, as the completion of what may be considered to be a true scientific induction. I hope I shall not be wasting your time if I occupy a few moments in explaining what I mean.

Without giving a regular history of the subject, I may say that we have probably come to our present state of knowledge somewhat in the following way:—If we examine the condition of a sick man, we find that the physiological functions impelled by some morbific influence, have lost their natural equilibrium. On the medical side we see, perhaps, fever, headache, and the like; on the surgical side, possibly pain, swelling, redness, and the other conditions of inflammation. The old professors of the healing art imbued with the teachings of the Ancient Schools of Philosophy speculated upon the nature of these Phenomena, and invented various theories more or less absurd to account for them. Theories which bore the stamp much more of the library than of the bedside or the dissecting room.

After a time it was noticed that in certain cases not only were these general disturbances present, but there were also developed some special symptoms which were peculiar to the disease in question, and that these symptoms were invariably present in some form in every instance in which this particular malady occurred. Further, when the disease spread (as most of those in question do), it, so to speak, always bred true —Small Pox always produced Small Pox, Scarlet Fever, Scarlet Fever, and so on. Sydenham observed that in this respect they were propagated just as truly as plants and animals. Varieties might appear from time to time, but there was nothing like the production of new species. These facts being established the diseases in question came to be looked upon as distinct entities, and so to be called *Specific Diseases*. When the same set of phenomena were observed to present themselves over and over again, with such regularity that a skilled observer, coming on the scene at any moment, could state with something like certainty what had already taken place, and could also predict what was about to follow, it was only natural to think that the results being so constant, the causes should also be constant. What were the causes? Argument from analogy helped very much to elucidate this problem. It was observed that if any given poison was administered to an individual, not only were symptoms of general illness developed, but also certain special indications appeared, just as these specific diseases, by which the special poison could be recognised. Mercury, Lead, and Phosphorus, Ergot of Rye afford examples. Again, if a healthy man dwelt for a time in a marshy district, he certainly took into his system something which would sooner or later set up an illness of a very definite character, although that illness might not show itself until after he had left the malarious district. Observations of this kind naturally led to the idea that these diseases were due to Specific Poisons, and so Physicians came to speak of the poison of Small Pox, the poison of Scarlet Fever, and so on.

An important difference, however, will be at once noticed between these two classes of poisons. In the first the noxious material enters the system, does its work, and there the matter ends. With the second class it is quite different. A fraction of a drop, say of the virus of Small Pox, is inserted under the skin of a healthy man. After a time a number of vesicles appear upon his body, each of which is capable of yielding much more virus than he received, and if he happens to mix freely in a community, it will not be long before many more persons are afflicted in the same way, each one developing a larger or smaller number of vesicles; every one filled with the same poisonous material, so that at the height of the epidemic the poison has been multiplied millions upon millions of times. In seeking for an explanation of this, it was noticed that analogous phenomena were to be seen in the process of fermentation. "A little leaven leavens the whole lump." A very small portion of fermenting material will in time set the whole mass in fermentation, and any small portion of this will start a similar process if again applied to fresh material. People saw that the action of Small Pox poison and similar diseases was so like that of a ferment that they considered these disorders were due to a kind of special fermentation or Zymosis. This theory which came so near to the truth was, nevertheless, afterwards abandoned. The expression is, however, still used, the term Zymotic Diseases having been introduced by Dr. W. Farr, I think, in the year 1841.

When a previously healthy man, after contact with a patient sick of a contagious disease, subsequently develops in himself an identical malady, it is only reasonable to suppose that something passed from the sick man to the healthy one, which set the process going. This hypothetical something, this poison, has hitherto eluded the grasp of all seekers. It received at one time the name of *materies morbosa* or *materies morbi;* however, by whatever name it was called, it was only known by its effects. As time went on fresh facts came to light. It was noticed that the infecting material, whatever it was, could not only pass directly from one individual to another, but that it could be conveyed long distances, and that it retained its potency for long periods. People in this country were infected with diseases through materials brought from the other end of the world. Epidemics reappeared in ships and houses long after the patients had been removed from them, and even after they had been, as was supposed, thoroughly disinfected. Men said is this not exactly what would occur if we were to imagine the infecting material a seed which remains dormant until it finds a suitable soil in which to grow? This view of the question obtained so much favour that out of it developed what is known as the germ theory, or more strictly, the theory of *contagium virum.* Those opposed to this view objected that as nothing in the nature of a germ had ever been seen, what proof is there that the contagious material is not a virulent chemical poison, or, if not that, an unorganised ferment, similar to pepsine for instance? The answer is, first, if it were a chemical substance, it would act as such, and when its force was expended the process would cease. Again, although unorganised ferments have the power of causing change in other substances without undergoing alteration themselves, we have no knowledge of any such substance having the property of spontaneous multiplication. Nothing in fact explained the phenomena so well as the idea that the *contagium* was a living organised substance. Many accepted the theory, not as proved, but as a working hypothesis which answered better than any other.

It was in the year 1856 that Pasteur first published the results of his researches into the nature of fermentation, into the details of which I entered on the last occasion. You will recollect that he showed that fermentation and decomposition were invariably associated with the presence of minute organisms, and that the insertion of the minutest portion of liquid containing these organisms, immediately started the fermentation process in another liquid, up to that time quite pure and fresh. Pathologists saw at once the resemblance of these processes to those as seen in disease. The insertion of a small quantity of infecting liquid was exactly similar in this respect to the inoculation of small pox virus or vaccine. Chauveau of Lyons afterwards investigated the nature of the liquid obtained from the small pox and vaccine vesicles. It was obvious that the *contagium* existed in the liquid, but what was its nature? By a careful series of experiments he was able to filter out solid granular matter from the liquid portion, and to ascertain that this granular matter alone contained the poison. These granules, according to Sanderson, consist of transparent particles from the 50,000th to 20,000th of an inch in diameter.

Little further advance was made until 1865, during the inquiries of the Cattle Plague Commission. Dr. Lionel Beale then stated that swarms of extremely minute particles were found present in the textures and juices of the infected animals, and these he believed to be the *contagium* of the disease.

In the following year Rindfleisch showed that the minute metastatic deposits sometimes seen in the heart in cases of pyæmia and other infective diseases were not really abscesses as they had hitherto been considered, but were really aggregations of *vibriones*. Not to weary you with too much detail, I may say at once that since that time minute organisms have been found to be associated with a considerable number of diseases such as Diphtheria, Pyæmia, Puerperal Fever, Typhus, &c.

You will say, no doubt, that the mere presence of organisms in these cases, does not prove that they acted as causes. Their existence may have been altogether accidental, or they may have appeared late on the scenes merely as parasites, in a material undergoing, or ready to undergo, a sort of decomposition. The truth can only be discovered by observation and research. Now obviously the necessary experiments can only be conducted on the lower animals, and so many diseases must be left untouched, but if the truth of the proposition can be established in one or more cases, it becomes more and more probable for the rest. Let us now examine the evidence.

As I said before, the investigation of this question is attended with the greatest difficulty; not only must the highest powers of the microscope be employed, but special reagents are also necessary. It is easy enough in the case of a more or less transparent vegetable or animal infusion to discover Bacteria when they exist in large numbers or are aggregated into *Zooglæa* masses, but it is very difficult when they are isolated and embedded in the meshes of a complex tissue. We are not surprised then to find that many mistakes have been made. Bacteria have been said to be discovered where none existed, and their absence has equally been declared when they were really present.

It is to Professor Koch that we owe very much of the recent improvements in the methods of investigation, and I ought to say here something about them.

Von Recklinghausen employed acids and alkalies in the form of weak solutions of acetic acid and of caustic soda or potash. In microscopic preparations granular matter is often seen which really belongs to the tissues, but owing to its form and size it cannot be easily distinguished from spherical Bacteria; the acids and alkalies have the power of dissolving this matter, leaving the Bacteria unaffected. Koch observed that this method was very useful in the case of large Bacteria and *Zooglæa* masses, but it failed with the more delicate specimens because the granular matter was sometimes unaffected while the smaller Bacteria were destroyed. Various stains were then experimented with, among others Hæmatoxylin was tried, but it does not stain rod shaped Bacteria at all, and the spherical forms only a little, so that although it was useful, it was not satisfactory. Weigert introduced the use of Aniline dyes using principally Methyl-violet. Koch worked at this method, and found that by using various Aniline dyes and by manipulating each tissue in a way special to itself, he obtained much better results. He came to the conclusion, however, that though the method is good for large Bacteria, it is difficult for smaller, and useless for the smallest, so that something more was required. When taking micro-photographs of Bacteria embedded in Canada Balsam, he observed that the image consisted of a *structure* picture and a *colour* picture, and that by varying the illumination either one could be increased at the expense of the other. If the diaphragm is small the illuminating rays approach parallelism and the structure picture is most distinct. If on the other hand you use a large diaphragm and flood the picture with convergent rays, you make the structure less distinct but the colour becomes much more obvious. Now in examining a section of tissue containing perhaps a few stained Bacteria, the numerous lines and shadows of a complex structure entirely obscure the minute organisms, but when the cone of rays is gradually widened the structure becomes more and more obscured, and at last the coloured organisms become visible. He tells us he did not find the means of accomplishing this satisfactorily until he came upon a condenser arranged by Abbe and constructed by Zeiss of Jena, which gave a pencil of 120° of aperture. He relates that when making experiments on Septicæmia in mice, although he was morally certain that Bacteria were present, he was unable, even after much diligence to find them, until he employed the condenser of Abbe to which he had added a regulated series of diaphragms.

Beyond matters of detail I do not know that up to the present time any material improvement has been effected in the methods of research in this department. No doubt, as time goes on, further advances will be made, and so the solution of the problem be more nearly approached. My special object in entering into these details was to show that, however difficult it may be to prove the presence of Bacteria, how more so it is to prove their absence, a matter of not less importance in a discussion of this kind.

Before we go any farther, the question suggests itself naturally, *Do Bacteria exist in Normal living Tissues?* This, like every other point on this question, has been fought over very vigorously. The weight of evidence is certainly in favour of the negative answer. Koch holds this opinion, and he is supported by such able observers as Burdon-Sanderson, Pasteur, Klebs, and others. I cannot stop to enter into particulars beyond saying that the battle was fought over the nature of certain minute particles discovered to exist in the blood, and which some held to be of the nature of Bacteria.

Next we know from the experiments of Pasteur, about which I have already spoken, that the air is full of infecting particles. *Is the healthy body affected by these Particles?* To determine this point Burdon-Sanderson pumped a large quantity of air through the cellular tissue of rabbits, which, however, remained quite unaffected.

He then injected a small quantity of water into the Peritoneal cavity, but with negative results. Then he injected water charged with Bacteria, bred in an innocent soil. Water and Bacteria were all absorbed, and abundance of the organisms were found in the blood vessels and lymphatics, but no harm resulted beyond that caused by the plugging of the small arterioles by the masses of organisms.

With these preliminary observations we may now inquire into what is known of the relation of Bacteria to disease. Two classes of diseases have been separately studied from this point of view. First, disorders arising out of wounds, which naturally come under the notice of the Surgeon, and secondly, general diseases, which belong more strictly to the Physician.

We know that wounds are prone sometimes to take on an unhealthy appearance. The discharges become fœtid, and at the same time the patient begins to suffer from constitutional symptoms, which frequently end in death. This ailment is known as Pyæmia or Septicæmia, according to whether local abscesses are formed or not. This state of things is specially apt to arise if the patient is exposed to insanitary conditions, or if he is in proximity to other similar cases. Sir Joseph Lister held that the first cause of this change was putrefaction of the discharge, due to contamination from the air. You recollect his experiments on milk, which showed, among other things, that souring milk contains a special organism which is rarely found except in and about dairies, and to which he gave the name of *Bacterum Lactis*. The outcome of these experiments was the establishment of the Antiseptic method of treatment of wounds, which has been attended with so much success, and has been accepted even more fully abroad than in our own country.

Much good work was also done on the Continent. In 1866 Rindfleisch showed that not only were organisms present in the wound, but that they were also to be seen in the tissues, and Von Recklinghausen and Waldeyer traced them into the walls of the metastatic abscesses of Pyæmia. Birch-Hirschfeld showed that the unhealthiness of the wound was directly related to the number of organisms to be found there. He further detected them in the blood, and showed that the severity and rapidity of the general infection was in proportion to the number of Bacteria there present. Klebs studied the mode in which the organisms found their way into the general circulation, and on one occasion saw them pass through the walls of an eroded blood vessel.

The experimental method was also adopted on the Continent, where observers were unhampered by Government interference. Majendie showed that these diseases could be transmitted by inoculation, and that by this process their virulence could be increased. Devaine continuing to experiment came to more exact results; he showed that less than 2000th of a drop of putrid blood was never fatal to a sheep; but he came to the conclusion that a trillionth of a drop, an amount too small for the mind to appreciate, after transmission through several animals might be fatal.

Professor Koch also conducted some very important investigations, to which I must refer somewhat in detail. For his infecting material he employed putrid blood or putrid meat juice. He found that the putrefaction must not be carried too far if the best results are to be obtained. In his first experiments he injected five drops of this liquid under the skin of a mouse. In many cases this caused the death of the animal in from 4—8 hours. On Post-Mortem examination the greater part of the fluid was found at the place of insertion, and contained a variety of forms of organisms, the same, in fact, as those present in the original liquid.

There were no marked tissue changes, the blood contained no Bacteria, and it was incapable of infecting other animals. It was nothing but a case of simple chemical poisoning by the Septine of Dr. Richardson. A mode of death so much insisted on by some observers opposed to the Bacterial Theory. If a smaller quantity, say one or two drops, were injected, sometimes nothing whatever happened; but when the inoculation was successful the animal remained well for the first twenty-four hours, and then a definite train of symptoms set in, followed by death on from 40—60 hours. On Post-Mortem examination nothing was found except enlargement of the spleen; but the blood from the heart was able to communicate the disease to other animals. Koch felt certain from this that Bacteria were present in the blood, but could not by any means detect them until he employed the condenser of Abbe, of which I have already spoken. Using this instrument he was able to find, not all the various kinds of Bacteria contained in the fluid injected, but only one very small Bacillus, varying from the 10,000th to the 1000th m. m. in lengths, showing that out of all the Bacterial forms introduced this alone had found a suitable soil, and been propagated. He further showed that as long as this Bacillus was present in the blood that blood was inoculable; but as soon as it disappeared the blood was inert. He found also that although house mice could be easily infected with blood taken from diseased members of their own species, rabbits and field-mice were altogether impervious to its influence.

The experiments did not end here. In some of his inoculations Koch discovered, not only the presence of the Bacillus in the blood, but he detected, in addition, a Micrococcus sometimes growing freely in the neighbourhood of the inoculation. This Micrococcus produced a local gangrene, which did not extend very far before the animal died from the more general disease. For a long time he tried to separate these organisms, but in vain. At last, instead of injecting the *blood* of the house mouse into the field mouse, it occurred to him to inject some of the liquid from the neighbourhood of the previous inoculation, which was on the ear. As he expected the Bacillus failed, but to his surprise the Micrococcus grew freely, and caused the death of the animal in a few days by extensive gangrene—*i.e.*, in another way altogether. Putrid Blood was then put under the skin of rabbits. Here again a different result was produced; extensive spreading abscesses were formed, and the animals died in from 12—15 days. On examination the blood was found free from organisms, and its injection into other animals had no effect. On the other hand the walls of the abscesses were found to consist of Zooglæa masses of extremely minute Micrococci, the smallest he had yet observed; he estimates their diameter approximately at the 167,000th in. The germ-containing materials from these abscesses readily reproduced the disease in other animals. Other similar experiments were tried; but I need not detain you further.

What now does all this go to show?—First, that in Septicæmia the wound becomes infected by organisms, and similar organisms are found in the tissues and blood.—Secondly, that putrid blood contains a variety of Bacterial forms, and if this blood is put under the skin of animals, in all probability a fatal disease is set up. This disease varies in its nature in different animals, and further by repeated inoculation through several animals the virulence of the poison can be vastly increased. Microscopical examination reveals the fact, that the various organisms present in the original putrid blood are not propagated indiscriminately, but one particular form, finding a suitable soil, grows freely, while the rest die. The particular disease, and a particular organism always being found together. Further, the disease can only be transmitted by inoculating with tissues or liquids, which contain these organisms. Just as in Lister's experiments with milk, wherever the inoculable poison is present there are organisms, and if there are no organisms there is no poison.

With the view of determining more exactly the relation of the organisms to these infective processes, and also of answering the objection, that these Bacteria were merely parasites or accompaniments, Klebs adopted the method of what he calls fractional cultivations. He took various solids and liquids from patients suffering from infective diseases, and inserted them into flasks containing cultivating liquids, previously carefully sterilized. After allowing time for growth, an extremely small quantity of this liquid was taken and put into a second flask similarly prepared. This process he carried on through a series sufficiently long to ensure that practically none of the liquid inserted in the first flask was to be found in the last, but only later generations of the living material. By inoculating animals with fluids thus obtained, Klebs succeeded, not only in reproducing the original disease, but also in discovering the special Micrococcus, both in the liquid, and in the animal infected.

Thus far we have dealt only with diseases associated with wounds, or produced by the inoculation of substances, such as putrifying blood, which at first cannot be considered as of a specific nature. I cannot, however, leave my subject without saying, as briefly as possible, something as to the more general diseases. Here again, of course, most of our knowledge has been obtained from the investigations of these affections in animals. The disease which has been, perhaps, more studied than any other is one which affects both man and animals. When it occurs in animals it is known in this country as Splenic Fever, in France as Mal de Rate. When it occurs in man it is known under the name of Malignant Pustule, Anthrax, and Woolsorter's disease. It is a very fatal disease among sheep and horned cattle in all parts of the world. It is usually communicated to man by handling portions of the body after death; so butchers and tanners may be affected; and also those who handle the wool or hair, wool sorters (whence the name), felt manufacturers, horsehair cleaners and furriers.

The disease may also spread from one country to another by these manufacturing processes. Diseased hair or wool (Persian mohair especially) is washed, the washings pass into drains, and thence sometimes over the surface of meadows, and so on to the systems of animals feeding there.

The fact that this disease was associated with a Bacterium seems to have been first discovered by Pollender in 1849. The subject was subsequently studied by Davaine in France and Coln in Germany, by whom the name *Bacillus Anthracis* was given to it. All parts of the body contain the Bacillus. The *Bacillus Anthracis* consists of a short motionless rod varying from the 1,250th to the 2,500th of an inch in length and is about the 18,000th of an inch in breadth. In the blood the Bacillus is multiplied by transverse fission but in artificial cultivating multiplication by spores also occurs. Pasteur has specially studied this Bacillus, and not only has he shown that it may be propagated by Klebs' method of fractional cultivation, but that if special precautions are taken the virus may be attenuated. I will not trouble you with the details of his method, because, although the fact is admitted, the explanation of Pasteur is disputed by other eminent observers, especially Koch and Klein. This attenuated virus has been used after the manner of vaccine, and as an example of the success of the method, I may mention that in the department of Eure et Loire, among a large flock consisting of a mixture of vaccinated and unvaccinated animals, the mortality of the unprotected was four times greater than of the protected. It is further stated that 1,650 inoculations of the attenuated virus were made without a single death. These facts are not I believe disputed, but unfortunately experimenters in other countries have failed to obtain an equal success.

If time permitted many other investigations of a similar nature could be recorded. For example you are all probably aware of Pasteur's experiments on Chicken Cholera, a disease by the way in no manner related to Cholera in man. Klebs also showed that Cattle Plague was due to a special *Micrococcus*. Klein similarly explained

Pneumo-Enritetis a contagious disease in pigs, and last of all as you know, Koch is at present engaged at Calcutta in investigating the nature of Cholera, and his most recent reports appear to show that he has discovered a Bacillus which is altogether peculiar to cases of this disease. His principal difficulty at present is that he has hitherto been unable to produce Cholera in any of the lower animals, and thus to test the power of this particular organism.

Had I not already detained you too long, I should have said something about the Bacillus Tuberculosis, the organism found in cases of consumption. I have, however, placed a specimen under one of the microscopes on the table.

With such evidence as this before us, it seems to me that the advocates of the Bacterial origin of certain diseases have made out a very strong case in their favour.

In retiring from the office of President it only remains for me to thank you all most sincerely for the kind co-operation and hearty support you have accorded me during my term of office. I must also thank the members of the Council and especially our Honorary Secretaries for the ready and invaluable assistance they have given me on all occasions. In electing my successor you have chosen a gentleman of such high scientific attainments that I look forward confidently to the continued prosperity of our Society, the success of which we all have so much at heart.

ABSTRACT OF A PAPER

READ BY

THOMAS HAZARD, Esq.,

ON

"SOME REMAINS OF EXTINCT MAMMALIA, FROM THE NORFOLK FOREST BED,"

28th MARCH, 1883.

Mr. Hazard exhibited at the Meeting two teeth of extinct Mammalia which had been obtained from the Norfolk Forest bed, one of the specimens being a tooth from an Elephas primigenius (Nicholson's Palæontology, vol. 2, p. 387), and the other a præmolar tooth from a young Elephas meridionalis (Nicholson ubi sup., p. 383.)

The specimen first mentioned he stated was dug out at the foot of the cliffs at Cromer, in Norfolk, the other specimen having been brought up in a fishing net off the coast of Yarmouth.

He referred to the Norfolk Forest bed as being one of the most interesting fields of geological research that our country offers, extending as it does from Cromer, in Norfolk, to Kessingland, in Suffolk (Sir Charles Lyell's Antiquity of Man, p. 214) and, stretching for an unascertained distance into the German ocean—its age goes far beyond the glacial period (Woodward's Geology, p. 291) and it has been subject to gigantic physical forces, having been successively sunken and re-elevated to the extent of 400 or 500 feet (Sir Chas. Lyell ubi sup). It rests upon the solid chalk and has a clay soil in which a pine forest is found to have flourished. No less than 20 species of Mammalia have been found to have inhabited the forest (The Rev. John Gunn), and when its subsidence produced sufficient marsh, the Osmunda regalis with an appropriate surrounding of reptiles had an abode there. From being a marsh the forest became an estuary, open to the North, having whales for its *habitués* (Rev. John Gunn). No trace of the Mastodon has been found in the forest; in the Pliocene period, while the pine trees were probably growing, the Mastodon was dying out in Europe, although he survived to a later date in America.

Some remarks were made upon the two teeth which were exhibited.

As to the tooth dug up at Cromer it was, as stated, in all probability the tooth of an Elephas primigenius, an animal which survived the glacial epoch, and possibly was contemporary with man. Its species was abundant in the drift soil at the bottom of the North Sea, and the Knole Sand off Yarmouth had contributed largely to its discovered traces.

The other and larger tooth could be clearly identified as a præmolar tooth of a young Elephas meridionalis, that it was a tooth from a young animal was probable, for the reason that the fangs were so well developed, and had not had time to grow into and form a part of the bone of the jaw. The species Elephas meridionalis must have migrated to the forest from the south at a time previous to the existence of the English Channel in its present state. Allusion was made to the controversy which had long occupied attention and had arisen in connection with the remains of extinct animals which had been discovered, namely, as to how far the date of man's first existence on the earth should be carried back into past time, and on a weighing of all the authorities on both sides Mr. Hazard came to the conclusion that nothing had yet been discovered to shew that the opinion which had been held for so many ages as to the supposed date when man first appeared on the earth was a wrong one.

Before closing his remarks, Mr. Hazard drew attention to the remains of extinct Mammalia recently discovered in digging out the foundations of Messrs. Drummond's bank at Charing Cross, and to the illustrations and description of them contained in the *Illustrated London News* of 13th January, 1883.

NOTES ON THE LIFE HISTORY OF THE AXOLOTL,

BY

REV. ANDREW JOHNSON, M.A., F.L.S.,

25th APRIL, 1883.

I HAVE the honour to-night to bring before the notice of the Society living specimens of what are commonly called Axolotl, which have been reared from the egg at Blackheath. I may, perhaps, be allowed to explain to some of the members present why these uncouth looking little reptiles have a special interest for naturalists. It is, of course, well known that the Division of Reptilia, which is called Batrachian (to which the frog, newt, and salamander belong), pass the first portion of their existence in the water, breathing by means of branchiæ, that is, certain appendages corresponding to the gills of fishes, but placed outside the body; the blood circulates through the ramifications of these organs, and returns to the system oxidized and purified by contact with the air contained in the water which has played over them. After a time these gills or branchiæ diminish in size, and finally disappear; the animal changes in form, loses its tail, if it belongs to the sub-division Anoura, or retains it if it is one of the Urodela, *i.e.*, a Salamander or a Triton; and comes to the surface to breathe by means of the lungs. Animals which thus eventually lose their branchiæ are called Caducibranchiate. But there are one or two genera which appear not to get beyond the imperfect or larval condition, and as far as is known, retain their gills all their lives. Such is the Proteus, and such was long thought to be the case with the Siredon Mexicanum or Pisceforme (so-called). Cuvier was the first to call in question the right of the last-named animal to the position assigned to it, as he felt convinced from its analogy in all particulars with the larval form of the Salamander that it must in its turn be the tadpole or immature form of some kindred species; nevertheless, as the most careful search failed to detect the perfect animal, Cuvier was compelled to leave the Axolotl among the perennial branchiates. Naturalists of authority relying upon the argument from analogy supported Cuvier's views; others, observing that these Axolotls possessed fully developed organs of reproduction, insisted on their claims to be perfect animals.

Thus stood the case when M. Duméril found that of four specimens (three male and one female) which had been preserved alone for three years in the Reptile Vivarium at Paris without undergoing any change, the female laid eggs, which hatched and produced young like the parents. This appeared to settle the question; no larval or imperfect animal (among the vertebrata, at least), had been known to breed, and therefore it was said these breeding Axolotls must have reached their highest state of development; but M. Duméril thought otherwise, and, as appears, rightly. Referring you to the Comptes Rendus of the French Académie des Sciences for his detailed observation, I pass on to give my own experience, as, though the Axolotl has been reared in England by Dr. Günther and others in ponds or lakes, I believe that the development of the young so produced has not been watched; while the young animals hatched indoors, in aquaria, have always died at an early stage from want of proper food.

At the end of April, 1880, I was fortunate enough to procure a couple of these animals, one of which was apparently a pregnant female, the other may have been either a male or barren female for aught I know. I at once placed them out of doors in a large shallow pan containing water; but finding it impossible to watch them with sufficient minuteness in this position, I removed them to a bell-glass aquarium about 20 inches in diameter, containing a little gravel, which I planted with Vallisneria Spiralis; this I filled with water, and placed in the west window of my sitting-room. The

Axolotls had not long been in this position when the female began to lay.* In depositing her eggs she climbed upon a leaf of Vallisneria, clasping the narrow blade to her vent. She then drew herself up a little higher, leaving the egg behind attached on the leaf. As a rule, she moved upward, but the eggs were not laid symmetrically or in any particular order, but in no case did one touch another. There was no attempt to fasten down the leaf over the egg, as is done by Triton. The deposition was continued, with a few pauses, for twenty-four hours, and then ceased. The eggs were 95 in number. The female at once resumed her normal appearance. The ovum when first laid was about the size of a flattened mustard seed. It consisted of a blackish vitelline nucleus, held in the centre of the vitelline membrane, which was so remarkably transparent that every feature of the growing embryo was most plainly discernible. The whole was enveloped in an albuminous sphere which in a few hours absorbed so much water that the whole attained the size of a very large pea.

I will not trouble you with a detailed account of the development of the embryo during the four weeks which preceded the hatching. I must say, however, that the whole process is most interesting, being so easily observed owing to the transparency of the medium. The segmentation of the vitellus began to be apparent at the end of four or five days. Next appeared the primitive median band, and soon the creature began to assume a definite shape. In thirteen days the two branchial buds made their appearance behind the head ; soon each of

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* Neither at this time nor any other, though I watched carefully, did I see the supposed male show the slightest interest in the proceedings, nor go through any of the evolutions described by M. Duméril. My own impression is that the eggs must have been impregnated previous to the removal of the animals to my house, and that their deposition was retarded by the sudden exposure to the much lower temperature of the garden (The Axolotls had been kept in a hothouse). It is a matter of the experience that the spotted Salamander, which is viviparous, can, when deprived of access to water, delay parturition for a considerable time.

these developed three short cylindrical appendages; and latest of all were seen the two little nobs which were eventually to become the front feet. The embryo manifested signs of life at eighteen days by occasional convulsive struggles, which increased in frequency and energy until the albuminous envelope was ruptured at the end of the fourth week, and the little animal escaped into the water where it supported itself with difficulty, swimming by jerks. Its density was considerable, and those individuals which could not find a resting-place near the surface, sank to the bottom and perished, after making desperate efforts to rise. The hatching was very unequal, some not escaping until ten days or a fortnight after the rest; the proportion of unfruitful eggs was very small. To resume, the mouth was opened after two days, when the little creatures snapped eagerly at Daphne and Cypris, which were, of course, much too large for them.

Even at this early age the fry emitted the bubble of air, which is characteristic of the possession of lungs in the perfect Urodela. It appears very desirable that very young specimens should be dissected with a special view to trace the development of this organ, which I believe commences contemporaneously with life.

The failure to rear Axolotls in confinement has always arisen from the want of proper food for them when very small. I used earthenware pans, eighteen inches across, and four inches deep containing decaying vegetable matter, and supplied with pond water. Herein under the influence of sunlight abundance of infusoria were constantly being generated, especially swarms of paramecia, on which the Axolotls lived. Hiding places of stone and slate were arranged to which the infants took at once. As they grew Daphne and Cypris were taken, and at length I was able to feed them with gnat larvæ and minute worms. The fore feet began to develope from the two gemmæ, already spoken of, at three weeks old, but the hind legs did not appear for as many months. The aftergrowth of the animals was extremely irregular; of two living under exactly the same conditions, one attained three times the size of the other, while later on the backward one would in his turn gain upon his brother. The power of endurance of these animals is extraordinary; I have left them in the shallow pans for hours in the blazing sun; they have remained in the same way out of doors for weeks together in winter, being at one time frozen into a mass of solid ice. They have passed weeks without food, when worms were difficult to procure,* and a number were left in a small aquarium out of doors from April to October without any visible supply. The impurity of the water when unchanged did not affect them, and I never lost one by a natural death. They seem to have, to a very great degree, the power of adapting themselves to circumstances. The time of full growth in the case of Duméril's specimens seems to have been from seven to twelve months. But in this case the animals were kept at a uniformly high rate of temperature in the Reptile Vivarium at Paris, and were regularly supplied with abundance of suitable food. My own specimens which have had a very different treatment, are not much more than half grown, although they are nearly three years old. Madame Carbonnier, the Pisciculturist, of Paris, informs me that with her Axolotls will breed in two years, but continue to increase in size for three.

Like our own Triton the Axolotl is sluggish and disinclined to feed when the temperature is under 55°. They take food at short intervals, but not much at a time, for though their gape is enormous their throats and stomachs are comparatively small. I suspect that in their native state they live on the small fry which swarm in the tepid shallows of the Mexican waters.

I must allude to the power which the Axolotl, in common with other Urodela, has of reproducing its limbs when damaged. Without having resort to the cold-blooded experiments of the French *savants* who vivisected them bit by bit,

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* The adults were fed on worms; they also took slugs very readily.

and so compelled them to reproduce tail, feet, legs, branchiæ, and even head, we cannot help having abundant evidence of this power. When they are hungry, and find no food within reach, they do not scruple to seize one another by the leg (their seizure of food is always made with great violence), and wrench off, sometimes a foot, and sometimes the whole limb. The sufferer does not seem much discomposed by the attack. He takes food himself as regularly as usual. The damaged portions slough away, the wound cicatrises, the limb sprouts, grows more or less rapidly according to temperature and other circumstances, and at length reproduces itself perfectly; a surprising fact when we recollect that, besides its tissues and vessels, each of these forelegs contains twenty-three separate bony pieces, and each hind leg twenty-eight. M. Duméril, who was anxious to manufacture a perfect animal out of this tadpole, cut off the branchiæ four or five times in succession from the same individual, and they were reproduced each time. The smallest and weakest of my own specimens was a great sufferer from the cruelty of his brethren, who pulled off his feet over and over again, until, at last, he was reduced to a fish-like state by the loss of all four limbs at once; thus, apparently, helplessly maimed, I gave him to a young American lady who is studying physiology at Cambridge, and under her care he has resumed his limbs in their entirety, and may, I believe, be seen living in solitary state in the Cavendish Museum.*

So far I have related my personal experiences. I must, however, allude briefly to an important observation, first made by M. Duméril. We saw just now that that gentleman endeavoured in vain to convert an Axolotl into a perfect Salamander, by repeatedly removing its branchiæ. What his art failed to accomplish, Nature performed for him. He discovered that a specimen which had escaped his notice for some time, had entirely lost its branchiæ; the membraneous

* I am informed that he has since expired owing to indulgence in an inordinate meal upon frog tadpoles, after long fasting.

crest of the back and tail had disappeared, and the shape of the head had changed. Irregular spots of a pale yellow colour had also made their appearance on the limbs and body. From a second instance, it appeared that the transformation took sixteen days to accomplish, *i.e.*, for the larval to become a perfect form, and that during this time no food was taken. In the course of two years, sixteen of this brood had been thus converted into the Salamandrine form, all the rest remaining larvæ still, as was the case with the parent Axolotls, which, with their two male companions, showed no advance whatever upon the tadpole form. Careful observation of my own home-bred specimens shows no important change in this direction, although the branchiæ have certainly diminished in size, while the animals breathe atmospheric air from the surface as frequently as the fully developed Triton, which has no branchiæ at all: probably dissection would show considerable development of the lungs. In one instance only have spots appeared on the sides, and the feet have become partially webbed.

Even now, Cuvier's surmise that Siredon must be expunged from the list of the perennibranchiates is not established, for the Axolotl, of which we have been treating, turns out not to be Siredon at all, but the larval form of a well-known species of Amblystoma, viz., A. Mavortium; while the closest search in its native haunts has failed to find any Amblystoma to which the Siredon Mexicanum of Cuvier can be referred as tadpole.

We have seen that so-called Axolotls may change into Amblystoms or perfect forms, or they may remain indefinitely in the larval state, and so reproduce themselves. We learn further that: "The eggs laid by Axolotls have been placed both on dry ground and in water, out of which the young could readily emerge. Under the first condition four turned as usual to gilled Axolotls, and two were hatched as perfect gill-less Amblystoms; under the second, four became Axolotls, and one an Amblystom. Then an Amblystom laid eggs, and they were treated like the others, and many more Axolotls were produced than Amblystoms. One of the Amblystoms thus produced laid eggs which hatched into tadpoles, which presented all the characteristics of Axolotls, but the colour of the marking was different."

ABSTRACT OF A PAPER

READ BY

E. W. BRABROOK, Esq., F.S.A.,

ON

RECENT INVESTIGATIONS

INTO THE

HEIGHT, WEIGHT, AND OTHER PHYSICAL CHARACTERISTICS OF MEN IN THE BRITISH ISLES.

28th NOVEMBER, 1883.

THE British Association, at its Bristol Meeting in 1875, appointed an Anthropometric Committee for the purpose of collecting observations on the systematic examination of the heights, weights, and other physical characters of the inhabitants of the British Isles. The committee, after eight years' labour, presented at the Southport Meeting in the present year its final report, prepared by Sir Rawson W. Rawson and Mr. Charles Roberts. It had collected observations of about 53,000 individuals so distributed among the various classes of society and over the surface of the country as to afford a sufficient indication to warrant conclusions as to the effect of nurture, race, locality, and occupation upon the physical condition of the people. For example, in the 12th year of age, the mean height of boys in country public schools is 55 inches; town, 54½; in upper middle class schools, 54; lower, 53½; in elementary schools among agricultural labourers, 53; among town artizans, 52½; among factory workshops in the country, 52; in towns, 51½; in military asylums, 51; pauper schools, 50½; industrial schools, 50. At ages a little older, the statistics of the Committee afford means of interesting comparison with some with which Dr. Ord has favoured me, collected by himself several years ago, of candidates for admission into training ships in the Royal Navy. The close correspondence between the results is confirmatory of the accuracy of those collected by the Committee, and reflects high credit upon Dr. Ord as a pioneer in these investigations.

Some of the bearings of the Committee's report on questions of race have been pointed out by Mr. Grant Allen, in an ingenious paper on the subject. He says that the report supports the theory that the modern population, even of South-Eastern England, contains numerous remnants, not only of the Celtic peoples, but also of the earlier Neolithic aborigines, and that a belt of dark faces runs across the centre of England, marring the supposed Teutonic purity of Essex, Kent, Hants and Sussex with its touch of the Neolithic tar-brush. In this evidence of the continuity of the English people, the Committee confirms the conclusions which Mr. Coote arrived at by a different route in his important work, "The Romans of Britain."

The French Anthropologists have much more ambitious views on the matter of Anthropometry than are entertained in England. They have prepared a Schedule in which no fewer than 104 separate inquiries are to be answered with respect to each individual. It is obvious that, however interesting many of these may be, it is wholly impracticable to get a sufficient number of observations of this magnitude to form a fair induction. They must, of necessity, be limited to such special classes as can be induced, or are unable to refuse, to submit to a prolonged examination. Dr. Collignon, however, reducing the number of inquiries to 20, has published the results of his observations of recruits belonging to the different races of France, which fit in exceedingly well with those of the English Committee.

The British Medical Association has formed a Collective Investigation Committee which is doing very good work. It has adopted a system of cards, similar to those provided by the Anthropometric Committee, and though taking up subjects from a more strictly medical point of view, its observations throw great light on questions of race, heredity, &c.

Though the British Association Committee has made its final report, the work it has commenced may still be pursued. Its collections are now in the possession of the Anthropological Institute, and may be augmented or further investigated by any member of that body, or other person interested in the subject. It is because we, as a Natural History Society, cannot think any inquiry into the natural history of man foreign to our purposes, that he ventured to bring this matter forward. He was frequently in receipt of communications of fresh information from various parts of the country which lead to suggestions of new points for enquiry, and he felt quite sure that the matter ought not to be, and would not be, allowed to drop.

ABSTRACT OF A PAPER

READ BY

C. KNOX ORD, Esq., M.D., F.L.S.,

Fleet Surgeon, R.N.,

ON THE

PHYSICAL DEVELOPMENT OF LONDON BOYS OF THE LOWER CLASSES,

Who were Examined for the Royal Navy, 19th December, 1883.

Out of some 8,000 London Boys of the Lower Classes, who were desirous of entering the Royal Navy between 1st July 1866, and 31st October 1869, when I was Senior Medical Officer of H.M.S. *Fisgard* at Woolwich, I obtained the following observations on 3,060, from 14½ to 16 years old, who were measured physically before being examined medically.

From 1st July, 1868, and afterwards, boys under 15 were not required. There were, therefore, *Two Series* separated by that date. The *First Series* included 700 boys from 14½ to 15 years; also 1,400 from 15 to 16; and was published in a Blue Book (Report of the Health of the Navy for 1867). The *Second Series*, consisting of 960 boys from 15 to 16 years only, has been computed specially for this paper, and *has never been published*. Some 300 boys from 16 to 16½, whose measurements were recorded, are completely *excluded* from the present observations.

I may state here, that not having required to refer to the Records of the First Series since it was published (1869) I did not discover, until searching for them preparatory to this paper, that they were lost or mislaid. The *results*, which were all that was actually required, are fortunately preserved in the above Blue Book. But during this search, I was much pleased by alighting unexpectedly on the Records of the Second Series, which I forthwith proceeded to analyse for my present contribution.

Social Condition.

This may be deduced from their occupations and education. I have not calculated the Second Series; but the First Series of 2,100 boys will be a very fair criterion of the whole 3,060. They were all Londoners, and stated that the following were their *occupations* per 1,000:—

1. In-door (trades, shops, messengers, errand-boys, &c).	472
2. Out-door (labourers, principally masons and plasterers, van-boys, &c.) ..	353
Total	825
3. From *Warspite* (Training Ship in the Thames)	89
4. Been at sea or in boats	47
5. From Schools, their Homes, &c. ..	33
6. Clerks in offices	6
Total	1000

Education.

The ratio of 108 per 1,000 were unable to read and write.

The Report on the "Health of the Army for 1881" states that "there is a marked decrease in the proportion of (army) recruits unable to read and write, which has fallen from 218 to 147 per 1,000," *i.e.*, in 1865 and 1881 respectively.

Boys only who "actually entered the Navy" were required to state where they had been educated, which was as follows per 100:—

National Schools	90
Private Schools	9
Government principally	1

It may be an interesting digression that, on an average, one only out of four or five boys was so fortunate as actually to enter the Service!! Particulars are here out of place; but it may be explained shortly that this startling disparity was due to the numerous tests they underwent as to age, sight, education, moral character, general eligibility, physical development, &c., prior to medical examination, to which barely one-half were admitted, and one-third of these were rejected.

Age.

By the Regulations of the Service, their age was strictly scrutinized, *and they knew it*, as rejections for improper age fell from 180 to 106 per 1,000 candidates. It was the first and cardinal enquiry. *Written* evidence was required from boys who were admitted into the Service. It was of the first importance in connexion with their

Physical Measurements.

I may premise that, being outside my professional duty, whatever I did was perfectly *voluntary*, and simply to *secure such valuable data*. Without being in any way responsible, either I or a Medical Officer, not only superintended, but also *recorded* all the measurements, ages, and numerous other particulars *at the time* clearly and legibly in the Official Register, from which mine was copied for future purposes.

There were never at any one time more than three officers, all R.N., viz., one Medical and two Warrant (Boatswains), who were relieved according to the exigencies of the Service, so that there were in all eight, viz., five Medical and three Warrant.

Nearly all the observations, some 10,000, were taken under my supervision by the Senior Boatswain, who remained during my whole tenure of three and one-third years. He commenced this duty, for which he was specially detailed, about two years previously, probably from the inception of the examination of such boys. So also had the first Medical

Officer, who remained nearly two years, *i.e.*, through the first series of observations. In my occasional absence he or his successor acted exactly as I should have done if present.

The Physical (and Medical) Examination was conducted, not in the *Fisgard*, but in a room specially fitted and appropriated, in Woolwich Dockyard, which was then in full operation.

The measurements of stature, weight, and chest girth followed in this order, and the method requires explanation. 1st.—Stature *without* shoes, to inches and quarters was easily determined under a standard affixed to a wall. 2nd.—Weight, *clothes included* (without shoes), while standing on a Pooley's Patent weighing machine, (similar to those used for weighing luggage at railway stations) was read off to the nearest pound under or over one-half, omitting fractions. After deducting the weight of clothes, that of the body only was registered. From various trials, before I joined, the Boatswains found that such clothes varied from under three to about seven pounds, with an average of five pounds. From long practice they were able to fix the weight, in each case, either by ocular inspection or by holding in their hands; but when at all doubtful they immediately resorted to the machine.

The accuracy of these "Old Salts" in this matter was very curiously confirmed by the celebrated M. Quetelet, of whose observations they had never heard. In his Treatise "On Man, &c.," to which I shall have to recur, he remarks: "From different experiments I think we may admit, as near the truth, that the average weight of the clothes is one-eighteenth of the total weight of the male body, and one-twenty-fourth part of the total weight of the female." By his plan, the average for these junior and senior boys would be 5·2, and 5·8 pounds respectively; but in their case the fractions may, I think, be safely omitted, and five pounds be considered a fair average, which I have accordingly adopted.

It will be seen from Table I., that although *minima*, according to age, were fixed for height and chest-circumference, the "Admiralty Standard" entirely omitted weight. Luckily a column for it had been inserted in the printed heading of the Physical Register, which was regularly filled up, though not actually required. To prevent confusion I have always noted the weight *with* clothes throughout this Paper.

3rd.—*Chest-girth* being the most difficult measurement, it was taken, under special medical superintendence, in inches and quarters, thus:—Divested of all his upper clothes, the boy was made to stand perfectly upright, his shoulders well back, both arms raised straight above his head, backs of the hands touching each other, their palms turned outwards, and after counting 10 slowly, the measurement was read off *in front*, the measuring-tape having been passed *horizontally* round the chest, its lower edge touching the nipples. This was exactly the plan adopted by the British Army, except with the "arms hanging loosely by his (the recruit's) side."

This completed the Physical Examination, and the Medical Examination followed.

Table I. gives the average measurements of these 3,060 boys according to age. They were as under:—

Number.	Age.	Stature *without* Shoes.	Weight *with* Clothes.	Chest Girth.
		Inches.	Pounds.	Inches.
700	14½ to 15	59·0	94·0	28·5
2360	15 to 16	61·0	104·8	30·2

The average for the younger boys was from the whole 700, who formed part of the First Series only. I had no subsequent opportunity, and was glad to have obtained their measurements. That of the older boys was the average of two averages, viz., of 1,400 who were part of the First Series, and of the 960 who formed the Second Series entirely. This

Table also contains the "Admiralty Standard," to which they were always superior, viz., in stature, both ages, by 2·5 inches, and in chest-girth by 1·0 or 0·7 inch, as they were under or over 15.

These observations were almost unique, inasmuch as they were conducted—

(1) For a lengthened consecutive period ($3\frac{1}{3}$ years).

(2) On a systematic and uniform plan.

(3) Under a single observer (myself).

(4) At a peculiarly limited age.

(5) On a special class,—and especially,

(6) On the *same* individuals, by which I mean that the stature, weight and chest-girth were inter-associated, and were not obtained from different persons on various occasions, when such were available. Some special or public appointment only can afford similar opportunities, and on so large a scale.

Comparison with other Boys.

Before publishing the First Series I was naturally anxious to compare my results with others; but strange as it may appear, I neither knew then (1869), nor could I hear of any similar observations for this limited age, except a few in the Standard Treatise "On Man, and the Development of his Faculties," by Professor Quetelet, of Brussels (English Translation, W. and R. Chambers, 1842), already quoted, which contained, mainly in its appendix, the only available observations. I gave my comparisons in the above Blue Book, appendix, pp. 16 and 17, but need not repeat them here, as this void has been completely filled by the late researches of the Anthropometric Committee of the British Association.

The Times of 24th September, 1883, gave an abstract of their Report, headed "British Calibre," but the Report is not yet published. Mr. Brabrook, its Secretary, has kindly favoured me with a copy, and my present endeavour is to keep up the interest on this subject excited by his Paper read at our last meeting, 28th November, "On recent investigations into the height, weight, and other physical characteristics of Man in the British Isles."

From pp. 38 and 40 of this Report, and from my Table I., I constructed Table II., and compared these Londoners with other English boys of their age. The last two lines show their respective differences, and may be read summarily thus:—(1) Class I. proved superior in every respect, as might have been expected, and considerably more so than any other class. Their curve of height from 14 to 15 years overtopped Londoners from 15 to 16. Table III. Eliminating these A1 tip-top, well fed, and highly favoured young *gentlemen*, these "Pure Cockneys," as I consider them, were throughout (2) heavier, but (3) shorter than all compeers, and taller only than classes III. and IV. from 14 to 15.

Table II. shows the exact differences, which are marked below, + or — according as the *Cockneys* were superior or inferior:—

	Stature, inches.		Weight, pounds.	
	14 to 15	15 to 16	14 to 15	15 to 16
CLASS I. ...	− 2·29	− 2·61	− 8·2	− 9·5
G. POP.	− 0·33	− 1·24	+ 2·0	+ 2·1
CLASS II. ...	− 0·47	− 1·19	+ 4·5	+ 5·4
„ III. ...	+ 1·06	− 0·82	+ 4·8	+ 4·2
„ IV. ...	+ 0·39	− 0·36	+ 6·7	+ 8·4

AGE 14—15.

As no Cockneys were under 14½ years, it is manifest that the above was not a comparison for the whole year of age, but rather a "contrast" between junior boys ranging through the whole twelve months, and Cockneys confined to the *last half-year* with the concomitant advantages of this specially growing period ($14\frac{1}{2}$—15). Nothing else was possible with such *data*. The above reservation applies also to

Chest-Girth.

The Anthropometric Committee records the chest-girth of the general population only, which was taken by the Army method, already explained. These Cockneys were wider by 0·04 and 0·46 inch, according as the age was under or over 15 years.

London Boys from 15 to 16.

I made a final comparison, viz., between the two series of these older Cockneys with an unexpected result. While striking the average for this age, I observed that the averages of the two series were almost identical; but I was led to ask myself why the Second Series, which was shorter by 0·1 inch = *nil*, but actually wider in chest by 0·4 inch, should be *lighter* by $2\frac{1}{2}$ (2·4) pounds? From my copy register I found that no fewer than 11 *per cent.* were not a day older than 15, 27 per cent. were from 15 to $15\frac{1}{4}$, and 22 per cent. from $15\frac{1}{4}$ to $15\frac{1}{2}$, making a total of 60 per cent. *under*, against only 40 per cent. over $15\frac{1}{2}$; while those under $15\frac{1}{4}$ nearly equalled all from $15\frac{1}{2}$—16.

(1) Knowing that they were debarred till they had attained 15 years, they applied as soon after as possible. Had the old rule existed they would most probably have appeared earlier, and in that case been included *under*, instead, as now, over 15, whose average they thus depreciated by their lighter weight. This, I consider, is the only explanation of so curious a difference, and to me otherwise inexplicable.

(2) I was struck still more by what may be called the "sensitiveness" of these observations to minute alternations of age, as affording intrinsic evidence of their precision, now suggested spontaneously after nearly 20 years.

It is gratifying to learn that the Inspecting Captains of H.M.'s Training Ships approve highly of London boys, and that they develope into good and smart sailors.

TABLE I.

Average Measurements of 3,060 London Boys.

Number Examined.	Age.		Stature *without* Shoes.	Weight *with* Clothes.	Chest Girth (bare).
			Inches.	*Pounds.*	*Inches.*
700	14½	15	59·0	94·0	28·5
2360	15	16	61·0	104·8	30·2
Admiralty Standard	14½	15	56·5	*Not*	27·5
	15	16	58·5	*required.*	29·5
London Boys *Superior.*	14½	15	2·5	No	1·0
	15	16	2·5	comparison.	0·7

TABLE III.

Anthropometric Committee & London Boys.

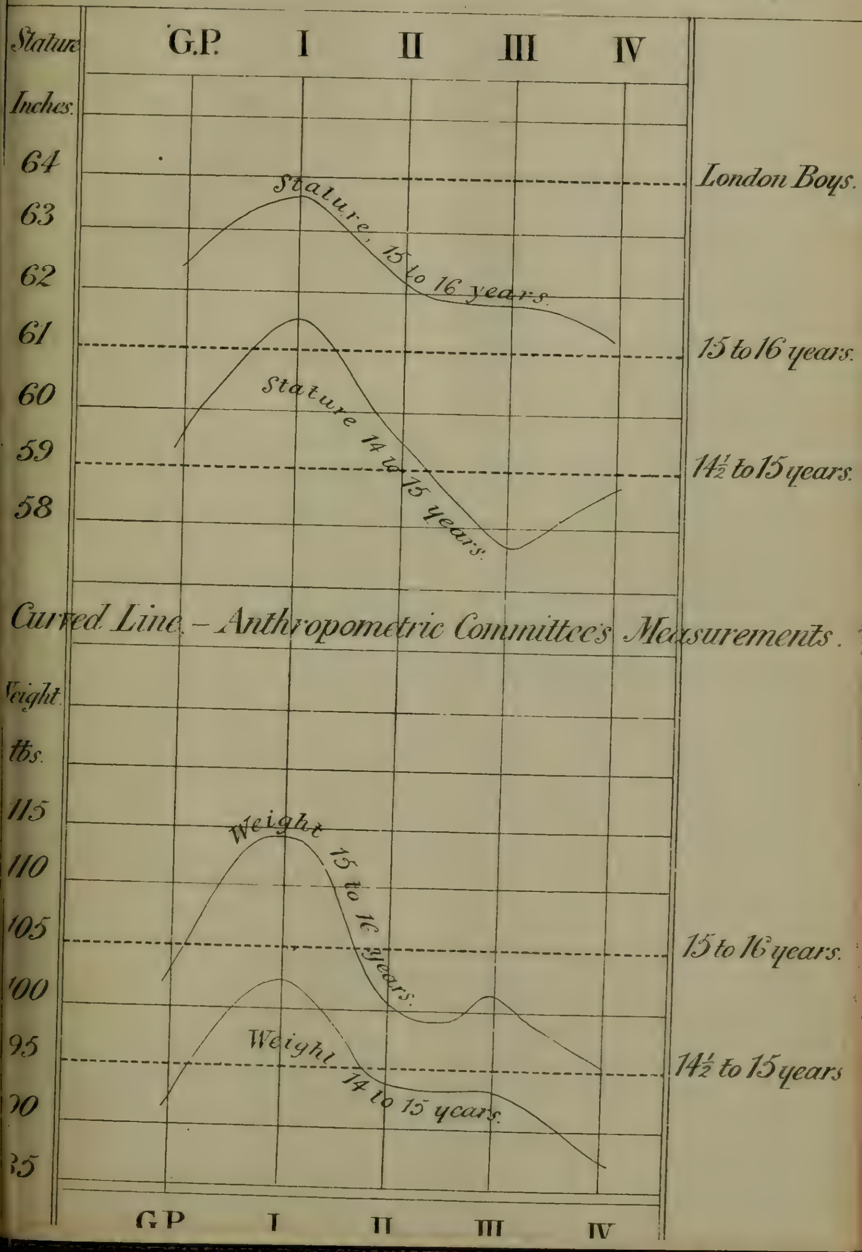

TABLE II.

Comparison of STATURE *and* WEIGHT *with the observations of the Anthropometric Committee.*

N.B.—No London Boys were under $14\frac{1}{2}$ years.	HEIGHT *without* SHOES (Inches).										WEIGHT *with* CLOTHES (Pounds).									
	14 to 15 years.					15 to 16 years.					14 to 15 years.					15 to 16 years.				
Classes explained below	G.P.	I.	II.	III.	IV.	G.P.	I.	II.	III.	IV.	G.P.	I.	II.	III.	IV.	G.P.	I.	II.	III.	IV.
Anthropometric Committee ...	59·33	61·29	59·47	57·94	58·61	62·64	63·61	62·19	61·82	61·36	92·0	102·2	89·5	89·2	87·3	102·7	114·3	99·4	100·6	96·4
London Boys ...	59·00	59·00	59·00	59·00	59·00	61·00	61·00	61·00	61·00	61·00	94·00	94·00	94·00	94·00	94·00	104·8	104·8	104.8	104·8	104·8
London Boys: *Inferior* ...	0·33	2·29	0·47	... ...	... ...	1·24	2·61	1·19	0·82	0·36	... ...	8·2	... ...	... ...	... ...	... ...	9.5	... ...	... ...	... ...
London Boys: *Superior* ...	... ...	... ...	... ...	1·06	0·39	... ...	... ...	... ...	... ...	... ...	2·0	... ...	4·5	4·8	6·7	2·1	... ...	5·4	4·2	8·4

EXPLANATION.—G.P. means General Population. All Classes. Town and Country.

Class I.—Professional Classes. Town and Country. Class II.—Commercial Classes. Towns.

Class III.—Labouring Classes. Country. Class IV.—Artizans. Towns.

RULES.

(As amended at the Annual Meeting, 22nd February, 1882.)

1.—The Society shall be called THE WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY, and have for its objects the promotion of the study of Natural History, Microscopic research and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s. in one sum. All subscriptions shall be due on 1st January in each year.

3.—The affairs of the Society shall be managed by a Council, consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c, shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman, not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.*

—:o:—

HONORARY MEMBERS.

Bossey, F., M.D., Oxford Terrace, Red Hill, Surrey.

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MEETINGS OF THE SOCIETY

FOR THE SESSION 1884-85.

Wednesday,	March	26
,,	April	23
,,	May	28
,,	October	22
,,	November	26
,,	December	17
,,	January (1885)	28
,,	February ,, Annual	25

———:o:———

THE CHAIR IS TAKEN AT 8 O'CLOCK.

———:o:———

THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

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WEST KENT

Natural History, Microscopical and Photographic Society.

THE

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PAPERS,

AND

Reports of the Council & Auditors,

FOR 1884-85.

WITH

RULES, LIST OF MEMBERS AND CATALOGUE OF THE LIBRARY.

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FOR THE SESSION 1884-85.

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FRED. W. SMITH.
FLAXMAN SPURRELL, F.R.C.S.
J. MORRIS STONE, M.A.

REPORT OF THE COUNCIL,

For the Session, 1884-85.

The Council in making their Annual Report regret that they have to announce the loss by death of Mr. W. Walton, who had been connected with the Society almost from its formation. Seven have retired from the Society, and five new members have joined it, the total number being at present 95, as against 99 in February, 1884.

The accounts of the Honorary Treasurer have been audited, and show a balance in hand on the 31st December last of £17 12s. 3d.

The Council regret to find that the subscriptions remaining unpaid amount to a large sum when compared with the income of the Society. A very urgent appeal made by the President of the Society (at the request of the Council) has, at present, resulted in a very limited response. Members, who may find a difficulty in forwarding their subscriptions annually, are reminded that they may commute such subscriptions by a life payment of £5, 5s.

Valuable papers have been read and objects of interest exhibited at the ordinary meetings, which have been fairly well attended.

A welcome variety was occasioned by the delivery of a lecture on "Crystallization," by Mr. W. P. Bloxam, F.C.S., which was most successfully illustrated by experiments. At this lecture the lady friends of members were present.

The Annual Field Meeting was held on the 19th June, and resulted in a most enjoyable excursion. The members and their friends proceeded by train to Sevenoaks, and were thence conveyed in waggonettes to Ightham Mote, which was most kindly thrown open to them by the owner, Mrs. Luard-Selby. They afterwards visited the camp in the neighbourhood, under the guidance of Mr. F. C. J. Spurrell.

On their return the party dined at the Crown Hotel, Sevenoaks.

On the 12th July the members dined together at the New Falcon Hotel, Gravesend. The subject of discussion introduced by the President was "Beans and Bacon."

The Annual Cryptogamic Meeting of the Society took place on the 11th October. Dr. Spurrell again conducted the members through the grounds of Messrs. Chillingworth and Mitchell, at Abbey Wood, and thence to Erith.

The Council were glad to see it so largely attended, and to welcome the presence of several members of kindred local Societies. The names of the Fungi observed on this occasion are appended.

The Council conclude by earnestly inviting their fellow-members to assist them in their efforts to make the Society as efficient and generally useful as possible, and remind them that the usual Soirée will be held this year in May next.

FUNGI COLLECTED AT THE SOCIETY'S EXCURSION TO ABBEY WOOD, 11TH OCTOBER, 1884.

Amanita rubescens
phalloides
asper
mappa
Armillaria melleus
Boletus luridus
bovinus
scaber
olivaceus
chrysenteron
subtomentosus
Clitocybe laccatus
Dædalea unicolor

Lactarius insulsus
quietus
subdulcis
fuliginosus
Hypoloma fascicularis
Lycoperdon pyriforme
Russula alutacea
virescens
heterophylla
emetica
Phallus impudicus
Scleroderma vulgare

NOTE.—On this occasion the President drew attention to the recent discovery by him, in considerable quantities, of a rare and little known agaric, viz., Pholiota leochroma, upon elm stumps at Kidbrook.

Statement of the Accounts

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, & PHOTOGRAPHIC SOCIETY,

For the Year ended 31st December, 1884.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
Balance in hand on 1st January, 1884	7	14	3	Balance of Soirée Expenses, 1883	6	1	11
Life Subscription	5	5	0	Expenses of Meetings...	0	19	6
Annual Subscriptions	48	16	6	Donation for use of rooms, &c.	6	5	0
				Fee to Assistant	5	5	0
				Subscription to Ray Society for 1883 and 1884 ...	2	2	0
				Insurance on Books, &c.	0	5	0
				Postage, Stationery, and Journals	5	14	1
				Printer's Bill	17	11	0
				Balance in hand on 31st December, 1884 ...	17	12	3
	£61	15	9		£61	15	9

Audited and found correct,

JOSEPH DEWICK,
EDW. W. BRABROOK, } *Auditors.*

17th February, 1885.

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, & PHOTOGRAPHIC SOCIETY,

BY

The President, Rev. ANDREW JOHNSON, M.A., F.L.S.,

On the 25th FEBRUARY, 1885.

GENTLEMEN,

It was only a very few days ago that I learned that it would be my duty to night to offer you an address. I received the information with some anxiety, for although it may be an easy and a pleasant thing to take one's part in a conversation upon subjects so deeply interesting as those which concern our society, it is a very different matter to be compelled at very short notice to give utterance to a soliloquy which may possibly be printed, and on the shortcomings of which, therefore, one's worst enemy (if such exist) may take the opportunity of leisurely wreaking his critical vengeance. The subject which I have taken this evening is suggested by one of the titles of our Society. I say one, for we are, as Mrs. Malaprop said of Cerberus, "three gentlemen rolled into one." It is somewhat difficult, therefore, to secure each section its fair proportion of consideration, and may be worth while for the Council to consider whether, by some special arrangement for providing discussions and papers on days previously announced on our proceedings card, an opening might not be given to members who are now silent for want of some specified opportunity for rallying round their favourite subject.

The Progress of Photography.

Photography may be described as the Art (or Science) of reproducing the images of objects by the agency of light. Of course it has been known from time immemorial that light has the power of altering or wholly discharging the colours of certain substances; but it was not until the year 1802 that Thomas Wedgewood availed himself of the facility with which nitrate of silver, combined with some organic substance, is darkened by the agency of sunlight, to make experiments in the copying of pictures by this means, and about the same time profiles thrown on the wall were taken at Paris, in the same way by M. Charles, on paper overspread with chloride of silver. You know, of course, that if a diaphanous or partially transparent body, as a piece of lace, or a leaf, be laid upon such a surface, those portions of the prepared paper which are least shaded by the object are darkened in proportion, and we obtain a reversed or "negative" image, in this case a white picture on a dark ground.

Of course it soon occurred to the experimenter, that if he could thus reproduce shadows or images of objects in the flat, he ought to be able to copy solid objects, nay, to realise a landscape itself with its varied outlines, its gradations of light and shade, as it appears on the screen of the camera obscura. But it was found that the silver chloride which was easily darkened by the sun's direct rays, received little impression after indefinite exposure to the very much weaker light which reaches it through the camera lens. Passing by the experiments of Niepce, I come to the important discovery of Daguerre. Daguerre substituted for silver chloride, spread on paper, a thin film of silver iodide produced by the action of iodide on a silver plate. He did get a picture in the camera but it was a weak one and required a very long exposure. One day, however, he put away in a cupboard a plate which had received a very slight exposure, there being, of course, no visible image upon it. To his great surprise the next morning he found thereupon a fully developed picture. After several experiments he discovered that the unexpected result was owing to the action of fumes from an open bottle of mercury which lay in the neighbourhood of the plate. This was the first instance of what is called the development of the latent image.

At the same time that Daguerre in France was availing himself of the action of iodine on a silver plate, Mr. Fox Talbot, on this side of the Channel, was combining the silver with the iodine upon paper. His process which, slightly varied in detail, is still used, is an excellent one, though now considered very slow. A piece of silver is washed with silver nitrate solution, dried, and then floated on one of potassium-iodide; so as to leave silver iodide on and in the paper. On this surface, as in the case of Daguerre's experiments, an image was obtained after very long exposure in the camera. Here again, by a somewhat similar accident it was found that a latent image was formed in a much shorter period, which might be developed by a wash of gallic acid in the presence of free silver nitrate. The Talbotype labours under the great disadvantage that the prepared paper must be used very soon after sensitizing. We saw also that it is very slow. The keeping property of the paper but not its rapidity was improved by the introduction of the *waxed paper* process, which was practised with great success by a distinguished member of this Society.

But it was the introduction of the collodion process which gave the first real impetus to the practice of photography, and brought it within the range of every-day life. Several different vehicles had been suggested for the sensitive iodide of silver—albumen, gelatine, gum arabic,—and it occurred to Mr. Archer to utilize collodion for the purpose. Collodion is, as you know, simply gun cotton, or pyroxyline, dissolved in a mixture of ether and alcohol. In this collodion is further dissolved potassium iodide. A small quantity being poured upon a glass plate, the solvent quickly evaporates, and a very thin, delicate, and transparent film is left behind. The glass is then plunged in a neutral or very slightly acid bath of silver nitrate solution. In about three minutes the salts in the film are converted into silver iodide. The plate is exposed and the film is found to be exquisitely sensitive, pictures being taken in the camera in fewer seconds than minutes were required by the earlier processes, the rapidity being further increased by the addition of a small proportion of bromide. The exposed plate bears no visible image, but if a small quantity of sulphate of iron or pyrogallic acid (in solution) restrained by acetic or citric acid, is poured upon it, the picture rapidly appears. It is then fixed, as it is called, by washing with a solution of soda hyposulphite, which salt has the very convenient property of dissolving away the iodide or bromide of silver which has not been acted upon by light, leaving in its place a more or less transparent film, but not touching, at least for some time, the photographic image. The picture is then dried and varnished. This process is moderately rapid, and cannot be surpassed for delicacy of the finished picture. It therefore at once supplanted the Daguerrotype and Talbotype. Its great drawback arises from the fact that exposure and development must immediately follow the sensitizing of the plates, thus necessitating the transport of lightproof tents, nitrate of silver baths, and other paraphernalia. It is admirable for use in the home studio, but becomes almost an impossibility for the peripatetic amateur.

Let me pause here to explain the *rationale* of "development." When an iodized collodion plate has been taken from the bath and exposed, there is, as we have said, no visible image. Nevertheless, the light reflected from the object has acted upon the plate and reduced the iodide or bromide of silver to a subsalt in proportion to its intensity. The nitrate of silver with which the plate is still moist is reduced by the action of the ferrous sulphate to the metallic state. But the presence of the acid restrainer confines the deposit of silver to the subsalt. Now we know that when one particle is deposited another will follow, and so the picture is built up. Should the restrainer be inefficient, or extraneous light have reached the plate, the whole surface will be darkened by reduced silver, and "fogged" as it is technically termed.

It was found that the exposure and development of the sensitive plate might be delayed for a space of time, varying from a few hours to many years, by washing away the super-fluous silver nitrate, and coating the plate with an infusion or solution of tannin, gallic acid, gum, tea, coffee, morphia, albumen, and other substances, and then drying it; thus enabling the plates to be prepared in bulk at home, carried abroad for exposure, and brought back for development. This great gain in the matter of portability was, however, counter-balanced by a very great loss in sensitiveness, a long exposure being required.

In order to obviate the necessity for employing the objectionable silver nitrate bath, the plan was adopted of combining silver bromide in the collodion itself, an emulsion being thus found which could at once be poured upon the plate, washed and dried. Experiments made, in order to obtain a more convenient vehicle than collodion for this purpose, resulted in a discovery which has within the last three or four years revolutionised the practice of photography. Suffice it to say then that gelatine was found to be that vehicle. The original experimenter would, no doubt, have been satisfied with substituting the aqueous solution of gelatine for the expensive and dangerous gun cotton, ether, and alcohol, even had he gained a degree of sensitiveness only equaling that of bromized collodion. But it was soon found that the gelatinous bromide emulsion when cooked for a week at a moderate temperature, or boiled for half an hour, became most exquisitely sensitive, plates thus prepared exceeding wet collodion in rapidity, bringing down the exposure to fractions of seconds. Nor is this all the gain. In place of having to drag about the cumbrous tent with its wet-plate apparatus, the amateur can now wander about armed only with a camera and a few dry plates; while beautiful pictures of breaking waves, streets crowded with many objects, ships in full sail, a railway train taken broadside on and running at the rate of sixty miles an hour, and of a flash of lightning, show that the title of the instantaneous process is well deserved. Excellent portraits are produced in the studio in a single second, and groups out of doors instantaneously. A strong contrast that to the time when the adventurous sitter had his face artificially whitewashed, and was compelled to remain in the blazing sun for twenty minutes.

I should say that the development of these plates differs from that of the wet collodion in the absence of the free silver nitrate from the bath, and in the alkalineity of the developer, but the principle is analogous. To quote Captain Abney, when you have a strongly oxidizing agent in the presence of an alkali, and a silver compound, solid or in solution, then you have the last reduced into the metallic state. Such an oxidizing agent we have in pyrogallic acid; as in the case of the wet plate a restrainer is needed to induce the developer to confine its action to those parts which have been acted upon by light. This restrainer is found among the alkaline bromides.

The lights and shadows of all objects taken in the camera are, of course, reversed. A positive, as it is called, is therefore printed by the action of light through the original negative on paper prepared with silver chloride. These silver pictures are very beautiful, but liable to fade or decompose, and cannot be absolutely relied upon for perpetuating images. Where durability is required, a different process is resorted to. It has been discovered that soluble gelatine, treated with bichromate of potash, becomes insoluble in proportion as it is acted upon by light. A suitable pigment is therefore added to the gelatine, and the resulting tissue, as it is called, is exposed under the negative. It is then developed by being placed in warm water, when the black portion dissolves out, and the insoluble picture remains. It is by this process that the Autotype Company has reproduced absolute fac-similes of the drawings of the old masters; these pictures are as permanent as carbon or chalks can make them. But each of these direct proofs, whether produced in silver or in pigments, requires to be taken separately, and is therefore the work of time and labour which render it too expensive for commercial reproductions. The question therefore arises can we not employ the negative, or positive taken from it, as a sort of mould or type, and print off from it pictures in bulk, mechanically, in a printing or lithographic press, like a wood engraving or lithograph? This is done, and nearly thirty different processes are employed for the purpose—Woodbury type, Stannotype, Heliotype, Photo-lithography, Heliogravure, &c. A gelatine film, carrying its developed and fixed image, is rolled with great pressure into a soft metal plate, a cast is taken from it by fusible metal, or electrotype, which thus becomes a sort of type or mould from which a picture is taken in a press; the glass plate itself sometimes being taken as the foundation of the die; or a print is taken from a negative in greasy ink and laid down on an ordinary lithographic stone or zinc plate. Perhaps the most elegant of all these processes is the most recent one of Obernetter, which he entitles Licht Kupferdrucht. He transforms a dia-positive image on gelatine bromide into chloride of silver, strips the film from the glass, and places it on a copper-plate. Under the influence of an electric current the chloride of silver is decomposed, the chlorine uniting with the copper, and etching the plate to a greater or less depth according to the thickness of the deposit of chloride, the result being a grained intaglio plate capable of giving the most delicately graduated impressions. It is believed Photogravure will sooner or later entirely supplant engraving by hand.

The applications of photography are innumerable. The artist recognises its value in reproducing Form, and saving him much time in copying details from nature. For the delineation of architecture, and fabrics of all kinds, it is unrivalled. Rock hewn inscriptions hitherto undecipherable are copied and rendered legible. Maps, plans, the most intricate designs, are reproduced with perfect accuracy. Librarians tell us of its value for copying obscure title pages, books in antique spelling, priceless illustrations, far more accurately and cheaply than can be done by hand. It has become an indispensable agent in most hospitals for reproducing anatomical details and morbid growths. Sections of all kinds, bacteria, the minutest organisms, magnified by the highest power of the microscope are rendered as no hand could possibly depict them. In astronomy, splendid maps of the moon's surface, the solar spots, the spectra of comets have been reproduced; while the smallest stars have been registered, the transit of Venus recorded, and the sun's corona photographed not only during an eclipse but in broad daylight. At the Observatories, so admirably has this process been found adapted to register meteorological and electrical measurements that out of many thousand hours' observations not one has been lost by a photographic error. Photography has completely displaced hand painting of slides for the lantern, and converted what was little more than an interesting toy into a most valuable illustrator for the lecturer and the educationalist.

As a feature in our commercial system the practice of photography has taken an important place, giving employment to many thousands of professional operators and their dependents. In one photographic almanac alone I found this year no less than 211 pages full of advertisements of articles appertaining to this art alone, proceeding from 197 different firms. There are in England and Scotland 42 independent Societies devoted to the pursuit of photography, of which 23 have sprung up in the last four years; to say nothing of photographic sections of scientific societies like our own; and lastly I may state that in the past year (1884) alone, 123 applications have been made for patents connected with photographic inventions in the English Patent Office.

ABSTRACT OF A PAPER

READ BY

J. H. HARVEY, Esq.,

ON

"ANTS,"

26th MARCH, 1884.

Ants, like bees, have for a long time been held up as patterns of industry, and even in Grecian mythology their merits are noticed. Our knowledge of ants is by no means restricted to historical times, for several species have been found in the tertiary beds of Oeningen, and many also encased in amber.

In common with all other insects, ants pass through three stages of development before arriving at the "imago" or perfect insect, viz., the egg, larva or grub, and the pupa or chrysalis from which at last emerges the fully-grown ant. The eggs are white or yellowish and somewhat elongated and are not glued to anything when laid. Some say that they are hatched in about 15 days, whilst others have noticed that they take a month or six weeks; which difference may be accounted for by considering that the heat derived from the sun would vary very much with the time of year, and also the observations may have been made on different species. From the egg stage they pass into grubs or larvæ. These are white and slightly conical in form; they are also legless and so are dependent for everything on the workers who feed them by exuding the partly-digested food from their own mouths, and who carry them about in the nest to keep them in an even temperature. If the larvæ emerge from the eggs late in the autumn, they do not turn into pupæ as soon as usual, but lie dormant throughout the winter, as do the ants themselves, and I think that they do not grow at all during that period, because there would not be any ants awake to feed them. It is in this larval state that the ant does all its growing, for though the perfect insects eat, they do so only to furnish food for the larvæ and to sustain their bodies during their work. When the grub is full-grown, which in warm weather takes place in less than a month after the hatching of the egg, it turns into a pupa or chrysalis. The larvæ of some ants spin cocoons for themselves, whilst others remain naked and as a general rule among our English ants those species which have stings, belonging to the Myrmicidæ, do not spin cocoons, whilst those which have not stings, classed among the Formicidæ, usually enclose the pupa in a silken case.

But there are several exceptions to this rule, for some of the Myrmicidæ are found to spin cocoons, and if the nests of Formica fusca and F. flava are in a very sheltered position, such as under a stone instead of a mound of earth, their pupæ seem to dispense with the cocoon, and in the same nest, I think, some have been found with cocoons and others naked. After remaining for a short time in the chrysalis, the perfect and full-grown ant emerges, but in most cases it requires some help before it can escape from the cocoon.

Among ants there are three and very frequently four classes of individuals, viz., the males and females, which when they emerge from the chrysalis have wings, and the workers in which the wings are only represented by a highly chitinised spot. These latter (the workers) form the main body of the community, and on them falls all the work. Soon after the males and females have left the chrysalis they pair off and start on their wedding flight, and this is the only time they use their wings, for the males must soon die as they have no means of providing food for themselves, whilst the females after breaking off their wings by working them backwards and forwards, settle down and hardly ever again move from the nest. It does not seem to be known how an ant's nest is started.

In many species there is a second and larger kind of worker, the difference in size varying with the species, for whilst in Lasius niger there is not much difference between the two kinds, in the meadow-ant, Formica flava, the large workers are nearly twice the size of the small ones, and sometimes the difference is still greater. In the genus Pheidole of Southern Europe, some workers have very large heads so as to give plenty of room for the muscles of the jaw which are largely developed, as they seem to be the soldiers of the community. A Mexican species, called the honey-ant, uses these workers as honey jars in which to store up the honey collected in summer to supply food for the larvæ in the winter. In their bodies the honey undergoes a kind of distillation so as to become something like mead. Some species, though they cannot sting, can eject the poison which is secreted in their bodies to a great distance,—I think it has been stated to as far as eighteen inches—and this seems to have almost as bad an effect as the sting itself. The acid of ants, called Formic acid, is the same as that which is secreted by stinging-nettles, and is very similar to acetic acid.

Queen-ants are produced only by a difference in the food given to them in the larval stage, as there is no apparent difference in the eggs, and this idea is supported by the fact that queens are rarely, if ever, produced from larvæ which have been hatched and brought up in captivity, in which state the ants would not have access to all the different kinds of food which they would obtain in their natural condition.

The queen is naturally the only individual in the nest which lays eggs, but sometimes in a queen-less colony some of the workers lay eggs which, however, never produce other than male ants.

Ants have been proved by Sir John Lubbock to live for as many as six years, and probably longer, though the previous idea was that they died after about twelve months. He has also had two queens since 1874, and in 1881 they were still laying fertile eggs.

The food of ants consists of insects—large numbers of which they destroy—and almost any sweet substance. Although none of our English ants store up food for the winter —indeed their food is not of a nature to allow of this—yet in the S. of France four species provide for the winter by storing up the seeds of grasses, &c., thereby confirming the statement of King Solomon in the Book of Proverbs, which was until quite recently considered to be erroneous. The ants by some means prevent the seeds in their nests from sprouting without destroying the germ, for in a deserted nest the seeds will begin to grow. The harvesting-ant of Texas clears a disc of ten or twelve feet diameter round its nest of everything except a plant called 'ant-rice' and a kind of grass, the seeds from which, when they fall off, are carefully collected by the ants.

Some kin ds—as for instance, Lasius niger, climb bushes to get the larvæ of aphides. When an ant has found one of these, it strokes it with its antennæ, and the aphis exudes from a tube in its back a drop of sweet fluid which the ant drinks. The ants keep these aphides in their nests, and even take care of their eggs until they are hatched.

It seems natural to many kinds of ants to carry off the larvæ or pupæ of other species, and this leads to the strange system of slavery which exists among them. A species, F. sanguinea, makes periodical expeditions to carry off from neighbouring nests the pupæ of the slave-ant, F. fusca, and when the ants emerge from these pupæ, they set about the household duties as if they were in their own nest. Another species has become so dependent on its slaves, that it cannot even feed itself, and its mandibles have lost their sawlike teeth from long disuse.

The worker-ants in a nest are females, whose generative organs are almost entirely undeveloped.

Some species occasionally form a very large colony of nests close to one another. I found near Cambridge a meadow, in which there were over fifty nests of the yellow meadow ant, and they were so close together that they did not cover a space of more than thirty yards by ten.

I think that the intelligence of ants is popularly somewhat overstated, and this idea seems to be carried out by the experiments given fully in Sir John Lubbock's book on ants. Before concluding, I will say a few words about the Termites, which are so commonly mistaken for ants, as is shewn by their popular name of 'white ants.' These belong to the Neuropterous order of insects, while ants are included in the Hymenoptera. Most of the species are confined to tropical countries, where they frequently build conical nests above-ground nearly as large as native huts, which they very much resemble. Like ants, their colonies are divided into three classes of individuals, the males, females, and neuters or workers. The latter differ from the others in having no wings, a stouter body, head much longer, and in being provided with long jaws which cross at the tips. They sometimes make their nests in the wood-work of houses in which they form innumerable galleries, all of which lead to a central point, but in making these galleries they avoid piercing the surface of the wood, so that it appears to be quite sound until it is touched.

PAPER READ

BY

WILLIAM HENRY HAZARD, Esq., LL.B (Lond.)

ON

DRY PLATE PHOTOGRAPHY,

28th MAY, 1884.

The subject of my paper is at the present day a topic so universally familiarized to all educated, (not to mention scientific) men, that it seems to need a brief apology from me as its introducer before I proceed to suggest the equally brief, and (I fear) common-place considerations which I shall venture to address to this Society.

My motive in proposing dry plate photography for discussion arises indeed from no intention of attempting to bring forward an original theory of its phenomena. I can but hope that the numerous members of our Society who are far more fully qualified than myself to state authoritatively the scientific aspects of these phenomena, will aid in rendering the occasion at once interesting and serviceable to those among us who are amateur photographers.

I may therefore be allowed to refer to the numerous dry plate processes, which, prior to the monopoly now secured by gelatine as a vehicle for our silver pictures, were at different times and in various localities in fashion. These all employed the ingenious compound called collodion, as the means of disseminating the sensitive salts throughout that film spread upon a plate of glass, which has ever since photography assumed its popular position in industry, been the most important item in its apparatus. There were, however, only two radically different methods in the preparation of the film. The one, which was based upon the earlier, and till quite lately common, application of the nitrate of silver bath solution, only differed from what was called the wet plate process in interposing an interval between the sensitizing of the plate, by dipping it into the bath, and its exposure in the camera, which with wet plates had necessarily to follow very speedily upon the former. This was achieved by coating the sensitized plate, after washing it in water, with a preservative, generally composed of some familiar household decoction. Thus tea, coffee, beer, albumen, and gum have each been used as a preservative.

But the other group of collodion dry plate processes was dependent upon a different reaction; one, namely, in which the sensitive silver salts were formed in the collodion by the application of a solution of silver nitrate to it, before coating the plate, and not (as with the first mentioned) by dipping the plate, when coated, into a bath. This was termed the preparation of an emulsion, and this process it is which, with the substitution of gelatine for collodion, has given us the nearly perfect material now at the command of photographers. I propose to trace briefly the preparation of a collodion emulsion, with the view of comparing it with that in which gelatine is employed.

The first step was the impregnating (if I may be allowed the expression) of the solution of pyroxyline and ether in alcohol, which constitutes collodion, with a soluble bromide; that is a compound of bromine and some other element from which it will readily part company in favour of the silver contained in silver nitrate—in its turn a readily decomposed compound of that metal. This was done by dissolving the bromide in a known proportion in plain collodion, and then adding to the solution thus formed a given weight of silver nitrate, also dissolved in alcohol. The immediate result of this addition was the formation of bromide of silver, the element previously in combination with the bromine deserting it, to unite with the nitrate left free by the separation of the silver, and forming a new nitrate. The effect of this double decomposition was therefore to cause an insoluble bromide of silver to be intimately blended with every particle of the collodion in which the original bromide had been dissolved, while the new nitrate (which was fortunately readily soluble) remained to be eliminated by either washing the film in water after the plate had been coated, or by a more complicated process of evaporating the emulsion to dryness and then washing the pellicle to which it had thus been reduced, and re-emulsifying it by the addition of fresh ether and alcohol. I need only advert further to the development of the latent picture on a collodion emulsion plate, when produced by exposure in the camera.

The theory of development is no doubt the key to all photographic processes. I will not venture to do more than refer briefly to the methods by which the extension and stimulation of the invisible action of light on silver bromide are attained. I must observe in passing that although I have only spoken of bromide I must not imply that it alone possesses the properties which I have described. The other haloid elements, viz., chlorine and iodine, give also much the same results, but from various causes bromine has taken and seems likely to keep the lead. To return,—the development of what has been called the latent image, (though Capt. Abney, the leading authority on the subject objects to this term,) has been effected in two ways, called respectively physical and chemical development. The former of these worked somewhat crudely though with exquisite results on wet plates, by abstracting the oxygen from the free silver nitrate which was always present on those plates, and depositing the metallic silver on the film. The reason for this deposition following with such exact fidelity the required lights and shadows of the picture, was the formation, by the action of the light in the camera, of an unstable compound termed a *sub*-bromide of silver, containing two atoms of silver to one of bromine, instead of equal proportions of each as in the original bromide. This new compound necessarily left free a certain, though excessively small, amount of silver, which had been deserted for good by its last companion, bromine, and the tiny metallic particles thus existing seized upon their kindred atoms as soon as these were separated by the developer, and formed with them a solid but infinitely delicate deposit on the plate.

The other process, or chemical development, depends of course on precisely the same action of light, but utilizes it in a rather different way. It is only used with dry plates, in which there is never any free silver nitrate, and what is required is to obtain from the bromide compound itself the free silver necessary to render visible the infinitesimal atoms of that metal separated by the light. This is usually effected by pyrogallol, or as it is inaccurately called pyrogallic acid. This substance has a strong affinity for bromine as well as for oxygen, which is rendered very much more intense by adding to it an alkali, and especially ammonia. It then acts in two ways—the pyrogallol takes up the remaining particle of bromine left in the sub-bromide of silver, and thus converts all the bromide which has been acted on by light into free silver. But as even this amount of silver would be imperceptible, the proportion of the bromide in the film directly affected by the short exposure to light which it has received being very small the ammonia is called into play. This dissolves some of the unacted on silver bromide, and renders it susceptible to the action of the pyrogallol, and more silver is thus gradually added to the image, till in the judgment of the operator sufficient has been deposited, when the action is summarily stopped by a copious application of cold water.

Further than this I must not go in speaking of development, though I have not even commenced to state all its principles. I must pass on to the modification of the dry plate process which now prevails.

What I have said indeed has been chiefly with the object of shewing how little the modern revolution in dry plates has affected the now time honoured processes. With the single substitution of gelatine for collodion, (though of course with corresponding alterations in the proportions used in formulae), a marvellous change has been worked in photography. Where with collodion dry plates, (especially those which had been treated with beer as a preservative), hours were necessary to obtain a picture of a landscape, less than as many seconds, and even a fraction of a second, now suffice; and it is not only the time of exposure that is, I may almost say, annihilated. The other conditions to obtaining sun pictures, such as for some subjects the necessity for bright sunshine, and the impossibility of photographing interiors lighted through stained glass, as well as the vexatious blemishes which often spoiled an otherwise satisfactory negative, have disappeared.

A short description of the preparation of gelatine dry plates will bear out my statement that all this depends on no fundamental change in dry plate formulae. In working with gelatine, nitrate of silver is dissolved as before, (though this time in water), and mixed very gradually, and with constant stirring, with a soluble bromide which has been dissolved with a small quantity of gelatine in hot water. This is found to produce silver bromide in an excessively fine state of division, though it is not yet very sensitive to light. The mixture is however now generally boiled, or sometimes treated with ammonia, and it has been allowed to remain for some time in a cold state. All these treatments result in the silver bromide becoming highly sensitive, though I must confess that the reason for this is not clear to me. No chemical change appears to take place in it, though it alters considerably in color, and the ultimate tint which it attains, a kind of blue grey, is not the most sensitive. However this may be, when the emulsion is sufficiently ripe, as it is termed, it is either allowed to solidify by cooling and washed in a dry state, like collodion emulsion, or the silver bromide is precipitated and re-emulsified with fresh gelatine and water. After washing, it is ready for use, with the addition of some more gelatine to enable it to set properly, and it can be kept for an indefinite time either before or after coating, or even exposing, the plates.

Development is almost universally effected in England by pyrogallol and ammonia in the same way as with collodion plates. But abroad a solution of ferrous oxalate is used, which works more slowly, and has been thought to allow of more latitude in the exposure.

Thus the radical essentials of the formation of silver bromide in the emulsion, its washing to eliminate the soluble nitrate also formed, and the development of the picture, are practically unchanged, and it only remains to speculate, for I fear I cannot do more, on what may be the cause of the alteration in the effects produced by the new process.

The action of light on a sensitive film is no doubt mechanical. The interesting contrivance known as the radiometer, I think, demonstrates this, and it is besides difficult to conceive how light *per se* can set up chemical reaction. That the impression on the film is not caused by the heat rays is also certain. It therefore results that the bromide in the film must either be more accessible to the blow which its exposure to light entails, or that the medium which contains it must permit the effect of this blow to be more deeply, for I must not say widely, transmitted by means of the developer. Unfortunately gelatine is so complex and inconstant a body, that it is extremely hard to trace any definite change in it, caused by its treatment in emulsifying. But it is to the use of gelatine rather than to any modification of the sensitive salt that we should, I think, look for an explanation of the increased rapidity and other phenomena which I have mentioned. I must, however, offer this suggestion with the greatest diffidence, as I make it without authority, and I must apologize, by anticipation, if it should prove to be misleading. I may, in conclusion, tender my thanks to the Society for the honour which has been done me in allowing me to open what I hope may be a valuable and not an unrepeated discussion on photography.

NOTES
ON
THE PHYSICAL GEOGRAPHY AND GEOLOGY OF WESTERN CANADA,

BY

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26th NOVEMBER, 1884.

THE object of this paper was to give a brief account of Western Canada, and more especially of such parts of the country as were seen during the excursion of the British Association. The most important excursion was that to the Rocky Mountains. Starting from Toronto, the party took rail to Owen's Sound; then steamer over Lakes Huron and Superior to Port Arthur, then again the railway, past Winnipeg and over the Prairies, to the Rocky Mountains.

The country between Lake Superior and the Rockies may be divided into four zones, each corresponding with geological structure.

(*a.*) The most Easterly zone is that between Lake Superior and the Red River Valley. This is a wooded hilly region, formed chiefly of crystalline Laurentian rocks, the oldest rocks known. The rocks lie at steep angles, often almost verticle, the edges of the beds having been worn away by long continued denudation. In long past geological times these Laurentian rocks may have stood up as great mountain chains; but what we now see are only the stumps and cones of the old mountains. The latest denudation has been that of the glacial period, when a great sheet of ice overspread the whole of Canada, and stretched far into the United

States. The evidence of this is seen in the grooved and polished surface of the rocks, when these are freshly exposed, and in the deposits of boulder clay and gravel which overspread the country.

These deposits, over the district traversed by the Canadian Pacific Railway, are not sufficient to entirely cover up the solid rocks; the general character of the country is rocky with marshy hollows, which are in some cases due to ice-worn hollows in the solid rock, and sometimes to deposits of drift blocking the drainage. In these marshy hollows the vegetation is peculiar, as is described by Mr. Mennell. The whole of this area is unsuited for settlement, the soil being poor and thin, and the woods thick; but it contains many districts of great natural beauty. The neighbourhood of the Lake-of-the-Woods being especially fine.

(*b*.) The next zone is that of the Prairies, which stretch across the continent to the "Foot-hills" of the Rocky Mountains. These Prairies may be divided into three parts. In the East there is the Red River Valley, in which Winnipeg (the old Fort Garry) stands. This is a great plain, opening out to the North to include Lake Winnipeg and the neighbouring lakes. It is entirely formed by alluvial deposits of the Red River, and contains some of the most fertile soil in the world. In many farms large crops have been raised continuously for sixty years without any manure. Land of similar character stretches up the North Saskatchewan River; and again, further North-West, along the Peace River.

The Western limit of the Red River Valley is a low range of hills, the Eastern limit of the 2nd Prairie level on which Regina stands. This Prairie is formed of a variety of drift deposits, mostly loamy and of good quality. A series of hills rise from the plain; these are mostly formed of gravel, and when so are generally wooded, but the normal character of the Prairie is a vast grassy plain.

West of Regina we come to another belt of rising land, which extends southwards into the States, and is known as the "Missouri Coteau." This forms the Eastern limit of the 3rd Prairie level. The solid rocks are rarely exposed across the Prairies, but may be seen in the river valleys. They are mostly of Cretaceous and Eocene age, with some of an intermediate age. In fact, the great gap in time which in Western Europe exists between the Chalk and the beds next above, is here bridged over. The beds of this doubtful age contain important seams of coal, which are now being largely opened out. Near Medicine Hat, the coal is bituminous; here it lies in a nearly horizontal position beneath the drift soils of the Prairies.

Where the Cretaceous and Tertiary rocks come to the surface the soil is sometimes alkaline, and much difficulty is found in obtaining pure water. But alkaline soils are also formed where the drainage has been blocked by drift deposits, and where evaporation has taken place, leaving the solid matter of the river water in the soil. In these places the Flora is very peculiar and interesting.

(*c.*) The third zone is that of the "Foot-hills" of the Rocky Mountains. It has no strongly marked boundaries; it shades off into the Prairies on the East, and into the wilder regions of the Mountains on the West. The rocks comprising it are of various ages, but are often greatly disturbed. The coal is here a true anthracite, the change in character being probably due to the great disturbance of the beds. These "Foot-hills" contain districts of great natural beauty. Scattered woodlands, open glades, meadows with rushing streams, rapidly succeed each other. This is the great "ranching" district of the North West.

(*d.*) The last and most Westerly zone is that of the Rocky Mountains, in which the scenery is exceedingly wild and beautiful. The rocks, chiefly of Palæozoic age, are deeply carved into precipitous valleys and gorges. They are thickly covered with forest in their lower parts, but the higher regions are bare, whilst the peaks are snow covered.

ON THE

FLORA AND VEGETATION OF WESTERN CANADA.

BY

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26th NOVEMBER, 1884.

Mr. H. T. Mennell followed Mr. Topley; his address, on the Flora and Vegetation of the Canadian Dominion, being chiefly directed to show their dependence on the Geological features of the country as described by Mr. Topley.

The Eastern and Central regions of Canada, including the Great Lakes (consisting chiefly of Laurentian Rocks, overlaid over a large area by glacial deposits, boulder clay and drift), are still and have formerly been universally clothed with forest; where the rocks crop out, they are rounded, and worn into hollows of varying size, with little or no drainage from them. The larger ones form lakes and pools, the smaller and more superficial depressions—bogs and marshes, or "swamps," as they are called in America. Here we find the characteristic swamp Flora of the American Continent, consisting largely of flowering ericaceous shrubs, Kalmias, Andromedas, Vacciniums, Ledum, Chiogenes, &c., familiar to us as the "American" plants of the Nurseryman, with these are a rich flora of reeds, sedges, and rushes, three species of Osmunda abound, and the noble carnivorous Sarracenia purpurea is a striking feature of the wetter portions of the bog.

The forests consist, besides the numerous Coniferous Trees, of a large variety of species of Maples, Birches, Poplars, with Oaks, Walnuts, Hickories, &c., in the Southern portions. The trees are mostly ill grown, crowded, and comparatively small. The undergrowth and wood margins are rich in shrubs, Corni (including the beautiful dwarf C. Canadensis, with its brilliant crimson berries), Guelder Roses, Elders, &c.

The vastly greater number of species of trees in America strikes a stranger; this is due to the mixture of Northern and Southern forms, the latter having met with no Geographical barrier, like the Mediterranean in the case of Europe, to prevent their gradual return northward at the close of the glacial period.

The herbaceous Flora of Forest regions is always poor in species, hence when the land is cleared, as a large portion of the Eastern States of the Union and of the Dominion was, by forest fires during the Indian occupation, and later by the settler, a floral vacuum resulted (as Professor Asa Gray describes it), and to fill this, Northern, Southern, and largely Foreign introduced forms rushed in, and hence we have to a large extent here a derivative, non-indigenous flora, and we see a vast number of the most familiar weeds of the Old World flourishing in abnormal vigour. The Mullein is a good example of this.

Passing westward beyond the Lakes to the Great Prairies, consisting largely of rich alluvium resting on cretaceous clays, we have an entirely distinct and thoroughly indigenous flora, in Spring and early Summer, presenting a carpet of brilliant and beautiful flowers.

Leguminous plants, especially species of Astragalus, Petalostemon, Lupinus, and Lathyrus, and Composites, of the great American genus Aster, Solidagos or Golden Rods, Rudbeckias, Liatris, Erigeron, &c., are the most striking features.

This flora is of interest as containing so large a number of plants, recently introduced into our gardens, among the now fashionable "hardy perennials." Some, however, such as species of Aster (Michaelmas Daisies), Golden Rods, and Sun Flowers, are among the oldest denizens of our gardens.

The Tree Flora of the Prairies is extremely meagre. Chiefly small poplar by the river banks, and round the pools.

Certain tracts of the Prairie, where the underlying Cretaceous rock has been denuded of the alluvium and eroded, or where we have small isolated drainage areas without any outlet except evaporation, a saline condition is found greatly modifying the Flora. The genera are mostly the same, but the species are distinct, and all assume a grey green, mealy or hoary appearance, which distinctly marks the landscape. This is the so-called "Sage Scrub." The most striking plants here are the aromatic Artemisias, and two dwarf Cacti, Opuntia Missouriensis, and Mamillaria vivipara.

Passing from the Prairie with its entirely American Flora, to the Rocky Mountains, a remarkable change is at once observed. As the Flora becomes alpine, the genera and species approximate more and more closely to our own Swiss and Scotch alpine Flora; this alpine Flora is therefore of great antiquity, and has survived the climatical changes of long ages—changes the operation of which have been common to the whole Northern Continental area of the world. In one long day's ramble among the mountains from the summit of the Kicking Horse Pass up to the snow line, 196 species of plants were gathered and named, of these about 40 per cent. were European. Among them were many of our most familiar and beautiful Alpines, such as Silene acaulis, Saxifraga oppositifolia, Lychnis alpina, Dryas octopetala, Draba incana, Oxytropis campestris, Potentilla fruticosa, (a Teesdale plant, there growing on or near Basaltic intrusive dykes, as it does also on the shores of Lake Superior) a Trollius closely allied to ours, Carex atrata, &c., &c. The ferns also are identical with our own; the Holly Fern, Parsley Fern, Asplenium Trichomanes and viride, Cystopteris montana, Woodsia, Lycopodium annotinum, &c.

The most marked absentees, are the Primulas and Gentians, which form so striking and beautiful an element of the European Alpine Flora.

Among distinctive plants are the three species of Bryanthus or Menziesia, which take the place of our true heaths, here absent. Several liliaceous plants, as Smilacinæ, Veratriums, &c.

The Forest Trees here are almost all Coniferæ, and attain a large size, though far short of their brethren on the Pacific slope of the Mountains. We observed ten species of Conifers, amongst which may be noted the Banksian Pine, Douglas' and Engelmann's Spruce, Larix Lyallii, &c.

Speaking broadly, we find in the journey across the continent, four Floras, viz., the Eastern mixed Flora of the cleared lands; the forest and swamp Flora of the lake region from Ottawa to Winnipeg; the Prairie Flora, and the Alpine Flora of the Rocky Mountains. Their boundaries are well-marked and definite. The railway is however a great leveller, and it was interesting, not only to see our common weeds rapidly spreading along the track westward, but also to find some Western types and species travelling eastward, as for example, the very singular grass, Beckmannia erucæformis, which we found at Port Arthur, on Lake Superior, many hundreds of miles east of any previously recorded habitat.

DIGEST OF A LECTURE

ON

"CRYSTALLISATION,"

BY

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28th JANUARY, 1885.

THE crystal, par excellence, both by virtue of its exceedingly common occurrence and its beautiful variety of form is Water Crystal, or Ice, and, indeed, the class name Crystal comes to us from the Greek word (krustallos), meaning clear ice.

The word Crystal seems always to have been associated with an idea of value and beauty, although doubtless applied indifferently as a general term to many substances (gems, rock-crystal, &c.), exhibiting, by the light of modern chemistry, widely differing properties and composition. Thus, in the Bible (Job xxviii. 17), "The gold and the crystal cannot equal it."

All matter in the chemist's arrangement falls under one of two heads, and is either Amorphous or Crystalline.

A good instance of an Amorphous substance is a piece of clay, whose properties we will consider. It possesses no fixed definite form, may be cut with equal difficulty in all directions, is opaque to light, conducts heat equally badly in any direction through its mass, and cannot certainly be accused of possessing any brilliancy or lustre whatever. It is, in fact, shapeless or amorphous, *i.e.*, not built up on any fixed geometrical plan about certain lines (the axes) as crystals are.

Quite distinct in character is a crystalline mass of Ferro-cyanide of Potassium (Yellow Prussiate of Potash), a substance used in the manufacture of Prussian blue.

Its form is definite, and built up geometrically about its axes ; it is transparent, and if we attempt to cut it, it differs in an important respect from the amorphous mass of clay. It cuts easily in one direction, splitting into thin plates, like mica. This is said to be the direction of the plane of cleavage of the crystal, and by exertion of much force the crystal may be cut in other directions ; not, however, splitting readily into thin plates as before, but being merely pulverised. We may note, in passing, that these crystals have been grown on a piece of string, as sugar-candy is ; the string is lowered into a strong solution of the substance, and greatly facilitates crystallisation by affording a suitable bed or growing ground.

The essential and distinctive features of a crystal are that it is geometrically built up about certain lines (the axes) ; exhibits a tendency to split more easily in one direction than another, this direction being termed the plane of cleavage, and the tendency is held to be evidence of regularity of internal structure, confirmation being obtained by the optical properties and mode of expansion by heat, which are generally found to be similar for crystals of the same class.

The occurrence of the same substance in a constant geometrical shape has enabled us to arrange crystals under six general classes.

Each class includes many substances, differing widely in *chemical composition*, but exhibing the same *geometrical shape*, and such substances are called, in a general sense, *Isomorphous* (Greek = same shape).

One and the same substance may occur in two or more *distinct* crystalline forms, such difference can generally be clearly attributed to the presence of a larger or smaller quantity of water in combination with the substance, or to the formation of the crystal under differing conditions of pressure, temperature, etc.

A series of models, showing the typical forms found in each class, were exhibited at the conclusion of the Lecture.

Of the formation of crystals in the earth but little is at present known, and the report of work done in the laboratory to interpret this portion of the book of Nature is so laden with technicalities that it will not bear abstraction with advantage.

This, however, we must remember, that the more slowly a crystal is grown, the finer the crystal obtained; and we, feebly imitating Nature, have but a brief time to effect our experiment; consequently, to obtain in one year, month, or week the result yielded in Nature's laboratory by an age's growth, we must compensate for the shortness of time by proportionately increasing other conditions of experiment—a necessity fraught with the greatest difficulty.

The specimens of natural crystals exhibited are very large and fine—the results of gradual growth—compared with those which can be obtained in an evening; still, it is not altogether impossible that even the diamond may be grown by artificial means, though the success attending attempts to produce it has been at present but small.

Water, united with other substances, plays a most important part in determining the colour, and even the form, of their crystals.

On taking some of the large blue crystals of Sulphate of Copper, powdering them roughly, and introducing them into a glass retort, we find, on applying heat to the vessel, that the crystals split and steam rises from them, passing down the neck of the retort, and condensing as clear water in the receiver. At the same time the blue crystals crumble, and lose all geometrical shape, becoming almost white. Chemical examination proves that the only difference between the fine blue crystals and the white amorphous powder is, that the former is Sulphate of Copper, with water in combination; the latter, Sulphate of Copper deprived by heat of the water previously held in combination.

We are led, then, to the conclusion that both the colour and crystalline form of this substance depend on the presence of water in combination with Copper Sulphate, and this may be clearly shown by the converse experiment.

Placing on a plate some white Sulphate of Copper (deprived of its water by means of heat), and pouring pure water upon it, immediately the blue colour returns, the added water recombining with the Copper Sulphate, and the white amorphous powder regains at once its colour and crystalline form. Water so combined with a crystal, that when heat is applied to it it is driven off, leaving the crystal amorphous, is termed *Water of Crystallisation*; and such water is generally driven off when the point of temperature is reached at which water boils (*i.e.*, 100° Centigrade, or 212° Fahrenheit).

Another interesting fact, shewing the important part water plays in determining crystalline form, is that one and the same substance (for instance Carbonate of Soda), will combine with different amounts of water, the crystalline form being in many of these cases entirely different, according to the amount of water of crystallisation present.

The so-called *Sympathetic Inks* are now easily understood. We take a weak solution of Cobalt Chloride in water and brush it over cartridge paper. The characters traced are practically invisible, for Cobalt Chloride, united with its water of crystallisation, exhibits a pale pink colour, but on warming the paper over a lamp the water of crystallisation is driven off, and the Cobalt Chloride becomes dark blue, the characters traced being now easily seen. If steam were blown over the paper, the water of crystallisation would be again taken up, the pink colour restored, and the characters fade away.

Barometric Flowers, very commonly seen some five or six years ago, were cut out of linen and dipped in solution of Chloride of Cobalt. When the air was laden with moisture —rain impending—the flowers were pink; if, on the contrary, the air was dry—portending fair weather—water passed from the flowers to the air, leaving them blue, and from the colour the coming weather could be predicted with some certainty.

Another property of crystals deserves attention. We take some crystals of Chloride of Calcium and place them on a glass plate, placing the whole in one pan of a balance, adding weights to the other pan until equilibrium is attained. The crystals are now dry and the balance true, but almost immediately they become damp, absorbing moisture greedily from the air, and the balance is disturbed, more weights being required to compensate for the moisture taken up from the air. This absorptive property is termed *Deliquescence*, and is made use of to keep valuable apparatus dry and free from rust; for if a pan of Calcic Chloride is placed under the glass case of the instrument, the air is kept constantly dry, all moisture being taken up by the deliquescent body.

Again, to obtain gases dry, it is only necessary to pass them through a long glass tube loosely packed with fragments of the same substance (Calcic Chloride). Some crystals exhibit an exactly opposite tendency, thus Sulphate of Soda (Glauber's Salt, discovered by him in 1658) is, when first exposed to air, perfectly colourless and transparent, but quickly becomes white and opaque, owing to water passing *from* the crystal to the air—such crystals are said to be *Efflorescent*.

Mr. Bloxam then demonstrated some of the methods by which crystals may be quickly obtained.

(1.) *By Sublimation.*

In this method a volatile substance is converted by means of heat into vapour, which is condensed by contact with a cold surface yielding a crop of crystals.

Place in a large glass flask some powdered Iodine, and warm the bottom of the flask over a lamp. A magnificent violet vapour rises (whence Iodine takes its name), and on meeting the cool upper portion of the flask, deposits very brilliant grey-black crystalline plates of pure Iodine. Again, suspend a bunch of leaves and fern in the top of a glass bell-jar, which is placed over a dish containing a substance called Benzoic Acid. As before, vaporize the substance by heat, and the hot vapour, meeting the cold leaves, is deposited on them in long white silky needles imitating closely ordinary hoar-frost.

(2.) *Fusion* and slow cooling.

Fragments of metallic Bismuth are crystalline, but the crystals are so intermingled that no clear idea is obtained of their individual form. Melt the metal down in an iron ladle until the whole is well molten, and set it aside until the *surface* metal just begins to solidify again—through contact with the cold air—then quickly pierce with an iron rod two holes through this crust, and turning the ladle upside down, the still liquid metal from the interior is poured out, leaving a crust of metal the shape of the ladle.

On allowing this to cool, detaching it from the ladle, break it with a hammer, when the inside is found to be covered with beautiful and characteristic crystals of metallic Bismuth. Sulphur, treated in a similar manner, leaves a mass of long, yellow transparent needles.

(3.) *Electro deposition.*

By this method, many metals may be deposited from solutions containing them on a mass of metal introduced into the liquid.

In two large flasks were placed the following solutions in (1) Lead Acetate (prepared by dissolving metallic Lead in Acetic Acid), (2) Chloride of Tin (prepared by dissolving metallic Tin in Hydrochloric Acid), and to each flask pure distilled water was added. A piece of zinc was suspended by means of a thread in the neck of each flask, allowing the metal to rest an inch or two below the surface in each case.

An interesting change was seen to take place, for on the surface of the zinc, in both instances, crystals of metal were quickly deposited: on examination, the deposit in (1) proves to be crystalline metallic Lead, in (2) crystalline metallic Tin. The appearance of the crystals is very different, those of Lead exhibiting a purplish lustre, whilst the Tin appears like silver.

We, in this manner, obtain crystals of the metals Lead and Tin by simply placing pieces of Zinc in contact with their solutions, and it is worthy of remark that an interchange of metals goes on in each flask, so that, if time permitted, all the Lead and all the Tin would be withdrawn from the solutions, Zinc taking their place, (1) finally containing *only* Zinc Acetate, (2) Zinc Chloride.

The possibility of thus depositing one metal on another is the basis of the operation of Electro-plating, and the metal is said to be obtained by Electro-deposition.

(4.) *Solution.*

This may be called the general method of obtaining crystals, and the liquid in general use as a solvent is Water.

A very large percentage of substances which we have in common use will dissolve in water, and if we place salt, sugar, or alum in contact with cold pure water, in suitable vessels, we shall obtain solutions of them.

Every substance which dissolves in water does so in obedience to a definite fixed law, which may be enunciated as follows :—

(1) Of one and the same substance a fixed amount is always dissolved by water at the same temperature.

(2) For nearly all substances the amount dissolved is greater as the temperature of the water is higher.

We unconsciously demonstrate the second law by *boiling* any substance with water, when we wish to dissolve a large quantity of it : this increased solution holds good for most solid substances, but there are some which dissolve to a greater extent in cold than in hot water, good instances being Lime and Strontium Sulphate.

By the first law, it follows that if we take some crystals of Alum, powder them, and place them in a beaker, and cover with cold water, they will continue to dissolve until we reach a limit at which no more of the substance dissolves, unless we warm the water. If we now poured off the solution of Alum and weighed it, and repeated the experiment with more Alum and water at the same temperature as in the first experiment, we should find the *same* weight of water at the *same* temperature would always dissolve the *same* weight of Alum.

Experimenting on the various substances which dissolve in water in this manner, using throughout the same weight of water at the same temperature, we are able to arrange the substances in the order of their solubility.

A cold saturated solution of any substance is obtained by stirring the solid with cold water until further solution ceases, *i.e.*, the limit of solubility is reached for that temperature.

A hot saturated solution is obtained by treating the solid with boiling water until again solution ceases.

If a hot saturated solution be allowed to cool gradually, the converse process takes place, the water as it cools is able to dissolve less and less, and the excess is deposited on the sides of the vessel, becoming finally *a cold saturated solution*.

This deposition is very prettily seen when a hot saturated solution of Lead Iodide in water is cooled by running cold water over the outside of the containing flask. Almost immediately, crystalline plates, resembling fragments of gold leaf, separate out from the liquid, for the water, as it cools, being unable to hold so large an amount of the solid in solution, deposits it gradually and continuously until just so much is left in solution as it can dissolve when cold.

In the previous experiment, it was seen that a hot saturated solution began to deposit the excess of dissolved matter immediately its temperature fell, but it has been found that under certain circumstances a hot saturated solution may be cooled without such deposition taking place.

If distilled water be boiled in a flask, and Alum added so long as it dissolves, the water boiling steadily the while, a true hot saturated solution is obtained, close the neck of the flask with a plug of clean cotton wool whilst the liquid is still boiling, and set the flask on one side to cool: it is now found that the water deposits no crystals on cooling, but remains perfectly clear; and, indeed, if the flask be not shaken or exposed to great cold, the liquid will remain quite free from crystals.

In this state the water is said to be *Supersaturated*, for if we remove the plug of wool from a solution, previously prepared in the manner we have indicated, and a crystal of Alum be dropped on the surface of the liquid immediately, crystals of Alum grow rapidly on this *nucleus*, and to so great an extent does this take place, that, in a minute, the liquid of the flask has become apparently a solid mass of Alum crystals.

This sudden crystallisation is attended by a large evolution of heat, so great as to be appreciable by the touch; or if, on the introduction of the crystal of alum, the bulb of a mercurial thermometer be placed in the liquid so soon as crystallisation sets in, the mercurial column rises, indicating an evolution of heat.

At this stage, we may say, occurs a sudden manifestation of heat, and so true and just is Nature, that we look back into the history of solution to find whence this heat comes. We have a large thermometer of special construction, consisting of a large, thin glass bulb, blown at the end of a glass tube, of which the free end dips into a cistern of coloured water. The bulb and tube is filled with air, and if, by any means, we cool the bulb, the air contained in it contracts, and the coloured liquid rises from the cistern into the long tube, a contrary effect being observed if a hot body is placed in contact with the bulb. Such an arrangement is termed an *Air Thermometer*, and is far more sensitive to heat and cold than the ordinary mercurial instrument, but its bulk prevents its general use. Surrounding only the bulb with a glass vessel, in which water can be placed, we are now in a position to observe what heat changes take place on dissolving a solid in water.

If we pour cold water into the vessel, and wait until the level of the coloured liquid, in the long tube, remains constant, and then add powdered Nitre (Potassic Nitrate) to the water, stirring to promote solution, we find that the coloured water rises rapidly in the narrow tube, indicating the production of cold, or, to state it in scientific language, *there is an absorption of heat*. And experimenting on various soluble substances in succession, we find that heat is absorbed—or rendered latent—during solution, and that that amount of heat is evolved, or given back to us on crystallisation.

The general law may be stated that a solid, on melting to a liquid, or a solid dissolving in a liquid, absorbs heat, which is given out again when the molten liquid solidifies, or crystals are deposited from solution.

Having considered the evolution of heat on crystallising a supersaturated solution, we will now notice some special properties pertaining to the state of supersaturation.

In the first place, the existence of a supersaturated solution evidently depends upon the plugging of the neck of the flask, and as the early experiments were made with flasks corked or sealed whilst boiling was in progress, it was supposed that a partial vacuum being created, crystallisation could not take place.

Now we take a flask containing a supersaturated solution of Sulphate of Soda (Glauber's Salt), which has been plugged with an india-rubber cork whilst the liquid boiled; and we have some difficulty in removing the cork, a partial vacuum being created by the cooling and consequent contraction of the air in the flask, but immediately we succeed, the air rushes in with considerable violence, and crystallisation immediately follows.

Apparently, then, something in the air itself causes crystallisation, and we see that this active principle is removed by allowing the air to filter through a plug of cotton wool (for this latter may be substituted for a cork in the flask) the liquid still remaining supersaturated.

It sometimes happens that if we remove the wool air-filter with very great care, that the solution does not crystallise even, although in contact with unfiltered air, and will remain clear, as was shown in the case of Sodic Sulphate, for some seconds ; but on placing a minute dust of the same substance on the hands, and rubbing them together over the flask, crystallisation immediately ensues, as if by magic.

We may now vary the experiment by shewing that not only is *filtered* air unable to effect crystallisation, but that air which has passed through water or has been heated strongly, is equally inert.

Thus, by a suitable arrangement, we pass air down a tube plugged with cotton wool, and then through a supersaturated solution of Sodic Sulphate, which remains unaffected, and air expired from the lungs, or, steamed air, are alike ineffectual; but if ordinary air be driven, by means of a pair of bellows, into the liquid, crystallisation follows.

The foregoing experiments point clearly to dependence on material particles in the air as a starting point of sudden crystallisation, and it will be noted in the experiments above, that whenever means were adopted to exclude or destroy these particles, the air proved by itself impotent to cause crystallisation. Moreover, it has been found that these particles causing crystallisation must be themselves crystalline, and therefore the application of heat or steam to air containing them, by destroying or dissolving the crystals, renders the air inert.

Again, a supersaturated solution of Alum is not affected by the introduction of clean crystals into it—if these be of different chemical composition—even though they be of identical crystalline form.

Thus, we wash crystals of different substances and drop them gently into a supersaturated Alum solution, but no result follows until, on introducing the minutest fragment of Alum, crystallisation sets in from the nucleus and extends rapidly through the solution. The resemblance between the propagation of crystallisation and that of infectious disease is thrust upon our notice by these experiments, for in both cases we find a material particle of a definite and fixed nature to be the active principle. This active principle may be removed by means, some of which are common to both cases, and we note that just as the lethal germs of disease are carried hither and thither freely in the air, so are the crystalline particles translated; indeed, so numerous do the particles of a common substance like Sodic Sulphate appear to be in air, that it is hardly possible to expose a supersaturated solution of this substance, to unfiltered air, for at most a few minutes, without crystallisation following.

We may be pardoned the flight of imagination if we push the resemblance a little farther, to suggest that a supersaturated solution which does not crystallise, though crystals are brought in contact with it, is the case of the healthy man who breathes germ-bearing air with impunity, and the last experiment possesses some interest when thus considered. In a cylinder are two supersaturated solutions, placed in contact one above the other, and containing Sodic Acetate and Sodic Hyposulphite respectively. If, now, we drop a washed crystal of Sodic Acetate, it falls harmlessly through the layer of Sodic Hyposulphite being inert to it, but as soon as it reaches the lower layer immediately is active, and crystallisation follows. If, now, a crystal of Sodic Hyposulphite be dropped into the upper and still liquid layer, that, in its turn, falls a victim to the active germ.

It is interesting to compare the two solutions to a man in good and bad health, subject to the same material germ, the one escaping, the other falling under the baneful influence.

RULES.

(As amended at the Annual Meeting, 22nd February, 1882.)

1.—The Society shall be called THE WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY, and have for its objects the promotion of the study of Natural History, Microscopic research and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s., in one sum. All subscriptions shall be due on 1st January in each year.

3.—The affairs of the Society shall be managed by a Council, consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and Auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.*

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MEETINGS OF THE SOCIETY

FOR THE SESSION 1885-86.

WEDNESDAY,	MARCH	25
,,	APRIL	22
,,	MAY	27
,,	OCTOBER	28
,,	NOVEMBER	25
,,	DECEMBER	16
,,	JANUARY (1886)	27
,,	FEBRUARY ,, ANNUAL	24

—:o:—

THE CHAIR IS TAKEN AT 8 O'CLOCK.

—:o:—

THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

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WEST KENT
Natural History, Microscopical and Photographic Society.

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FOR 1885-86.

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1886.

WEST KENT

Natural History, Microscopical and Photographic Society.

THE

PRESIDENT'S ADDRESS,

PAPERS,

AND

Reports of the Council & Auditors,

FOR 1885-86.

WITH

RULES, LIST OF MEMBERS AND CATALOGUE OF THE LIBRARY.

GREENWICH:
PRINTED BY E. G. BERRYMAN AND SONS, 84, BLACKHEATH ROAD.

1886.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 25th, 1885.

FOR THE SESSION 1885-86.

———:o:———

President.

REV. A. JOHNSON, M.A., F.L.S.

Vice-Presidents.

R. MCLACHLAN, F.R.S., F.L.S., &c.
H. T. STAINTON, F.R.S., F.L.S., &c.
F. T. TAYLER, M.B., B.A., &c.
J. JENNER WEIR, F.L.S., F.Z.S.

Hon. Treasurer.

TRAVERS B. WIRE.

Hon. Secretaries.

H. HAINWORTH. | HUGH WILSON.

Council.

H. F. BILLINGHURST.
E. CLIFT.
F. G. COX.
J. DEWICK.
T. O. DONALDSON, M. Inst. C.E.
G. H. FREAN.
W. GROVES (Lee).
STUART KNILL.
W. G. LEMON, B.A., LL.B., F.G.S.
E. R. PEARCE.
FRED. W. SMITH.
FLAXMAN SPURRELL, F.R.C.S.
J. MORRIS STONE, M.A.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society.

Elected at the Annual Meeting, February 24th, 1886.

FOR THE SESSION 1886-87.

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President.

T. O. DONALDSON, M. Inst. C.E.

Vice-Presidents.

REV. A. JOHNSON, M.A., F.L.S.
W. G. LEMON, B.A., LL.B., F.G.S.
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F. G. COX.
J. DEWICK.
W. GROVES (Lee).
HERBERT JONES.
STUART KNILL, ALDERMAN.
R. MCLACHLAN, F.R.S., F.L.S.
E. R. PEARCE.
H. T. STAINTON, F.R.S., F.L.S.
J. MORRIS STONE, M.A.
F. T. TAYLER. M.B., B.A.

REPORT OF THE COUNCIL,

FOR THE SESSION, 1885-86.

THE Council have to report that the Society continues to maintain its position, although its numerical strength is slightly diminished. The total number at present is 106, viz., 6 honorary, 7 life and 93 ordinary members.

The loss by death includes Professor John Morris, F.G.S., for many years an honorary member, and Mr. J. M. Burton, F.R.C.S., who was one of the founders of the Society, and took an active part at the meetings.

The accounts of the Honorary Treasurer have been duly audited, and shew a balance in hand on the 31st December, 1885, of £5 10s. 11d. There are still some items outstanding for the expenses of the Soirée, but there is the large sum of about £45 due to the Society for subscriptions in arrear.

The Council regret to have to remind many members that a Society like this cannot exist without funds, and that for a small society the sum outstanding is unduly large. The ordinary meetings of the Society have been well attended, and valuable papers have been read or objects of interest exhibited at each of them. The papers or abstracts thereof will be published with this Report.

The Soirée was held on the 20th of May, 1885, in the large hall adjoining the Congregational Church, Blackheath, which was, as on many former occasions, kindly placed at the disposal of the Society for that evening. The Council have to thank the Rev. Dr. Lansdell, for his very interesting lecture on "Turkestan," Messrs. Edwards, Wainwright, and Young, for the flowers, &c., so generously lent by them, and the many members and friends of this and other local Societies for their valuable contributions. The attendance was far larger than usual.

The Field Meeting took place on the 24th June, at Rochester. After visiting the Cathedral and Castle, the party drove to Cobham, where, by the kind permission of Lord Darnley, they were shown over the Hall and Park. The Old Church, famous for its numerous brasses was also visited. The members and their friends returned by way of Gad's Hill to the "Bull" Hotel, at Rochester.

On the 18th July, the members and their friends dined together at the "New Falcon" Hotel, Gravesend. The President introduced the subject of "Foreign Birds in Captivity," for discussion.

The Cryptogamic Meeting was held on the 10th October. On this occasion the members of this Society were joined by those of other local Societies, and were conducted by Dr. Spurrell, from Abbey Wood Station, through Abbey Wood to Belvedere. Many species of fungi were collected and named by the President. A list of these is given on the following page.

The Council have to thank Mr. W. P. Bloxam, F.C.S., for a most instructive lecture on "*Explosives*," which he delivered and illustrated by numerous experiments on the 16th January, 1886. All the experiments were very successful, and an abstract of the lecture will be published with the Report.

A valuable addition to the Library has been made by the presentation by Mr. T. O. Donaldson, of a copy of a work "On the Construction of Timber," by John Mill, M.D., *published in* 1774.

The Council would be glad if Members would make known to their friends the existence of this Society, and would be pleased to welcome any new Members.

FUNGI FOUND AT THE CRYPTOGAMIC MEETING, OCTOBER 10TH, 1885.

Amanita mappa
rubescens
vaginatus
Lepiota cristatus
Armillaria melleus
(abundant)
Tricholoma acerbus
terreus
lascivus
nudus
Clitocybe nebularis
phyllophilus
dealbatus
fumosus
infundibuliformis
flaccidus
pruinosus
laccatus
Collibia platyphyllus
butyraceus
velutipes
stipitarius
Mycena tenuis (?)
sanguineolentus
vulgaris
Omphalia buccinalis
Galera tener
Flammula decipiens
(on charred ground)
Claudopus variabilis
Panæolus campanulatus
Lactarius blennius
insulus
piperatus
quietus
subdulcis
Russula furcata
emetica
heterophylla
Lenzites betulina—
Boletus chrysenteron
subtomentosus
luridus
Polyporus squamosus
Phallus impudicus
Lycoperdon pyriforme
Scleroderma vulgare
Crucabulum vulgare
Peziza carbonaria
(covering the charred ground)
Craterellus cornucopioides
Dædalea unicolor

Statement of the Accounts

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, & PHOTOGRAPHIC SOCIETY,

For the Year ended 31st December, 1885.

RECEIPTS.	£	s.	d.
Balance in hand on the 1st January, 1885 ...	17	12	3
Annual Subscriptions	33	1	6
	£50	13	9

PAYMENTS.	£	s.	d.
Expenses at Meetings and Lecture	3	5	3
Donation for use of rooms, &c.	6	5	0
Fee to Assistant	5	5	0
Subscription to Ray Society, 1885	1	1	0
Stationery, Postage, &c.	5	12	0
Journals	1	13	4
Insurance of Books	0	5	0
Printer's Bill	16	1	3
Soirée Expenses	5	15	0
Balance in hand on 31st December, 1885 ...	5	10	11
	£50	13	9

Audited and found correct,

19th February, 1886.

J. JENNER WEIR, } *Auditors.*
HERBERT JONES, }

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL, & PHOTOGRAPHIC SOCIETY,

BY

The President, Rev. ANDREW JOHNSON, M.A., F.L.S.,

On the 24th March, 1886.

GENTLEMEN,

I very much regret that I was not able to be present at your Annual Meeting in February, for I fear that the Presidential Address now delivered a month after date must appear somewhat stale. The Report of the Council has already been presented to you and furnishes full information as to the present position of your Society.

The past year has not proved very eventful. Our monthly gatherings have presented fewer blanks than usual, there having been a fair supply of Papers read, some of which have possessed very considerable importance and interest. These Papers or abstracts thereof, will of course be published with our Report. I heartily wish that it were possible to preserve some record of the discussions which followed; some of the remarks made from time to time possessing a value almost, if not quite, equal to that of the original Papers themselves.

The Conversazione has been described as a great success; a result which was due to the liberality of the Exhibitors and to the zeal and energy of the Sub-Committee.

The Field Meeting in June was very well attended, and, if many scientific discoveries were not made on that occasion, most of us will at least preserve a delightful recollection of the various beauties of nature and art which were presented to us on that glorious summer day.

The Cryptogamic Field Meeting or Fungus Hunt was much more successful and enjoyable than the unpromising opening of the day led us to expect, and I believe that we were favoured with a more numerous attendance than on any previous occasion. May your President, as one specially interested in the subject which is supposed to occupy attention on that annual outing, venture to suggest that some arrangement should be made for the systematic collection and identification of the mycological specimens. It is impossible to recognise every species which is met with during a rapid march in the waning light of a late autumn afternoon. Possibly an earlier start, some organization for the collection of specimens, and a provision for their transport to a convenient centre for examination, might bring to a focus the labours of the day which are now somewhat aimless (of course I speak from a scientific point of view) and would add considerably to our knowledge of the local Cryptogams.

At present the social element in our Society may be thought to prevail over the strictly scientific. Probably many will consider this an advantage rather than a subject of reproach. The more important scientific societies have their inner Clubs for the cultivation of social amenities apart from their severer pursuits. We combine both in one.

It is indeed doubtful whether a local and especially a suburban Society can in any case maintain itself upon science alone in the present day. The study of Natural History in its several branches is every day becoming more and more of an exact science and demands its rigorous apprenticeship—and this can only be carried out successfully at the great centres. Certainly one of our old-fashioned Naturalists would be surprised if he could see the amount of practical work, of minute and even painful training, which is required of students in Biology, with its handmaids, Botany and Zoology, as they are represented at Cambridge and South Kensington. Again, concentration is the order of the day in intellectual pursuits as well as in those of a commercial character, and now that locomotion is so easy, it is not surprising that both enquirers and those who have the results of long and careful observations to communicate, gravitate towards the great societies at Burlington House and elsewhere, where men of mark most do congregate, or else impart their observations to the specialist journals, where they are sure to find the largest number of appreciative hearers and readers.

But while for these reasons we are likely to be disappointed if we expect to have to record startling discoveries or to achieve notoriety as a Society, still a most useful field lies open to associations like our own. Our very presence here to-night shews that in our informal intercourse and mutual interchange of experiences as well as in the more formal discussion of topics of common interest, we, each of us, expect to gain as well as give something: we are all of us lovers of Nature, and some are her diligent servants though in different fields; Nature, who is such a beneficent mistress that while she reserves her richest rewards for her most patient and devoted followers, she leaves neither the humblest nor the youngest enquirer to go away empty-handed; Nature, of whom we may safely say what Xenophon makes Socrates declare of a country life, that her pursuits are alike profitable to the body and the soul. For Nature, while she affords the most exquisite gratification both to the intellect and to the senses, yet never wearies the one nor dulls the other with satiety, such is her exquisite variety. She exacts no price or penalty for her richest favours. Her most devoted service brings no remorse in its train, damages no future, and weakens no constitution; but unlike most other pleasures, it brings health and peace of mind, if not wealth with it.

In one branch of Natural History our Society is fortunate in possessing some members who have a national, nay, a world-wide reputation. I think that the younger Entomologists of Blackheath hardly understand their opportunities, or they would come in greater numbers to sit at their feet. Again the Society used to be great in Microscopical work. How is it that so few members bring their Microscopes to the meetings for the common instruction, as they used to do? As to our other pursuit, Photography, I myself have striven during the last two years to make our Society more responsive to its title of "Photographic" as something more than an empty name, but with only partial success. I hope that our new President, who is himself a Photographer, will not allow the matter to drop. It should be remembered how well this last-named of our professed pursuits is calculated to assist the rest; indeed, I think it is not sufficiently well understood how easy it is to produce the fleeting images of the minutest objects under the microscope by means of photography, how valuable are the results as permanent objects of study, how exquisite they are in detail—far surpassing in fulness and accuracy the most elaborate hand-drawings. I have seen a *bacterium* photographed with a one-tenth of an inch object-glass, again enlarged, and the image of the resulting photograph made by the aid of a lantern to cover a screen eight feet in diameter in such a manner as to shew distinctly the granular formation of its protoplasm.

I had proposed to myself this evening to present to your notice a complete review of the progress which has been made in an important branch of mycological science, viz., the Agaricini, during the last twenty years. The publication of Mr. Berkeley, "Outlines of British Fungology," made in 1865, affords an excellent starting point. Our acquaintance with the Cryptogamic Flora, especially the Fungi, has shared in the great advance made in all branches of Science during the present generation. With respect to our British Mycology, the labours of Berkeley and Currey, of

Dr. Bull, and latterly of Worthington Smith and Dr. Cooke, who indeed commands a whole army of observers, have greatly extended our knowlege of the species which are visible to the naked eye, while with respect to those which require the aid of the microscope for their investigation, a new territory has been acquired, which is bounded only by the powers with which the skill of the optician has supplemented our vision.

Nor is our interest in this research merely of a scientific character; the malign influence which many of the smaller fungi have been proved to exercise upon our agricultural and domestic economies has compelled attention with a view to restrain and counteract their ravages. The *Mucedines* or *Moulds*, the parasites which feed upon the tissues of the higher plants; the *Botrytis* or silkworm disease; the *Oidium* which has paralysed the vine-growths of Madeira; the *Peronospora* of the potatoe disease which has caused such disastrous famines; the *Pucciniæ*, distinguished by their articulated spores, of which the wheat mildew is a type; the *Cœomacei*, including the "*Bunt Rust*" and other simple spored fungi; all these though minute are formidable enemies to the agriculturist; but their interest has recently been eclipsed by that excited by the latest addition to the kingdom—viz., the *Schizomycetes*, the Splitspilze of the German naturalists, atoms of exceeding minuteness which propagate themselves by fissure as well as by spores. One genus of these, Bacterium, is now fascinating the attention of physiologists, for it is said to possess a terrible power of self-multiplication at the expense of the living tissues and fluids of its unlucky host. But I propose in this paper to confine my attention to the additions which have been made to the list of one of the most conspicuous of the families of the Fungi—viz. the Hymenomycetes—and only to a single order of these, viz., the Agaricini.*

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*As this paper consisted principally of strings of names of little popular interest though of much technical importance, the President proposed that it should be taken as read, and passed on to consider the subject of Edible and Poisonous Fungi.

Edible and Poisonous Fungi.

I have often been asked if it is possible to distinguish the poisonous from the non-poisonous or eatable Fungi, and I am compelled after much reflection, to answer that it is impossible to do so except by personal experience. No hard and fast rule can be laid down. It cannot be said of any genus or alliance that all its members are wholesome or the reverse. On the contrary a reference to the two sheets of illustrations,* which I have the honour to present for the acceptance of the Society, will shew that one species may be a wholesome and even delicious article of food, while its next door neighbour of the same genus contains a most dangerous poison—nay, the nature of the noxious principle varies continually—in one case it is a simple narcotic, in another a narcotic irritant, that is to say if the poison does not kill by narcotising it goes on to irritate the organs and disturb or destroy their functions; while a third kind is simply irritant, each requiring a totally different medical treatment. It seems unfortunate that this injurious property should be attached to substances which are in themselves so wholesome and nutritious.

The fleshy kinds of Fungi abound in Albumenoids, most valuable for nutrition, their nutritive value being indicated by the percentage of Nitrogen which they contain. This percentage is very high in Agarics, much higher than in any other class of vegetable food. Many of these Fungi, perhaps 200 kinds, are esculent, although we cannot recommend more than 40 or 50 as being in all respects desirable. On the other hand we find mixed up with these, apparently indiscriminately, some 50 species, the juices of which are known to possess properties more or less injurious to the human constitution, and as I said these injurious kinds can only be distinguished by experience.

* The sheets to which the President constantly referred, were prepared by Mr. Worthington Smith, and contained very accurately drawn and coloured representations of all the desirable Fungi, and also of those known to be most injurious.

To illustrate my meaning I take the first sub-genus of Agarics on the sheets—namely, *Amanita*. In this section the spores and gills are white, and where a sheath at first encloses the plant it soon breaks up into a cup at the base, leaving patches or scales on the cap or pileus. *Amanita rubescens* is a very common Fungus in woods ; it is esculent and highly prized by some people, though to myself it tastes like whitewash. Now its immediate neighbour—*Amanita phalloides* is virulently poisonous; even a portion of a single plant has been known to produce death. In this case the poison seems to reside largely in the bulbous base of the stem. It is an alkaloid which in common with the poison of other Amanites is called Amanitine. The action in all seems to be the same ; it is narcotico-acrid; the symptoms comprise derangement of the nervous system, rapid coma and death ; smaller quantities produce functional disturbances. Its chemical constitution is $C_5 H_{15} NO_2$, its proper title, Trimethyloxethylammonium hydrate.

It is a remarkble fact that this base seems to be identical with the animal bases—*choline* which is obtained from bile, and *neurine* which is obtained from brain and nerve tissue—thus giving us another link between these Fungi and the animal kingdom. Now if you take away from this base two atoms of Hydrogen you get Muscarine, $C_5 H_{13} NO_2$, a still more poisonous alkaloid which is found in *Amanita muscarius*, a lovely Fungus of a brilliant scarlet colour, closely allied to the esculent *A. rubescens* already mentioned. Its trivial name arises from the fact that it used to be employed as a fly poison. In Eastern Siberia it is used to produce a wild and furious intoxication. Although Muscarine is more active as a poison than Amanitine, yet *A. muscarius* is not so injurious as some other Amanites, probably because in it the alkaloid is less concentrated. *Amanita vernus* which, as its name implies, is found in spring and which is white in all its parts, and *A. mappa* which is white or primrose coloured, are two most graceful and innocent looking Fungi, but yet they are full of Amanitine, and therefore very deadly. On the other hand we have another Amanita (*strobiliformis*) a very large Fungus which is most wholesome and delicious; again *Amanita vaginatus* is good and wholesome. I may say that the poison of Amanita may take a whole day before it begins to act, but then proceeds most rapidly; its venom is also absorbed by the skin when laid or rubbed upon it with precisely the same results as when swallowed.

In the sub-genus *Russula*, we again find noxious and innocent species intermixed. *Russula heterophylla*, with white gills and solid ringless stem, having a cap varying from green to purple in colour and known by its sweet nutty flavour is excellent eating; so is *Russula alutacea*, with buff gills and red or pale crimson caps, but on the other hand some species are very noxious. For instance, *Russula sanguinea* and *Russula emetica* (which at first sight is very similar to *R. alutacea*.) The poison is narcotico-acrid in character, when externally applied the juice is harmless in so far that although it will produce outward inflammation, it exhibits no toxical effects whatever through absorption, its effects thus differing directly from those produced by Amanita.

The sub-genus *Lactarius* contains some wholesome and several most noxious species; from all of them alike a milky juice exudes when the cap is broken. The name *deliciosus* applied to a *Lactarius*, which is always found in fir plantations, speaks for itself. *Lactarius volemum*, rich in colour with buff gills, when fried resembles lamb's kidney, but these are the only safe species. Beware of *Lactarius rufus*, "the slayer" as it is called, the most deadly of all, with its chestnut coloured polished cap and corrosive white juice, this also is found in fir woods. Its action is different from that of *Russula* or *Amanita*—a very small quantity of it kills immediately; the poison being violently irritant, producing inflammation and ulceration of the intestines, and causing so much agony that death is welcomed.

The whole of the sub-genus *Hypholoma* is very baneful; *H. fasicularis* is the commonest of all Agarics, growing everywhere all the year round on stumps of old wood, in clusters or bunches. It bears a speedy, violent, and exceedingly virulent poison of a terribly irritant kind.

None of the *Entolomas* are safe. Mr. Worthington Smith records that he was nearly killed by eating a very small portion of *E. sinuatus*; he suffered fearfully and did not recover for nearly a fortnight. Another species *E. clypeatus*, the "Buckler," produces delirium and paralysis when swallowed in very small quantities. Its essence seems entirely narcotic, and in this it differs from the earlier mentioned kinds.

From these dreadful species it is a relief to turn to such pleasant and wholesome species as *Psalliota campestris*, the common mushroom, and its variety *arvensis*. *Lepiota procerus* or "parasol" mushroom, with its very scaly top, moveable ring and deeply pitted gills is, I think, the most delicious of all Fungi, mushrooms included. I believe that all the *Lepiotæ* are edible, though not equally nice. *Coprinus comatus*, a black-spored Agaric, is singularly rich, tender, and delicious; last year I saw quantities growing in an old burial ground in Tooley Street. Then there is the "plum" mushroom, *Clitopilus prunulus*; the "St. George's," *Tricholoma gambosus* a rare delicacy, and one of our very few Agarics which appear in the Spring; the "Clouded Fungus," *Clitocybe nebularis*; and the little *Marasmius oreades*, the "True Champignon," which is to be found on Blackheath, and which grows in large quantities in the fields between Kidbrook and Eltham, possessing an exquisitely rich and delicate flavour which must be tasted to be understood. This species will keep a great length of time when dried, and is admirable for giving flavour to stews or soups. But beware of its brother *Marasmius urens*, which sometimes grows with it, for it is decidedly poisonous. Mr. Worthington Smith gathered it by mistake, and ate some, very much to his discomfort.

Passing from the gilled Agarics to the tube-bearing Fungi, we have the *Boleti*, of which a score may be eaten, at least half that number being of a first-rate quality; *Boletus edulis* is very good, nutritious, and wholesome, but *Boletus felleus* must be shunned; it has a bitter taste and pink spores. The same is to be said of *Boletus piperatus*, which is highly acrid—*Boletus luridus*, common and distinct enough with its bright red under surface, and flesh turning blue when bruised. *Boletus satanas*, a magnificent and rare Fungus, is more virulent than the others, though not perhaps so bad as its name would suggest, certainly not half so bad as the beautiful, tempting, but terribly poisonous Amanites. Boletus poison is irritant, and acts immediately; the symptoms are severe but soon subside and leave no after effects. Indeed, the worst kinds, when dried, may be safely stored and cooked.

Other esculent non-agarics are the Chantarelle, looking like a ball of gold, a well-known delicacy, which must be also distinguished from its congener, the false Chantarelle: *Fistulina hepatica* or "Liver" Fungus, which I have found in Epping Forest, and which has been called the vegetable beef-steak, its taste resembling beef in a remarkable manner, it carries with it its own acid sauce; it generally grows on the oak. Then there are the *Hydna*, with spines in the place of gills. The morell and the truffle are both of them well known; and the giant puffball, often no larger than an apple, but sometimes attaining the size of a child's head, is very delicious when taken in a young state, cut into slices and fried in fresh batter.

But I have said enough to show how much good and nourishing food is stored up in these humble members of the vegetable kingdom, and how much care and discernment is necessary in attempting to use them for culinary purposes.

Meeting held 25th March, 1886.

Mr. Brabrook exhibited, by permission of Mr. J. Park Harrison, M.A., three albums of photographs, collected for the Committee of the British Association, appointed for the purpose of obtaining photographs of the typical races in the British Isles.

Mr. Brabrook also communicated a correspondence which had taken place between Mr. Lingard, Professor of History; T. Mason, of Washington, and himself, with regard to a remarkable case of hereditary hypospedias, involving indirect atavism, communicated by Mr. Lingard to the *Lancet* newspaper.

ON THE CULTIVATION & MICROSCOPICAL EXAMINATION OF MICRO-ORGANISMS

BY

THOMAS MOORE, Esq., F.R.C.S., S.ScC. Camb.,

MAY 27th, 1885.

UNDER the name Micro-organisms are included several varieties of Microscopic Fungi,* which, although so minute that the lens has probably still to be invented that will show the smallest of them, are yet setting the scientific world by the ears, and have produced a vast amount of ill-feeling and bitter argument.

It would be superfluous for me to go into their general history and morphology now, as that subject was so ably dealt with by your late President, Dr. Francis Tayler, in his inaugural address last year, which has been printed in the Society's transactions. It is necessary, however, for the elucidation of this paper, to remind you of certain facts about them.

They and their spores exist in myriads, in the soil of the earth, and in water, especially if it be stagnant, and contain much organic matter, in fact, wherever decomposition is going on. Thence they are easily displaced, and wafted about by the slightest breath of wind, for they are so light, that a single moist bacterium has been estimated to weigh but the ten thousandth part of a milligramme. They are found consequently, in great numbers in the air, and their presence there is the great difficulty to be contended with in making artificial cultivations of them.

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* Called also Microbes, from *μικρός* little, and *βίος* life; and Micro-zymes, from *μικρός* and *ζύμη* ferments.

Another characteristic is their rapidity of growth, which is most extraordinary. Cohn, the German naturalist, found that a certain bacterium could double itself in two hours, and calculated that a single specimen, if unhampered, would become 4,772 millions in 3 days, and that under a week its progeny might fill the ocean. Fortunately this somewhat allegorical idea can scarcely be realized, for the "rolling sea," from the antiseptic properties of the Iodine of its waters, and of the ozone of its surface, even from its very restlessness, is by no means a good "culture medium." Many other things moreover hinder their indefinite reproduction. In water, monads and other small creatures feed upon them; in confined places they overcrowd and destroy one another; in the air they become dry and shrivelled up if long exposed.

A few words about their uses and functions in the economy of nature. They appear to exist to split up complex dead organic compounds, which would otherwise be useless, into more simple substances, such as ammonia, nitrates, and various gases, so as to fit them to be the food of plants.

They thus act as the principal scavengers of the earth's surface, as well as chief manure producers, and the world could not very well get on without them; yet, whilst playing this beneficent *rôle*, they are unfortunately gifted with the power of doing much evil, and are the causes of most noxious smells and of dire diseases.

The Blastymocetes, or Yeasts, which have been most carefully investigated by Pasteur, preside over the fermentations. One produces that of sugar into alcohol, the most abused and lauded of liquids; so that without them we should have neither beer, nor wine, nor grog,—nor drunkenness. Another causes alcohol to further ferment into acetic acid or vinegar, so that to them we owe our pickles, and the flavour of our salads; whilst others produce Lactic and Butyric fermentations and the like, which cause abominable compounds to appear in our milk, beers, and other articles of consumption. Of such importance indeed has a knowledge of these organisms become to brewers, that many of them keep a well-paid analytical chemist on the premises, whose duty it is to superintend the working of the wort, and take care that no deleterious organism is allowed to grow in it.

The Schizomycetes or Bacteria act also by a process akin to fermentation, but they have no particular affection for sugar, for they principally attack dead organic matter. In extracting its favourite nourishment from its food each one, much as do the yeasts, breaks it up into its elements, and produces a secretion peculiar to itself, which may be mere colouring matter, some acrid or stinking product, or some poison inimical to the growth of itself or species, and deadly to animals or the human race. Indeed the Bacteria are credited with being the causes of most of the diseases which human flesh is heir to; and it has been proved that they are the causes of suppuration (*i.e.*, of the formation of matter), in wounds, so that the use of antiseptics, to prevent their growth, is now pretty generally adopted by surgeons after operations.

The Hyphomycetes or moulds, act in a similar way; and although they are of a somewhat more complex structure, appear to finish off the scavenging which the others began. There is no doubt that some of them also are the causes of disease.

Now, as regards the nutriment of Micro-organisms, they require substances containing nitrogen, carbon, certain mineral salts, and water. Most of them flourish best in oxygen, *i.c.*, in the air, and are hence called Aerobies. Some grow best out of it and are called Anaerobies.

They may be cultivated artificially in many ways. Some grow well on potatoes, and the colour producing bacteria make very pretty objects on them. Their presence in the air may be easily shewn by this means.—Take two slices of newly boiled potato, cut with a knife which has been heated to redness, put one on a plate under a glass bell-jar at once, let the other stand for half-an-hour or more in the air, so that dust may fall upon it, and then put this also under a bell glass jar. In two or three days the latter will be covered more or less with growths of bacteria and other fungi, whilst the former will be almost or quite free from them.

To grow pure cultivations on potatoes, they should first be washed, and then soaked for half-an-hour in a solution of bichloride of mercury (1 part to 1,000 of water), as no micro-organism can grow in this, and afterwards steamed until they are cooked; each potato should then be carefully cut in two with a knife which has been heated to redness, and each piece, with the cut surface uppermost, put on a plate under a bell glass. On the plate should be laid three or four thicknesses of blotting paper, soaked in the aforesaid solution of bichloride of mercury, to supply moisture which is necessary for the growth of the organisms, the whole being covered with a bell glass. The potatoes are then inoculated by being scratched with a platinum needle, set in a glass handle, which has been previously heated to redness, in a Bunsen's burner or spirit lamp, and dipped in the organism to be grown.

On the table are several specimens of such cultivations, the blood-red Micrococcus Prodigiosus, the scarlet Micrococcus Indicus, the yellow Micrococcus, the black Torula, the violet Bacillus, &c.

They may also be grown in milk, in various meat broths, and in solutions of certain organic materials.

The method now most generally used is one introduced by Koch, the German bacteriologist, by which they are grown in solid media in test tubes, because in these they form what are called colonies; and it is an extraordinary fact that nearly every bacterium has some peculiarity in its growth, by which it may be distinguished from every other. The microscope will shew whether an organism is a yeast or a micrococcus, a bacterium or a bacillus; but one micrococcus, for instance, so examined, is just like another, though when grown in a solid medium they may appear as different as chalk from cheese.

The most useful culture medium is a "meat jelly," composed of a pound of lean beef made into a broth, with a litre of water, to which is added 5 per cent. of gelatine, 0.5 per cent. of peptone, and 0.25 per cent. of common salt. This is cooked and filtered, according to directions which may be found in any of the undermentioned works on Bacteriology, and is transferred to sterilised test tubes, plugged with sterilised cotton wool. The filtration, which is absolutely necessary to secure a perfectly clear medium, is a most tedious process, so that I should advise anyone who wishes to experiment with cultivations of bacteria, to buy the tubes of nutrient material ready made.

Most important is the sterilisation of the jelly in the test tubes. They are placed in iron crates in a steaming apparatus, like that in the room, and kept at a temperature of 100°C. for 15 or 20 minutes. This kills all micro-organisms, but not their spores. To get rid of them the tubes are kept at a temperature of from 80° to 90°F. for 24 hours, which causes them to germinate; and then the steaming process is repeated for 10 minutes or so, to kill the fresh growths. The next day the process should be repeated; and afterwards the tubes should be kept at the same temperature for three weeks, when, if they remain perfectly clear, they may be pronounced sterile. The steaming should not be carried on for more than 20 minutes at the outside, or the jelly loses its consistency, less than 10 minutes will not kill the bacteria. Some of the tubes, on the table were prepared in this way more than a year ago, and you will see that the jelly is still perfectly clear.

This jelly is suitable for the cultivation of those organisms which will grow at the ordinary temperature of the air in summer; but many flourish only at 90° to 100°F., at which it melts. To get a mixture which will remain solid at this higher temperature, Agar Agar, or Japanese isinglass, is used instead of the gelatine. The drawback to this, however, is that the shape of the colonies is not so well marked in it.

Steriiised blood serum is another medium in which some micro-organisms grow best, especially the Tubercle Bacillus. This is obtained from the blood of the Ox or Sheep, and is sterilised and rendered solid, without losing its transparency, by an elaborate process, which want of time prevents me from explaining now.

As the atmosphere abounds in bacteria, and moulds and their spores, all the apparatus employed must be sterilised by heat before being used. All flasks, test tubes, beakers, and the cotton wool for plugging, should be exposed for three hours to a heat of 130°C. in an iron box similar to that on the table. Or the glass apparatus may be heated for a minute or two in the flame of a Fletcher's or Bunsen's burner, but this method, though expeditious, is attended by woeful destruction of the glass. The hands of the operator, after being well washed in soap and water, and well cleansed under the nails, should be rinsed in the aforesaid solution of bichloride of mercury (1 to 1,000).

To inoculate the jelly in the test tubes a platinum needle, with a glass handle, previously sterilised by being heated to redness, is dipped in the organism to be propagated. The plug of the tube is then carefully withdrawn, whilst the tube is turned upside down to prevent dust falling in, and the needle is thrust for a distance of an inch, into the meat jelly, and finally the plug is replaced.

As before stated, the majority of micro-organisms form colonies of different shapes when thus grown. On the table are some thirty cultivations, and no two are alike ; so that they may be distinguished from one another better by them, than by their appearance under the microscope. For instance, here are four specimens of micrococci, which look exactly alike under the lens, but the first, a micrococcus found in milk, forms merely a thin white line along the needle track ; the second, found in some forms of inflammation of the lungs, the m. pneumoniœ, grows along the track and forms also a large round head on the surface, so that it looks very like a tenpenny nail; the third, the m. osteomyelitis, found in certain diseases of bones, liquifies the gelatine, forming a white film on its surface, and a red sediment at the bottom; whilst the fourth grows in a yellow mass on the surface.

Quite different from any of these, the Bacillus of Anthrax, grows out in a thick cloud from the needle track, and ultimately liquifies the gelatine; whilst that which produces septicæmia, or blood poisoning, in mice, grows in a very delicate thin cloud, and does not liquify the gelatine.

If it be desired to separate Bacteria from one another, or from tissues in which they are growing, plate cultivations are made use of. A test tube is inoculated in the ordinary way; but as this will contain too great a number of organisms, the jelly is melted by immersing the tube in warm water at 40°C., shaken up, and a little of it poured into another tube. The jelly in this is again melted and shaken up, and poured out carefully on to a piece of sterilised plate glass, about two inches square. This is placed on moist blotting paper, on an ordinary plate, and covered over with a bell glass. The micro-organisms will be separated by this process, and a colony will grow round each one. As nearly every Bacterium produces a different shaped colony, any one may be picked out, on the point of a platinum needle, under an inch or half inch lens, and a test tube may be inoculated with it; thus, what are called "pure cultivations" are made.

To examine micro-organisms whilst growing, especially to see the formation of spores, a small quantity of the jelly may be placed in a glass cell, with a cover glass over it, luted with vaseline, and inoculated in the usual way.

Micro-organisms grow best at different temperatures, according to the species, and an incubator is necessary for those which require summer heat or more. This is a tin box, with double walls containing water, which is kept warm by a Bunsen's burner beneath it. The heat may be regulated by a Page's regulator; and the one in the room has sometimes, in my laboratory, scarcely varied three degrees in a week.

To observe Bacteria under the microscope it is best to have a good one-eighth dry lens, which will shew all the larger ones fairly well. But for the smaller varieties it is absolutely necessary to have a high power. There are several of these on the table, lent by Messrs. Beck, and the best of them is their one-tenth water immersion, which defines very clearly.

The lens to my own microscope is a one-twelfth oil immersion made by Powell and Lealand. It was used at the Biological Laboratory at the Health Exhibition for all the more important investigations which were carried on in it, and was the best there.

There must also be an achromatic condenser affixed to the substage. This is merely a lens turned upside down to concentrate the rays of light from the mirror on the lower surface of the objects. I have had one fitted to my microscope by Messrs. Beck, but you may see that Dr. Tayler has made one for himself, with an ordinary object glass, which answers the purpose admirably.

To examine micro-organisms in the fresh state, a minute portion from a cultivation may be placed on a slide, with the point of a platinum needle, a drop of sterilised distilled water being added, if necessary, and covered with a clean cover glass. They look like glittering moving particles, and are best seen through a small diaphragm, admitting but little light.

The most satisfactory way, however, of preparing Bacteria for the microscope is by staining, for they will take the colouring matter of certain aniline dyes, whilst fatty and albuminous granules, which may be mistaken for them, will not do so. A little of the specimen is placed on a cover glass, with a small drop of sterilised distilled water, and another cover glass is placed upon it. The two glasses are then moved upon one another, between the finger and thumb, until there is a well distributed film on each. They are then put up on end to dry and afterwards passed three or four times through the flame of a spirit lamp, to set the film. A little of the dye is filtered through some fine filter paper into a watch glass, and the cover glasses, with the film downwards, are floated on it. They are left for half-an-hour or more, according to the dye used, are then taken off with platinum forceps, washed in water, then in diluted acetic acid (1 per cent.), to take out any superfluous stain, again washed in water, and put on end to dry. Next they are mounted in Canada Balsam, and are fit for examination under the microscope. Stained specimens are best seen with a large diaphragm and much light.

To examine Bacteria in tissues, sections must be cut with a freezing microtome, and treated as above. There are other and more elaborate methods of preparation, but as I fear I have already trespassed too long on the patience of the Society, I will refer you for them to "Magnin's Bacteria," by Sternberg, to Klein's "Micro-organisms," to the works of Pasteur, and to the article by Watson Cheyne in the International Health Exhibition Handbooks on Public Health Laboratory Work.

DOMESTIC ANIMALS,

BY

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16th DECEMBER, 1885.

Part I.—Mammalia.

For more than half a century I have been familiar with animals in captivity, and have had not less than a hundred species under my personal care, often as many as thirty species at one time, with this experience I have permitted myself to speculate on the subject of Domestic Animals.

A clear distinction must be drawn between domestic and merely domesticated animals, to the first category, as I define it, the Ox, Horse, Dog, and Cat belong, to the latter, the Elephant, Cheetah, Mongooz and others.

The distinction drawn between the two classes is, that, a domestic animal is one that has been tamed by man and adapts itself so thoroughly to the altered conditions of its environment, that its fertility in confinement is in no way decreased, but on the contrary is in most instances very much increased, thus, such animals having been for ages subjected to man, and having had all their wants supplied, have in most instances lost many of the instincts of their wild progenitors, and even their forms and constitutions have undergone such changes, that, if liberated they would be unable to survive in the struggle for existence necessitated by a feral life.

On the other hand, those I define as Domesticated Animals are simply wild animals tamed, subjected to man sometimes for an useful purpose, as the Elephant; sometimes to be used in the chase, as the Cheetah, Otter, or Falcons, and often merely as pets, as Monkeys, Squirrels, Dormice, and most cage birds.

It is clear that between the latter class and the ordinary tenants of menageries, there is every possible link, and it is highly characteristic of the animals exhibited in Zoological Gardens, that very few species reproduce in captivity, and even in those rare cases in which young are produced, but few are reared, and a much smaller number reproduce in the second generation, and still more rarely in the third. I have myself often observed the most promising cases of fecundity in newly imported specimens, ending in the sterility of the offspring in the second or at most the third generation.

The fact appears to be that of all the functions; that of reproduction is the most highly specialized and the most easily disturbed.

It is those only who have had great experience with wild animals in captivity know what difficulty there is in keeping in life and health those that have been born in the menagerie, as compared with those captured wild, subjected as the latter have been to all the vicissitudes of their journey to this country, often thousands of miles ; no doubt numbers die on the road and the weakest are eliminated.

I have had a bird bred in captivity die in a few hours, simply as the result of a change of cage, and I have known a Giraffe bred in England die of fright when an unguent was applied.

I do not in this paper propose to deal with others than Domestic Mammalia.

On the threshold of my subject it is startling to find that out of the many hundreds of species so very few are domestic.

Taking *Mr. Alfred Russell Wallace's Geographical Distribution of Animals* as my guide, I find that he enumerates the species of Mammalia as 2,668, of these but 23 are domestic, even when three useless pets are included, this is not one per cent. of the known species.

This restriction of the number must be qualified in one sense, that it is almost certain that many domestic animals are hybrids, but even when such is the case it is probable that domestication began with one species, which has since been hybridized.

An animal to become domestic must possess at least three of the following qualities, viz.,

1st, Unimpaired fertility in captivity.

2nd, Plasticity of constitution, enabling it to live under widely different conditions of environment.

3rd, Attachment to locality.

4th, Attachment to persons or tameness.

5th, Usefulness.

I shall have no difficulty in shewing that all domestic animals conform in a greater or less degree to these conditions, those which I have termed pets the least so.

If an animal is sterile in captivity, its perfect domestication as a race is barred. If an animal's nature is not sufficiently plastic to enable it to survive the altered condition of its environment, or to keep it in health, it becomes necessary to imitate closely the conditions in which it existed when wild, and it cannot become truly domestic.

If an animal is not attached to a locality, although not an absolute bar to its domestication, it probably determined, particularly in the early state of man, whether it would be reclaimed from the wild state or not, because before enclosures were made it was highly important that the animals subjected to his use should be attached either to his person or his homestead.

It is probable that the first animals which man domesticated were the young of those killed in hunting, if lambs, kids, or calves were so obtained, flocks and herds could easily have been originated, and as the pastoral habits of man followed after the hunting stage, and preceded the agricultural, I take it the early domestic animals were those species not given to straying.

As before stated there are 23 Domestic Mammals, viz.,

Canine	... Dog	*Feline*	... Cat
Musteline	... Ferret	*Equine*	... Horse and Ass

Bovine	... Ox, Zebu, Yak, Gayal, Banteng, Buffalo, Goat, and Sheep	*Cameline*	... Arabian and Bactrian Camels, Llama, and Alpaca
Leporine	... Rabbit	*Cervine*	... Reindeer
Canine	... Guinea Pig	*Suine*	... Pig
		Murine	... Rat and Mouse

The special object of my paper is to put very briefly before you, the probable causes why each of the species has been domesticated, and in some cases point out why others apparently very closely allied have not been subdued by man's use.

At the head of all domestic animals unquestionably stands the Dog, it has all the qualities a domestic animal should possess, amongst them companionableness in the highest degree.

The Dog is without doubt descended from the Wolf, indeed the dogs kept by the Indians on the shores of Hudson's Bay, I am assured by my friend, Mr. Walter Haydon, who spent five years there, are invariably bred from wolf sires.

The dog in the wild state associates in packs, hence its companionableness, the fox on the other hand is solitary, and in confinement is naturally morose, and under the altered conditions it is usually infertile, its domestication is therefore barred.

Mr. Darwin, in a letter to me, pointed out that domestication tends to the fertility of hybrids; this no doubt is so, and the dog has crossed with many of the wolves inhabiting the countries to which it has been taken, without becoming sterile, so that not only is this useful animal perfectly fertile in captivity, which was a necessary condition of its reclamation, but so little are the highly specialized reproductive organs affected, that even hybridity does not end in sterility.

The dog has doubtless been tamed from a remote antiquity; in the hunting stage of man he assisted in the chase, in the pastoral stage he became the guardian of his flocks and herds, and even now is the indispensable shepherd's companion and assistant.

It is beyond the scope of this paper to enter into the details of the various uses of the dog, the Chinese have, as is well known, even a breed of edible dogs, stated to recognize butchers as their enemies.

The attachment of the dog to the person of his master is far stronger than that of any other animal.

The Dog is the perfect type of a domestic animal, it fulfils all the conditions of domesticity in the highest degree and with regard to its food is commensal with man.

The Cat fulfils all the conditions of domesticity, though in its tameness and attachment to persons it falls short of the dog, but it even exceeds the dog in its attachment to locality, and by its great usefulness in destroying small vermin, beyond the reach of a dog's powers, it supplements the usefulness of that animal.

Like the dog it is not quite certain from which wild feline the cat was first obtained, but probably a North African species, perhaps *Felis caligulata* or *F maniculata*, but I feel convinced that the original of the domestic cat permanently tenanted the same cleft in the rock, hence its attachment to locality, and that this quality was availed of by the ancient Egyptians, by whom the cat was domesticated some thousands of years ago.

I have had unusual advantages in examining cats, having judged them for so many years at the Crystal Palace and otherwise, and have no hesitation in saying that they are mostly mules or hybrids.

Our British cats are without doubt in most cases the result of a cross with the wild cat of these islands, this is a wood haunting animal, *Felis sylvestris*, the cross has produced the tabby cat, a coloration not found in some Indian varieties, the Cabul and Siamese cats I have seen show no trace of stripes.

In no species of wild cat is the colour of the sexes different, yet it is quite inexplicable that out of the thousands of cats I have examined one tortoiseshell male only have I seen, and the female sandy cats are almost as rare, though I may have seen a dozen of the latter, this singular fact is a correlation of sex and colour brought about without either natural or artificial selection, and I am quite unable to advance any theory to account for it.

Like the dog, the fertility of the cat has been in no way lost by its having crossed with many other wild felines, I have seen one beautiful specimen which was a hybrid between the English domestic cat and *Felis Bengalensis*.

I have always thought that the cats which take to poaching and live in the woods are those in which the blood of *Felis sylvestris* preponderates, I have seen undoubted hybrids between this and the domestic cat.

It will be seen that the unimpaired fertility of the domestic cat is not lost even by hybridity.

There are upwards of 70 other species of cats known, among them the Cheetah only, is semi-domesticated, but I believe not bred in confinement, and is neither attached to persons nor locality.

The Ferret has not all the qualities of a domestic animal.

It is perfectly fertile, has a plasticity of constitution, is somewhat tame but uncertain, is useful for destroying rats and rabbits, but must always be kept closely confined, possessing neither the qualities of attachment to locality nor to persons.

I have known hybrids produced with the Stoat but they were too savage to be used.

The most that can be said for this tame Pole cat is that it is the only animal of the Weasel tribe which man has succeeded in domesticating.

The Otter, also a musteline animal, is trained sometimes to catch fish, but I am not aware that it is bred for that purpose in confinement, and is not domesticated to the extent of the ferret.

The Mongooz, a viverrine animal, is domesticated in India, and is used for the same purposes as the ferret, and in addition it is the enemy of snakes and reptiles, but I do not know whether it is bred in confinement and truly domestic, although it is much more of a tame pet than the ferret. An allied species, the Ichneumon, is also tamed in Egypt.

The truly domestic carnivora are but 3, and semi-domesticated but 4 more, out of 373 known species.

I now pass on to the herbivorous animals.

The Horse has nearly all the qualities of a domestic animal in perfection, it is fertile, has a plastic constitution, is eminently useful; is gentle, and is sufficiently attached to locality that it may be allowed to run on commons and in forests without straying away, as a rule.

In all these respects the Ass resembles the horse with the advantage of much greater sure-footedness, enabling it to be used in mountainous districts, the origin of the horse is uncertain, but the ass is clearly derived from *Asinus tæniopus*, a species still found wild in Abyssinia; there is a closely allied wild species, *Asinus Somalicus*, found wild in Somali Land, which differs in having the legs more striped than in *A tæniopus*, and does not possess the cross on the shoulder.

The wild Equine, nearest to the horse, is *Equus Przvalskii*, inhabiting the Dsungarian Desert, between the Altai and Thianschan Mountains, this animal has warts on the hind legs like the horse, and in this respect is unlike any other wild *Equus*, but it has an erect mane, and no bunch of hairs falling over the forehead, its ears are short, it is just probable that it may be the wild origin of the horse, but it is doubtful.

There are six other equine animals, three species of wild ass, and three species of zebra at least, but they are almost untameable, and further their fertility in captivity is nearly lost, their domestication is therefore barred.

There are not more than 10 species of Equidæ, and two of these truly domestic form a large per centage.

The Bovine, including the Ox, Buffalo, Sheep and Goat, is a far more numerous family than the Equine, about

150 species at least are known, and of these, 8 or perhaps 9 are domestic, about 6 per cent.

They are all gregarious, attached to locality but not much to persons, eminently useful, mostly of gentle dispositions, and all perfectly fertile in captivity.

The well-known Ox has been derived from more than one ancestor, I believe, probably from *Bos longifrons* and *Bos primigenius*, both now extinct. But the two species have been intercrossed, so that in some breeds it is difficult to determine on which side the blood of either preponderates.

The Indian Ox or Zebu, holds in many Eastern countries the same position as the Ox with us, both have been domestic from remote antiquity, certainly not less than 4,000 years.

The Yak of the Himalayas, with its long shaggy coat, takes in those high inclement regions the place of the ox, and is indeed almost essential to the inhabitants.

The Gayal, *Bibos sondaicus*, in some parts of India, and the Banteng, *Bibos Javanicus*, are used in the countries they inhabit for precisely the same purposes as the Ox, whether the former has been derived from the Gaur is uncertain, in fact, it is quite characteristic of a domestic animal that its origin is obscure.

As a proof of the fertility of hybrid Bovines, I may mention that a hybrid bred in the Zoological Gardens, between *Bibos sondaicus* and *Bos Indicus* produced a treble hybrid with *Bison Americanus*, and this hybrid in turn produced a quadruple hybrid with the American Bison again, indeed Mr. Bartlett is of opinion that the hybrid offspring of any of the oxen would prove fertile.

The Buffalo is used in India and other countries for the same purposes as the ox, and has been domestic for ages, its origin is not quite certain, but the Arnee is a closely allied wild species, if not its progenitor.

The Sheep is too well-known to need much being said regarding it, and the same is true of the Goat, the former is the more altered in character from its wild progenitor than the latter; *Ovis musmon* is taken to be the ancestor of the Sheep, and *Capra Ægagrus* of the Goat, but as there are several wild sheep and goats, very closely allied to the domestic, it is very probable that both species are hybrids to a great extent.

This concludes the hollow-horned ruminants, truly domestic, there are 11 other families of Bovidœ, containing many large and handsome species as the Eland and Koodoo, and it is remarkable that the gentle habits of some of them have not been taken advantage of by man, the thought suggests itself to my mind that if man had been more civilized in Africa, where so many of these fine Antelopes are found, it is possible that some of them would have been subdued to his use; I am the more inclined to adopt this view, because the only solid horned ruminant that has become domestic, the Reindeer, which alone in this respect represents the large group of Stags and Deer, consisting of eight genera and fifty-two species, was a necessity for the Lapps, as without this animal they could not have existed inland, the Esqimaux have not domesticated the Caribou of North America, and the result is they can inhabit the coast districts only, and subsist on the products of the sea. I have been further strengthened in this view by having recently heard, since I read this paper, that a resident in South Africa has tamed a team of Koodoos.

The Camels, including the Llamas, are a very restricted group, at most there are but six, perhaps but four species, and four are domestic, a proportion far greater than that of any other group.

The well-known two humped Bactrian camel, and the even better known Arabian, with one hump, are the only species of camels known, the origin of either from any wild species cannot be satisfactorily made out.

In Central Asia it is stated that wild camels exist, but admitting this to be the case, they may be descended from domestic animals, which have become feral.

The camels look so thoroughly unlike a wild animal that it is inconceivable that their ancestors were not very different looking beasts; it is a remarkable fact that all the members of the genus *Camelus* are domestic, and it would seem that unless they had been preserved by man that the genus would have been known only to the palæontologist.

Of the Llamas there are either two or four species, the Llama may be descended from the wild Guanaco, and the Alpaca from the wild Vicugna, but whether these may be specifically identical or not, it is certain that members of the genus are not extinct in the wild state, but if on the other hand the two wild species are not the ancestors of the domestic, then the ancestors of the latter are like the camels, extinct in the wild state.

The two domestic species conform to all the conditions of domesticity, being useful in the highest degree, naturally gregarious, and therefore easily kept in flocks, perfectly fertile, and though perhaps not quite so tame as sheep, yet thoroughly subdued to man's use.

Their value as beasts of burden in South America, and still more as wool producers, is well-known, and they possess a plasticity of constitution sufficient for their successful introduction into Australia and other countries.

The Suine animals do not form a large family, there are five genera known, and about twenty-two species, there seems good reason to believe that the domestic pig is descended from more than one wild ancestor, indeed in my own time the English pig, doubtless a descendant of the wild boar, has been crossed with Chinese pigs, *Sus Indicus*, so that a true *Sus scrofa* scarcely exists in England, but it was not so in my younger days, the Sussex pigs were at that time long-legged and long snouted, and I may add the flesh was of a very superior flavour.

The pig was domesticated in pre-historic times, its remains have been discovered with those of neolithic man, Rütimeyer is of opinion that even in those early days, there were two races or species domestic, one the true *Sus scrofa*, the other he terms *Sus scrofa palustris*, the latter approaching the type of *Sus Indicus*.

I cannot conceive any animal more easily domesticated than the pig, it will eat precisely the same food as man, it will live in all respects in exactly the same conditions, its fertility is very great, and unimpaired even by hybridization, its habits are gregarious, it is not given to straying, and generally seeks at night the shelter provided for it by its owner, its value as an article of food is well known, and its flesh can, by salting, be preserved for months, so that man, by keeping pigs, has been enabled to lay up a store of food for the winter months, no doubt a very important consideration in the early condition of the human race.

The Rabbit, the only useful domestic rodent, belongs to a very limited family of Mammalia, but one genus is known, the species of which are numerous, some forty have been described by naturalists, they are found over the whole of the Northern Hemisphere, a few species extend into Africa, and one is found as far South in America as Brazil, but no species is indigenous to Australia, although now so destructively common there and in New Zealand, this fact shows the plasticity of its constitution, and the ease with which it can even in the wild state adapt itself to altered conditions of environment, and as there is no doubt as to the wild rabbit, *Lepus cuniculus*, being the ancestor of the domestic, the life of a rabbit in a hutch, where it can be kept in perfect health, and that of its wild relatives on a bleak moor, affords a marked contrast.

The rabbit produces its young blind and naked, and below the surface of the earth, the leveret is produced as perfect in pelage and with its eyes as fully open as the hare, it is singular that all the other species of the genus are hares, but none are domestic, although as articles of food many are very much better than the rabbit, but so far as my experience goes, they are infertile in captivity and their wild habits are ineradicable.

The Rabbit, like the ferret, must in the domestic state be kept closely confined, it does not possess all the qualities of a true domestic animal, it is attached neither to persons nor place.

The rabbit is often kept as a pet, and forms a transition to the three domestic animals which I have termed pets.

The Guinea Pig belongs to the Cavies, a group restricted entirely to the Southern parts of America, there are six genera and about thirty species known.

The small size of this animal, varied colours, perfect tameness, great fertility, and the ease with which it can be kept confined, placing it on a shelf being sufficient, has no doubt tended to make it a pet popular with the young.

Like so many domestic animals the origin of the guinea pig is very uncertain, the name is corrupted from Guiana Pig, and it has been supposed to have been derived from the *Cavia aperea*, a view which the late Mr. Darwin did not entertain, the latter being a marsh frequenting animal; the guinea pig, on the other hand, must always be kept in a dry place.

I am inclined to think that this useless little mammal was domestic among the natives of South America, before the discovery of that continent, and brought to Europe already tame.

With regard to the other two pets, the variously coloured rats and mice, I have found them quite as tame as guinea pigs, and they could generally be handled with impunity. The tameness of the former leads me to think that they have descended from the Old English Rat, *Mus rattus* and not from the fiercer *Mus decumanus*.

This concludes the enumeration of all the species of mammalia which I consider truly domestic, they all thrive in captivity, under circumstances utterly unlike those of their wild ancestors, a wild boar of the woods and its descendant living healthily in a pigstye, present a contrast of environment as great as that adverted to in the case of the rabbit, yet both have had their fertility increased by domestication, it is this plasticity of constitution that in my opinion is the most important factor in the production of a domestic animal.

Some domestic animals vary very much from their ancestors, others do not; for instance, the wild Ass of Abyssinia, would, if seen drawing a cart in London, attract no more attention than the ordinary domestic animal, indeed the descendant has scarcely varied from the ancestor except in shades of colour and in differences of size.

On the other hand, it is difficult to recognize a Blenheim spaniel or a Maltese lap-dog as descendants of wolves.

There is one point in regard to domestic mammalia that is puzzling, it is quite certain that many hybrid domestic species are perfectly fertile, yet the hybrid offspring of the horse and ass is rarely so; when at Granada I enquired of the British Consul there, as to whether he had ever known of a fertile mule, he said, no, but that he had *heard* of such cases, this was said by a man who had been in Spain 15 years, and where many hundreds of mules may be seen in a day.

I had intended to have dealt with domestic birds in this paper, but although I have compressed what I had to say as much as possible, I fear that the proper limit has been exceeded.

DIGEST OF A LECTURE

ON

"EXPLOSIVES,"

BY

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13th JANUARY, 1886.

It is my intention to demonstrate by experiments, within the limit of an hour's lecture, a few of the leading properties of explosives which are in use for warlike or industrial purposes to-day. As, perhaps the simplest example of an explosion, I may shew the bursting of a paper bag, inflated with air, by driving it sharply on to my hand. In this case the air contained is suddenly compressed by the force of the blow, and its elastic force becomes too great for the paper envelope which is burst with almost explosive violence.

We have now to consider the technical meaning of the terms *Explosion* and *Explosive*.

An *Explosion* is said to occur when a solid or liquid substance is *suddenly* changed into gas or vapour, the gas or vapour occupying very many times the volume of the original solid or liquid, and, in addition, greatly expanded by the heat generated at the moment of explosion.

Any substance capable of undergoing such change upon the application of heat or other disturbing cause, is called an *Explosive*.

All explosives may be divided into two classes: (i) Explosive compounds (ii) Explosive mixtures.

In an *Explosive Compound* all the elements present are in chemical combination, though the force holding them together is but small, and on the application of a slight disturbing force, such as heat, friction, percussion, a breaking up into simpler bodies takes place; the products of explosion are mainly, if not entirely gaseous, of large volume and at a high temperature.

On the other hand, in an *Explosive mixture* we have certain ingredients "mechanically mixed," which can be again separated, more or less completely, by mechanical means, not involving chemical action. It must be noted that, as a rule, the ingredients of an explosive mixture have not separately explosive properties, but conjointly work together, under certain conditions, to produce an explosion.

I will, for the present, neglect the Explosive Compounds and consider, as being familiar to all, the most prominent member of the second class, Gunpowder.

Gunpowder is by no means a modern invention. The Chinese are credited with a knowledge of it ages before its re-appearance in Europe. In India we have evidence of the use of Rockets from time immemorial, and in a M.S. of the 9th century, attributed to Marcus Grœcus, and called the "Liber Ignium," the proportions for a rocket composition are given:—one part sulphur, two of willow charcoal, and six of saltpetre. Cannon was used by the English at the battle of Crecy (1346), but without doubt its moral effect in causing panic amongst men and horses largely exceeded the actual destruction caused by it. In the reign of Elizabeth, the manufacture of powder was fairly established in England, and the Crown constituted its manufacture a monopoly. The proportions of constituents used varied considerably at different periods, but on the establishment of the Waltham Abbey Works, under Sir W. Congreve, rapid strides were made towards its perfection.

The ingredients used in Gunpowder are Nitre or Saltpetre (Kno_3), Brimstone or Sulphur (S.), and Charcoal (nearly pure carbon.)

The average proportions in which these are mixed in

English service powder may be taken as in a 100 parts:—
Nitre 75 parts, Charcoal 15 parts, Sulphur 10 parts.

But these substances retain their individuality in Gunpowder, being simply intimately mixed like the ingredients in a pudding.

This I can shew by treating a sample of powder with boiling water, when all the nitre is extracted by it, and on filtering and boiling off the water we shall obtain at the end of the lecture a crop of crystals of nitre. The residue containing the charcoal and sulphur is now treated with bisulphide of carbon which dissolves the sulphur only, and on evaporating off the carbon bisulphide, crystals of sulphur are deposited. The residue of the powder now consists of charcoal only, and, of course, is non-explosive.

On the *perfect* incorporation of the ingredients of Powder, its utility entirely depends, and although time will not allow me to describe the preparation of military powder, it will suffice to say that it is incorporated thoroughly with water, the paste so formed pressed, dried, broken into lumps, divided by sieving into fragments of the desired size, and these lumps or grains "faced or glazed" with black lead. All these processes are carried on with the greatest care and regularity, and their importance is well seen if I lay two trains of equal length of powders of the same composition (i) being Military Powder, (ii) a powder made by me with great care but without any of the special appliances necessary. Firing these trains at the same moment, it is seen that whilst the Military powder fires with the greatest rapidity and leaves little or no residue, the home-made powder burns slowly and irregularly, and leaves a large amount of solid residue.

The question naturally occurs—Why are three ingredients used? In answer, the two essential are the nitre and charcoal. The nitre represents condensed oxygen (one cubic inch of solid nitre containing as much available oxygen as 3,000 cubic inches of air), and on explosion, the carbon of the charcoal acts on the nitre, and *gaseous* products are obtained occupying 280 times the volume of the powder used, and exerting a pressure, if fired in a closed space, of 40 tons on the square inch. The violence of this action is shewn when I melt nitre in a glass vessel over a gas flame, and throw on its surface a piece of charcoal slightly kindled at one corner. The charcoal becomes white hot, and is projected violently hither and thither on the surface of the nitre, very great volume of gases passing off into the air.

The third ingredient, sulphur, lowers the temperature of ignition of the powder, as I will shew by again laying two trains of powder (1) containing nitre, sulphur and charcoal (2) nitre and charcoal only. Firing them both at the same moment (1) burns far more quickly than (2), owing to the lower temperature at which ignition takes place.

The *Explosive force* of powder or other explosive depends on

(*a*) The *volume of gas* or vapour produced by the transformation, in proportion to the volume of the powder used.

(*b*) The *quantity of heat* generated during the action which expands the volume of the gases evolved and increases the explosive effect.

The *explosive effect*, however, depends generally upon the rapidity with which the change takes place.

It may be said that the *greater* the volume of gases formed, and the heat generated, the *greater* the explosive effect, whilst the *slower* the rate of firing the less the explosive effect.

Any solids formed on explosion are a waste of energy, for not only do they contribute nothing to the explosive effect, but they actually cool the gaseous products, and so weaken them.

The gaseous products of gunpowder only amount to 40 per cent. of the weight fired, but although in this respect gunpowder is inferior to gun-cotton (which yields about 98 per cent. gaseous products), it is a very safe uniform explosive and the rapidity of firing may be varied at will, and is regulated by the following physical properties.

(1) The density of the powder, (2) the hardness, (3) the size of the grains or pieces, (4) the shape of the grains, (5) the amount of glaze or facing imparted to the powder.

Before me are specimens of English military powders, the grains ranging in size from large prisms for heavy guns, to fine dust powder for small arms, the shape, size, etc., as mentioned above, being adapted to the use for which the powder is intended.

The *advantages* of powder over other explosives are—

(1) The rate of combustion is gradual, compared with most explosives, and by varying the mechanical processes of manufacture, can be modified so as to suit every kind of weapon.

(2) The ingredients are easily procured.

(3) They are comparatively cheap.

(4) Powder with proper precautions is safe in manufacture, store and transport ; it also keeps well.

Its *disadvantages* are—

(1) Large waste of effect, caused by formation of 60 per cent. solid products of explosion.

(2) Heating of gun, owing to contact with this solid residue at high temperature.

(3) Spoilt by exposure to rain or damp (the nitre being dissolved out).

Two other explosive mixtures deserve attention.

(1) *White Gunpowder*, a mixture of Chlorate of Potash, Sugar, and Ferrocyanide of Potassium. A few grains of this powder placed on an anvil detonates violently when struck with a hammer.

(2) A mixture of Chlorate of Potash and Sugar, which is fired by merely touching it with a glass rod moistened with strong Sulphuric Acid.

The most sensitive example of an explosive compound is Iodide of Nitrogen—a dark brown powder, obtained by treating, with certain precautions, Iodine with Ammonia.

It is a matter of the greatest difficulty to preserve a specimen of this substance for exhibition, as will be understood when I state that several portions have to-night been exploded, merely by dropping the dry powder on the surface of water.

I will touch another portion with the plume of a quill pen, it detonates violently, tearing the paper on which it is placed. This extreme sensibility of Iodide of Nitrogen has up to the present prevented its application to warlike purposes.

The three members of the explosive compounds class in common use, are :—(1) Gun Cotton, (2) Nitro-glycerine, (3) Fulminate of Mercury.

It was discovered by French chemists forty years ago that several organic substances—sugar, starch, muslin or paper—when treated with strong nitric acid, washed with water and dried, burned with almost explosive violence.

I have treated muslin and paper in this manner, and you will notice that in appearance they are but slightly changed, being perhaps a little harsher to the touch than before, but they burn with great rapidity and leave comparatively little ash.

Fourteen years later, Schönbein, a German chemist, found that if cotton wool were submitted for a short time to the action of cold strong nitric acid, washed and dried, it increased in weight to the extent of 80 per cent., and although its appearance was unaltered, become endowed with explosive properties.

I will now proceed to prepare some gun cotton before you, treating clean dry cotton wool with a well cooled mixture of strong nitric and sulphuric acids. Sulphuric acid is added to the nitric in order to keep the latter strong and in the best condition for acting on the cotton. It is a matter of the greatest importance, that the temperature of the acids be kept low during the action, in order that in the first place the change may be carried on without danger to the operator, and in the second it is found that if the acids be weak, or the temperature be allowed to rise, a second product is formed to which the name "collodion cotton" has been given. It has, as I show, a much less rapid rate of ignition, and has comparatively feeble explosive properties, but is of much use when dissolved in a mixture of Ether and Alcohol (in which true gun-cotton is insoluble) for coating glass plates, on which is afterwards deposited the film of silver salts, sensitive to light, and used as photographic plates.

The cotton wool after treatment with acids, as shown, is removed and washed with water until all traces of acid are removed, an operation which is performed in the manufacture of gun cotton, with the greatest care, for reasons stated immediately.

The early history of the manufacture of gun cotton in this country was most disastrous, numerous explosions taking place, owing to the spontaneous decomposition of the manufactured gun cotton. It is almost beyond doubt, that these were occasioned by free acid being left behind in the gun cotton—owing to imperfect washing—and under these conditions, decomposition took place, and heat being evolved in the centre of a mass of low conducting power, the temperature rose until the mass was finally raised to the point of ignition.

These disastrous explosions checked for a time the manufacture of gun cotton, but experiments were carried on in Austria by Baron Von Lenk, chiefly with a view to modify the rate of combustion of gun cotton, and thus render it a safe substitute for powder.

These experiments of Von Lenk, although apparently unsuccessful, revived the subject in England, experiments being made by Sir F. Abel, Chief Chemist at Woolwich, resulting ultimately in the adoption of a method of manufacture, whereby a complete purification from free acid is obtained, and the gun cotton is converted by pressure into compact homogeneous masses.

I will not enter into the details of manufacture observed in Abel's process, which is now used on a very large scale in the government factory at Waltham Abbey, but will proceed to demonstrate some of the properties of gun cotton.

Properties of gun cotton as compared with gunpowder :

(1.) Inflames at a temperature of about 300°F., or roughly speaking at a temperature half as high as that required to fire powder. This is seen when I touch gunpowder with a glass rod heated to the above-mentioned temperature I fail to ignite it, but gun cotton is immediately ignited by the same rod.

(2.) Gun cotton fired or exploded is unattended by smoke, and leaves no apparent residue, the small residue (1 to 2 per cent) being scattered by the explosion. This is strikingly illustrated by placing a tuft of dry gun cotton on my hand and lighting, when no inconvenience is occasioned.

(3.) The rate of ignition of gun cotton is much quicker than that of gunpowder, in fact, I will fire a tuft of gun cotton, placed on a heap of powder, without igniting the latter.

(4.) The recoil of a gun charged with gun cotton is less than that for powder. The projectile velocity being equal, the recoil of the gun charged with gun cotton is only two thirds that of powder.

I will demonstrate the difference in recoil by floating two porcelain crucibles on water, with the edge of each crucible just above the water level. Into the first I introduce seven grains of gun cotton, into the second, twenty-four grains of powder (the weight giving projectile force equal to that of the seven grains of gun cotton) and fire both with a hot wire. The recoil of the powder submerges its crucible and it sinks to the bottom, whilst that containing the gun cotton continues to float.

(5.) Gun cotton leaving only 1 or 2 per cent. of solid residue, whilst gunpowder leaves nearly 60 per cent., it follows that the former used as a projectile agent heats the gun but slightly compared with the latter. In practice it has been found that a gun after firing a hundred rounds with gun cotton, was not so much heated as after thirty rounds with powder.

(6.) Gun cotton is perfectly uninjured by moisture, and may be kept wet or stored in water for any length of time. This is a very great advantage over gunpowder, as even when heat is applied to the wet gun cotton it smoulders gradually away as it dries.

A ton of wet gun cotton has been treated experimentally with the above harmless results.

(7.) It has been seen that gun cotton fired in an open space burns quickly and quietly away. Even a large disc of compressed gun cotton which I light burns rapidly and evenly away, but the same weight fired in a closed space would produce disastrous effects. Thus so small a quantity of gun cotton as five grains, placed in a soda water bottle, loosely closed by a cork, and fired by a galvanic current, produces a loud explosion and drives the cork out violently.

Similarly firing twenty grains of dry gun cotton, sealed up in a glass flask and ignited by a galvanic current, a considerable explosion is obtained, and on lifting up the wooden safety cage all that remains of the flask is a heap of fine glass dust, showing clearly the force of explosion of even a small quantity of cotton when fired in a closed space.

The explosion of one cubic inch of gun cotton in a closed space gives by calculation a pressure of 109 tons on the square inch, as compared with a pressure of 40 tons yielded by powder. In order to obtain the full explosive force of gun cotton, it was in all earlier experiments confined in strong cases in order that the flame of the portion first ignited might raise the temperature of the rest to the point of explosion. The discovery by Mr. E. O. Brown, that unconfined gun cotton might be exploded by detonation opened a new career to this substance.

In order to explode the cotton a detonating fuze is placed in its substance in a hole drilled to receive it. This fuze consists of a tube of quill or metal containing fulminate of mercury, on passing a galvanic current through the fuze its contents explode, and the explosion of the cotton follows with great violence. Gun cotton may be detonated whilst wet or even whilst frozen, provided a small mass of *dry* cotton be placed in contact with the detonator, this mass being known as the primer.

The force of explosion so "detonated" is estimated at six times that of powder, the explosive force when fired in the ordinary way being only three times that of powder.

The second and remaining "Explosive compound" of practical importance is nitro-glycerine discovered in 1847, by Sombrero, an Italian.

To prepare it, ordinary glycerine is treated, certain precautions being carefully observed, with a mixture of strong nitric and sulphuric acids. An oil is formed which is nitro-glycerine, and on pouring the acid mixture into a large volume of cold water, the oil falls to the bottom of the vessel, and may be collected. As with gun cotton the greatest care is taken to free the product from the last traces of nitric acid, as the impure nitro-glycerine is liable to spontaneous decomposition and subsequent explosion.

Nitro-glycerine is exceedingly poisonous, a small quantity swallowed by accident proving fatal in a few hours.

The slightest blow will explode it, as I show by pouring a single drop on an anvil and dropping a hammer lightly on it, when a deafening report ensues.

When first employed in blasting, a hole was drilled in the rock, nitro-glycerine poured in and the hole filled up with water, and the nitro-glycerine exploded by a detonating fuze. Its explosive effect in blasting is given as equal to that of ten times its weight of powder. For convenience of handling and transport it is converted into dynamite which consists of nitro-glycerine absorbed by a porous earth free from grit. Enough nitro-glycerine is added to the earth to form a stiff dough, and it is then made up into cartridges by enclosing it in parchment paper cases. It may be fired by detonation in the ordinary way. I have now, in conclusion, to mention that Fulminate of Mercury used as a detonator is made by dissolving Quicksilver in Nitric Acid, and treating the product with Alcohol, when a very violent reaction follows, and crystals of Fulminate of Mercury are deposited on cooling. The dry fulminate is exploded by merely rubbing it, and for safety is kept in *corked* bottles (not stoppered) under water.

On its explosion, a residue of metallic mercury is left, which is prettily shewn by the following experiment. Over the surface of a perfectly clean sheet of glass Mercuric Fulminate is evenly dusted by means of a fine muslin sieve. Applying a taper to a portion of the powder it fires with a bright flash, burning with infinite rapidity; the mercuric left coats the surface of the glass, and on turning the plate over it is seen that a looking glass is produced. In conclusion, I feel it necessary to apologize for the trial to which I have subjected your patience in attempting to give a demonstration of some of the leading properties of explosives.

A SKETCH
OF THE
HISTORY OF THE RIVERS AND DENUDATION OF WEST KENT, &c.,

BY

F. C. J. SPURRELL.

27th JANUARY, 1886.

I PROPOSE to give in this paper a Sketch of the Denudation of the district familiar to the members of our Society, so far as the river courses and surface deposits have permitted me to examine it.*

The moment at which I cannot begin earlier is that when the flat dome of the Weald, having been slowly rising from the sea, but so slowly as to have given time for the sea and its breakers to cut off the top and produce what has received the name of "a plane of marine denudation," at last received an impetus which lifted it faster than the sea could wear it down, and left that district between the North and South Downs called the Weald, to the action of the "subaerial forces." Nowhere over the Wealden area is there to be found any deposit belonging to that old marine age, all has disappeared, nor excepting where the English Channel flows is there any evidence of the Sea's return. The existence here and there within the Weald of occasional pebbles of Quartz, Quartzite, Granite, Lydian Stone, Sandstones, and other old rocks, points to no recent droppings from ice-

* I regret that the latter part of the paper which deals with surface glaciation is necessarily confined in its discussion of a limited area, by which I am deprived of the opportunity of making some important comparisons, the result of an extended survey, but with which it is in accordance.

bergs, their physical condition, rarity and localization—for they are only found on ridges and high land (including the Downs)—is evidence of their being but the last remains of an old sea bottom.*

The area of the Weald inside the chalk ring was first an oblong table-land, with the oldest (the Hastings) beds running east and west, perhaps somewhat raised above the rest. This central area was surrounded, if I may say so, by concentric belts of beds of later origin than the central ones, dipping from them on all sides. Over the chalk downs lay the Tertiary beds level with the same marine plane, but perhaps declining to the Northward.

On the crest of the Downs there may be found in some places relics of the rocks from the Weald, Gault Clay, Chert, Greensand, Sand and Limestone, &c., lying on the chalk, not in the condition of river gravel, but of patches of the old beach. The soft tertiary strata were easily denuded as the sea retired, but portions still remain beneath patches of shingle, such as that on Well Hill, and some of them appear to have suffered from the action of shore ice.

With the exception, here and there of patches of Eocene beds and some of "doubtful age," left by the retreating sea, a great part of the stretch of chalk now covered by the deposit called Clay-with-Flints must have been left bare, from the top of the Downs down to a level which in our district coincides nearly with the 400 feet contour line.

In West Kent, a number of hills which reach up to or near that line are topped with beds of gravel, some of which gravels it is true differ from others, but which I must treat as being closely related. One of these patches deserves a special remark. It is that on Shooters Hill.

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*Some of these pebbles may have been derived from the pebble bed of the Lower Greensand, but judging from the size and kinds found in the thin layer as it exists in our district, it does not appear likely to have afforded the whole of those found capping the higher hills of the Weald the Greensand, and the Chalk.

This does not appear to exceed fifty feet in its greatest depth. It is formed of yellow sands and sandy clays with layers of gravel. These alternate. On the Eastern side of the hill, sandy layers predominate over gravel, in a section twelve or more feet deep; on the South, clays underlie a great depth of pebbles; while on the North-West, beds of clayey sand and pebbles are nearly equally laid. The pebbles are all tertiary, with the exception of small bits of quartz, such as are common in Bagshot beds, and resemble those identified by Mr. W. Whitaker, at Havering and elsewhere in Essex, as Lower Bagshot. (*Pl.* ii. *fig.* 5.)

On the Northern side of the hill the gravel has been "trailed," so as to remove all signs of bedding.

I therefore conclude that this gravel is largely composed of the wreck of some Bagshot bed, if, indeed, part of the bed does not cap the hill beneath the gravel. The upper part of the bed of gravel is thrown into confusion, and in its surface layer are some small pebbles of quartz, which belong to a later glacial disturbance than that which has moved the stones lower down in the bed.

The upper portion of this gravel resembles many patches at similar elevations in Middlesex and South Essex. But these Pebble Gravels (coloured red by Mr. Whitaker) on Shooters Hill, Hampstead, Barnet, Totteridge, Epping, Warley, Laindon, and Hadleigh, resemble each other sufficiently to permit of their being bracketed as one. With them I would couple those at Swanscombe, Darenth Wood, and Cobham, together with those on the summit of Lodge Hill (Hoo) and Eastchurch (Sheppy). All are not precisely alike, but I consider that, taken as a whole, and allowing for the greater proximity that the Kentish gravels have to the surface of the Chalk and the Wealden *débris* on it, there is a resemblance. The regularly decreasing level at which they are found, from 400 feet on the West and 200 feet on the East is in favour of this.

From the time the sea left the Chalk ridge clear, rain and snow commenced to work on the Wealden district within the Chalk ring; and doubtless at first many streams made their way from the centre, Southward and Northward to the sea. These rivulets, at first numerous, would ultimately, from peculiarities in the structure and differing hardness of the strata over which they had to make their way, be obliged to unite into larger rivers to overcome obstacles which singly they could not pass; as each rivulet left its course to unite with others, the old channel would be left as a slight gap in the ridge of rock it had partially worn, while the larger stream would be strengthened and have its channel enlarged in an increasing ratio. These streams again, some giving up and some uniting, would ultimately greatly increase the number of useless channels, while diminishing the number of active ones, until the whole number once great, ultimately became small; and this will, if nothing occurs to the contrary, become smaller.

The main or transverse streams which drained from the central portion of the Weald, were here and there forced to deviate from the direct line North and South, by the nature of the ground.

If a vertical section taken along the crest of the North Downs be prepared, the gaps made by the present rivers and also some made by rivers which from some cause have ceased to flow will be apparent. A similar section along the crest of the Lower Greensand escarpment will demonstrate some variations from the direct line spoken of. (*see pl.* ii.) If a vertical section of the South Downs be prepared like that of the North, similar gaps will be seen.

In the North and South Downs it was noticed long ago that these exits of the rivers from the Weald occasionally coincided, *i.e.*, that they were almost due N. and S. of each other, and it will also be found that if the larger gaps without rivers or passes, be included in the examination, the coincidence will be still more remarkable, river with river, and gap with gap.

If a map be made, marking distinctly with right lines so much of the river courses, stream valleys as well as dry valleys of the whole district as lie in lengths exceeding two or three miles, it will appear with considerable distinctness, that the valley lines tail on to each other (often running, however, in opposite directions) and develop by their persistency over great or small distances, lines which may be called master lines, and subsidiary lines, of weakness in varying directions.

This method has been worked out by Daubrée* with admirable effect, for parts of France, and these lines of weakness, joints, or fractures, serve as guides and indications in the search for the probable positions of abandoned river courses, between escarpments and through them, even after denudation has almost removed the last vestiges by which once their course was marked. It will be found then that there are strongly marked lines of weakness in the Weald, running North and South, with subsidiary ones between, together with lines of weakness or joints at right angles to the last and complimentary to them. By this means it may be shewn that this system of joints, and the next are not confined to the Weald, but extend far beyond it. There are also numerous and well marked lines of weakness taking a general direction N. E. by N. and S. E. by S. There also appears to be a series of lines of fracture which may be called Concentric with the oval shape of the Weald, these latter may have been produced by the Wealden upheaval, the two former systems must have preceded it.

The North and South fractures appear to be connected with the same causes which produced the transverse anticlinals, which Mr. Topley has so carefully examined, especially in the district under discussion, and which were first pointed out by Mr. Martin and Mr. Hopkins. The East and West lines have not received the attention they deserve, in consequence of their having

* Geologie Experimentale.

been overborne and masked by what Mr. Topley has denominated "The Chief Anticlinal lines of the Weald," in his memoir.

The upheaval of the Wealden Dome, besides causing a series of flexures or rugæ peculiar to the form of the upheaval, may be supposed to have started many an older fracture, and for short distances that fracture would serve for the new direction which a flexure required to take, thus we should find the flexures to be formed of, so to say, horizontal steps. This arrangement may be found on the chalk hills, or on either side of the Weald, giving rise to valleys running across the dip and nearly at right angles to the main stream lines, which run with the dip.

It will be noticed too, that these valleys often have on the side away from the Weald a series of small patches of tertiary beds, marking the edge of a ruga or flexure. To the existence of this tertiary escarpment as it may have been, is credited the peculiar direction of the valley, rather than, as I take it, to the line of weakness having diverted the stream for the benefit and preservation of the tertiary patches.

The rivers of the Weald run most extensively along the softer beds in the lateral or longitudinal valleys, uniting to pierce the harder ridges in transverse valleys.

The chalk escarpment is pierced by the Medway, Darenth, Mole, and Wey, which rivers continue to run through the chalk gaps as on the day they commenced their courses.

Mr. Topley* thinks that "originally there were six rivers passing out of the Weald to the North," which he enumerates as the Rother, Stour, Medway, Dart, Mole, and Wey; to these I would add the Lesser Stour by the Gap at Lyminge, the Old Wandle with the Caterham stream by their Gaps at Merstham and above Oxted, and the Old Blackwater by the Gap at Aldershot, and others. In the list below I have compared some of the more conspicuous

* Loc. cit.

Gaps in the Chalk escarpment, distinguishing as "wet" those still carrying streams, and the dry gaps by the neighbouring villages.

South.		*North.*
Treyford	Dry	Crondall.
Cocking	Dry	Aldershot.
Arun	Wet	Wey.
Adur	Wet	Mole.
Clayton	Dry	Merstham.
Ouse	Wet	Darenth.
Cuckmere	Wet	Medway.

In the case of the Merstham-Clayton Gaps the line of weakness with which they may be connected (see ante) is emphasized by the course pursued by the Railway from London to Brighton, in its endeavour, common with railways, to keep the lowest level.

Mr. Topley remarks that "passes have no relation to the drainage of the country inside the chalk escarpment," therefore, they were not formed by inward flowing streams; then he says, that "in no case does any stream run outwards from the Weald through them," if streams *did* run through them they would not be "passes," but river-gorges, as in the case of the Darenth, &c. To shew a difference between passes and river-gorges, Mr Topley says that, "passes are apt to occur where escarpments are faulted," but he shows that of the "passes" of the Weald, North and South, they are apter to occur unassociated with faults.*

Since then these passes and their associated valleys were not formed by drainage inward, I cannot help the conclusion that they were formed by drainage outward; the more, as streams still occupy the lower parts of some of the dry valleys. The passes of Mr. Topley, I consider to be the truncated valleys of diminished rivers.

The Chalk escarpment formerly extended Southward, its face originally of slight elevation, has increased vertic-

*. Weald, pp. 277-279.

ally with its retreat horizontally. Some of these extinct streams may be mentioned as having, with great probability, passed through the Greensand at its present escarpment, as the Darenth at Plaxtol, and the Wandle at Red Hill, but at a higher level than the present streamways, of course.

It will be seen that the crest of the greensand is pierced at Redhill, Godstone, Oxted, Plaxtol, and Nettlestead. In the case of the Medway the Gap at Nettlestead is on the N. and S. fracture, whose presence assisted the river in breaching the chalk, but the river does not at once run South, the obstinacy of the intervening mass of Greensand obliging the stream to take a curved course by Maidstone, some miles to the Eastward of the direct line; while from the Forest ridge the Teise runs to Nettlestead in the right line of the fracture. It is probable that the size and structural peculiarities of the area drained by the Medway have given it great advantages over neighbouring rivers.

In the case of the Darenth, at the chalk escarpment there is a transverse synclinal depression, opposite the breach in the chalk the lower greensand is not breached, and there is no synclinal depression, only a small flexure of a local character running E. and W. But a breach exists at Plaxtol, and I think that this breach was originally made by the Darenth. It will be obvious to anyone looking at a map, that there exists, though under altered conditions and at a lower level than formerly, a line of joint or weakness, which determines the direction of a stream from Crowborough Warren by Withyham to Penshurst, and a part of the Eden, in the opposite direction; this line if produced further South would join with that of the line of drainage of the Darenth through the chalk. Somewhere in this line I think it likely that the Darenth formerly commenced its course Northward, but obstacles interfering with its more direct course, the river ultimately found a way to breach the greensand further eastward. This appears to me to have occurred near Plaxtol, and then between the Comp and Ightham hills, the Old Darenth once crossed the present escarpment, curving round over the gault to the Westward, towards the opening in the chalk at Otford; a course not unlike that of the Medway at present.

There is evidence that the Atherfield clay which as Mr. Topley remarks, keeps the 500 feet contour opposite the breach in the Chalk, falls slightly near Plaxtol and continues to do so as it approaches the Medway. Between the above mentioned level position of the Atherfield clay and the Medway depression there is no evidence of a rise, but rather the contrary. Mr. Topley thinks that there is an anticlinal near Plaxtol to account for the Southerly course of the Plaxtol Brook, but he does not give evidence for it, and shews that though there is a synclinal Eastward (Weald, p. 277) there is none Westward, so that there is no anticlinal rise there even of that limited kind which consists in the recovery of a general level between two depressions. But I think it sufficient to suggest that the abandonment of its old channel by the Darenth is a good reason for the advance along it of a Medway feeder, after the supremacy of the latter river became established.

A similar instance to the cutting back of the Plaxtol Brook (or the Shob according to Hasted), may be mentioned in support of this on the West of the Darenth, where the Eden has cut back to the chalk; as in the East, so in this case the Eden passes the greensand escarpment where there is evidence of a fall in the Atherfield clay from its level at the 500 feet contour line. I suppose then, that the Old Darenth ran southward from near Crowborough, over the present site of Tonbridge or thereabout at an elevation exceeding 400 feet above that place. The bed of this old Darenth exists now at the greensand escarpment near Plaxtol at about O.D. 450 feet; and on the Easterly side of the Ightham Hills patches of river gravel and sand lie, forming one or more terraces, particularly at Bewley, Rose Wood, Fane Hill, and on Chart Farm, the last patch of gravel lying on the water-parting of the Shob or Medway and the present Darenth, all above the 400 feet contour line; while on the hills above patches of gravel also appear to belong to the streams tributary to the Old Darenth.

At the time when the Darenth ran in the course I have suggested, it will be remembered that the lower greensand extended further South over the Weald clay than now It appears probable that the Medway having the advantages of a quicker exit to the sea and a marked transverse trough, was enabled to cut back and lower the Weald clay faster than the Darenth was able to cut a passage through the greensand and maintain a free passage.

Mr. Topley has described patches of high level river gravel on the western side of Sevenoaks as far as Limpsfield, and most of these patches are wholly above the 400 feet contour. On Limpsfield Common is a patch of gravel at present lying on the water-parting of the Eden and the modern Darenth. The higher patches extend in the remains of a terrace, as far as Montreal in front of the opening of the chalk escarpment.

There is a patch of gravel at Broughton House, which Mr. Topley has described as piped into the chalk, and allowing for the piping, it apparently belongs to the same series. On the foot of the hill near Sepham Farm, river gravel is found from 400 feet downwards for some distance. All these gravels of the old Darenth contain flint and tertiary pebbles, besides those of the greensand. As yet I have found no Wealden sandstones in them, but inasmuch as the older Darenth at the time when these gravels were deposited, from Plaxtol to Sepham, may have been confined to the greensand and in its decline, I should not necessarily expect to find them. Flint implements are abundant, some of them much worn from long travel in the stream before reaching the remnant of the old bed, and thus point to a great age.*

* See a paper on them in Archæologia Cantiana, Vol. XV.

For a long period the Medway has been encroaching on and sapping the basin of the Darenth, it is doing so now, and probably its small Wealden basin is being robbed much faster than the retreat of the chalk crest is increasing its area.

The dry valley which lies in the chalk between Merstham and Croydon represents a river course which has received a surprising curtailment from the South and from the North; the system of branches on either the East or the West of it is similar in most respects to other streams, such as the Darenth and Medway in a similar situation, and offers apparently no obstacles to the belief that once this valley called Smitham bottom carried an open stream. As, however, the denudation from the South advanced, the Wealden drainage was curtailed, and the valley was not able to keep up the excavation of the channel, and when at last the greensand escarpment was undermined, the stream became fitful, an ailbourne, in fact, until the denudation reached a point at which even that ceased. The curtailment from the South was mainly accomplished by the enlargement of the basin of the Mole, assisted by the Old Darenth, both at the expense of the Old Wandle. Some of the tributaries of the present Mole whether running North or South still indicate somewhat the lines of the Old Wandle, and the probable sites of its breaches in the greensand crest.

At a later period the Medway by its branch, the Eden, cut back and usurped that part of the Darenth which had formerly occupied the area of drainage of the Caterham branch of the Old Wandle. The Mole which disputes with the Medway at the present day the old drainage area of the extinct stream, drains a considerable area to the South and Eastward of its gorge in the chalk, after passing which it inclines Westward towards the Wey.

The Wey now occupies as its area of drainage a very large part of the North-Eastern portion of the Weald, almost from the gap made by the Mole in the chalk crest as far as Alton. After the Wey has passed the chalk, it diverges from its Northern course, towards the Mole, and at one time it is possible that they may have united at some point before joining the Thames, of course above the present 200 feet contour. That some depression or combination of depressions which inclined the two rivers together existed at this spot, or as appears likely does now exist, is made the more probable by the abandonment of the Thames of its more direct course, by Acton and Ealing, to diverge Southwards by Chertsey and Walton; and it may be that the great quantity of *débris* which this conjunction caused to accumulate, with a rise in the land and diminished rainfall, separated the streams again, and now the gravel-capped St. George's Hill lies between, and still the two rivers run on the proximate margins of the Hill.

That part of the Wey, however, which lies Westward of Pepperharrow, I believe formerly ran Northwards through the gap or pass at Aldershot, and was the Wealden affluent of the Blackwater. This gap has its lowest crest but a few feet below the 300 feet contour line, and the streams which descend the greensand hills from the South still incline towards the gap, while the course of the Wey forms a deep valley between Farnham and Crooksbury Common, whose bounding hills exceed the elevation of the lowest level of the Aldershot Gap by more than 100 feet; which valley will also be seen to be inclined towards the gap from the S.E. During some period when the Blackwater valley was blocked, whether from *débris*, landslips, or ice, it is probable that the streams South of Aldershot were dammed so high that the waters were ponded back and found an outlet into the basin of the present Eastern part of the Wey, and this might have been assisted by some of the causes which contributed to the depression on the Eastward, which produced the approximation of the Wey, Mole, and Thames, near St. George's Hill, and enabled the Mole to supplant the Wandle in the Weald. Thus it is likely that the valley of the Wey under Crooksbury Hill, may present a true example of reversal of drainage.

Over much of the Chalk of the North Downs above a certain level lies a slight mixture of various rocks, derived from the greensand, &c., and the tertiaries. But wherever the chalk was bared, it is covered by a layer of red and yellow clay, containing in its lower part unbroken flints. Near the surface these flints are splintered and broken by weathering. This is the clay-with-flints, and appears to consist very largely of the insoluble *débris* of the chalk, the lime of which has been removed by chemical means; it may be called decalcified chalk. This layer is wholly unstratified, and in its lower part contains nothing foreign to the rock on which it lies. Though the clay lies along the crest of the Downs it does not continue down the edge of the escarpment. The upper portion of the layer of clay has everywhere been denuded by wind, and rain and snow, and its constituent angular stones are left covering its surface, while in some places nothing but the stones remain. It is a land deposit. It is marked on its higher limits by the crest of the Downs, and on its lower, or Northern, by a line which can only be approximately drawn, as being not found below the level of the 400 feet contour, to the South of London and in the Westernmost part of Kent. South of Gravesend this limit is found near the 300 feet contour, South of Sittingbourne near the 200 feet contour, and Mr. Drew has mapped it at Ham, some fifty feet above the sea level. In the East its identity may not be so marked as it is in West Kent at lower levels, but there can be no question that its lower level subsides Eastward. However that may be, it is clear that some form of denudation has left all the better marked and most extensive patches above that line. This is true of the patch at Dunn Street, near Westwell, and of a remarkable patch of apparently the same clay on the Northern slope of Oldbury Hill, near Ightham, both resting on rocks which are not those of the parent chalk-with-flints.

I have already mentioned the river gravels of the Darenth at high levels South of the chalk. But there are places here and there high up on the Chalk Downs where river worn gravels may be detected. There is a patch of such near South Ash, over 500 feet O.D., another is found on the hills above Eynsford; but between the 300 and 400 feet contours, there is generally an increase of waterworn materials which cover the hills, indicating the former presence of rivers. There is a particularly good example in the Ravensbourne area, North of Hayes, somewhat above the 350 feet contour, Southward of Gates Bottom. On the hill about half-a-mile S.E. from the farm called Upper Nash is a spread of red and coloured stones, flints, and tertiaries, extending along the brow of the hill towards West Wickham. There is little difficulty in procuring from the weathered surface of the patch old triturated "wasters," and Mr. Clinch has a collection of good palœolithic implements gathered from land on Rowes Farm (see Archæologia Cantiana, Vol. XV).

The crest of the tertiary escarpment of Hayes Common now rises nearly to this level, and the remains of gravel were once the bottom of a stream when the intervening area of Gates Bottom was still occupied by the tertiary strata, shewing a retreat of nearly a mile Southward and 100 feet of vertical excavation of the valley.

The patches of gravel on either side of the Darenth, South of Eynsford, which are suggestive of river deposits, may have belonged to the Darenth at a period not far removed from those lying at a high level on the greensand already mentioned.

There is river gravel on the chalk on the Eastern side of the Medway valley, but I have not seen a section there. On Strood Hill, however, there is a patch containing abundant remains from the Hastings beds. From this level 288 O.D., down to the lowest, the gravels of the Medway are formed of *débris* similar to that above-mentioned, and containing remains derived from most of the beds over which it spreads, which shews that its course has been always outward from the Weald. The Hoo gravels appear to belong to the united beds of the Thames and Medway, and in neither river is there a probability that their course was the reverse of the present. (*Pl.* ii. *fig.* 8).

The true river-worn gravels which are found in the upper part of the (extinct Wandle) Smitham Bottom do not so far as I can discover contain any Wealden Sandstone, but Chert and Ironstone from the Lower greensand; and it is probable, therefore, that these gravels were laid at a time when its tributaries had retreated within the greensand escarpment; but that must have still left the stream a fairly good one, for from the level of the 400 feet we can trace its old gravels lying under Foxley Wood on the right bank at 350 feet or more, and near Caterham Junction station a few feet lower, where a slip of the chalk hill has slid over the bed of the stream and preserved a patch of gravel beneath some 50 feet of chalk. The highest gravels of this river have suffered much denudation to the Southward, but they may be discovered capping the tertiary hills of Norwood, and at an elevation exceeding 300 feet. It is, I believe to a thick deposit of the gravel of the old river along the hills which stretch from Norwood towards Deptford that we are to ascribe the existence of those hills, which even where denudation has lowered them remain to show the course of the old river. The broad spreads of gravel about Croydon still attest the importance of the former stream by the large quantities of material which have been swept from its abandoned course to cover the gathering ground of the modern Wandle.

I would suggest that the old Wandle gravels of this high level at Norwood may approach the same date as those on Strood Hill already mentioned. In neither case are there any foreign or erratic pebbles mixed with them.

Along the Northern brow of the Thames Valley, near the district I am examining, is a layer of gravel. It is evidently Marine, and is frequently called by Mr. S. V.

Wood's name of Middle Glacial Gravel. It is mapped on the survey map as glacial gravel [pink]. It is cut off sharply at the brow, never descending near us below the 200 feet contour line into the valley; it lies on a surface which had evidently been levelled by marine action, and through it streams have cut gullies which previously had no existence. Its composition is of flint, tertiary pebbles, and so great an abundance of Northern rocks as to warrant the conclusion that it is the marine wash of materials transported by glacial action from a distance. This layer is much thinned out on its Southern limit, and if it (or the Boulder clay) extended Southward across the valley of the Thames, the quantity was insufficient to resist that denudation which has cleared so much from the country on the North of the Thames and left any remaining *in sitû.*

I have examined the higher land around Shooters Hill and the table-land from Blackheath to Erith especially, and although I think that the glacial gravel or clay may have reached so far, for quartz and quartzite-pebbles are not uncommon, yet as most of the table-land lies below the 200 feet contour, these diminished relics are not distinctly separable from those which might have been deposited by the Thames, which commenced to spread erratics derived from the glacial beds, from about the above level downwards to its present bed.

With the glacial gravel it is almost impossible to avoid an immediate coupling of the chalky Boulder clay, which lies upon it to so large an extent, and which constitutes the latest widespread deposit of Middlesex and Essex, covering the land like a "pall." Like the glacial gravel it lies at its Southern boundary between 200 and 400 feet contours.*

This Boulder clay is not so homogenous a material as to preserve its constituent materials through ages without change, consequently we find that its surface has been

* Compare remarks on a thick sheet of Boulder clay on the Weald clay at Shipbourne near the same level, &c., further on.

weathered; the first effect of weathering is decalcification, by which the clay and stones are left without the comminuted chalk, and then by the wash of rain and snow the fine clay and sand pass away and the larger stones remain.

The chalk in the Boulder clay is often found covered with glacial striæ, comminuted chalk is abundant. The chalk is usually much hardened; either from pressure, or its subjection to salt water, or to parts being infiltrated with the lime dissolved from other parts. The clay is usually dark coloured and blue. By weathering and oxidation it becomes greenish and yellow, at the same time losing much of the chalk which has been dissolved out. After it had been subjected to subsequent glacial kneading, and forced as trail down the valley sides, some of the remaining blocks of chalk may be found comminuted in the *altered* clay, for I do not consider the decalcified clay of the valleys to be in the original place, or to belong to the original species of the deposit, and believe that the clay lay on the upland plain through which the valleys have been cut, and down whose sides in varying states it has since made its way.

The Boulder Clay has not been found *in sitû* south of the Thames, but there is no reason that it should not, that I know of. The most southerly point at which it is found in Essex is due Northward of Shooters Hill, and the high ground to the Eastward of it; and I would call attention to the fact that on the patches of London clay on Bostol Heath and on the spurs of that tenacious clay which extend from Shooters Hill lying above 200 feet O.D., may be found a notable quantity of erratics in the form of Quartz, massive, saccharoid, and crystalline, Quartzites, Hard Sandstones and a few other rocks in small pieces resembling those of Essex, though of course these may be the remains of its subjàcent deposit the glacial gravel.

But on Northumberland Heath may be found here and there, clay, blue and yellow like altered London clay or Boulder clay, which I have traced in a trail of later glaciation, as having come from outliers of London clay, nearly or quite denuded, which lay or lie at elevations well above the 200 feet contour. The gravel spread of Dartford Heath, Greenhithe and Swanscombe, contains many rolled shells of Gryphæa; on the Brent especially I found some suspicious clay like washed Boulder clay, and numerous specimens of Gryphæa incurva and dilatata in a reduced condition. There is, therefore, just a probability that the clay lay in Kent.

Whatever the origin of the Boulder clay, if we may suppose that the upper level of the sea, at whose bottom lay its near relation the Glacial gravel, extended upwards to whereabout is the present 400 feet contour and the lower level of the chalk-with-flints, we can picture the basins of some of the rivers within the Weald as presenting somewhat the character of lakes in their deeper portions, and I would refer some of the difficulties in tracing the course of river denudation there, to this cause. In the Wealden district, Southward, there is a plane which appears to lie somewhere between the 400-500 feet contours, above and below which a difference in the mode of denudation of the district may be detected. No distinct river gravels are found above it, while they are below. Above it river valleys have been cut off, as in those of the Darenth and Wandle, and the re-arrangement of river basins appears to have commenced below it. The outlets of the Darenth and Medway at the chalk crest shew a narrowing of the channel below it, and the difference in breadth is marked by a terrace or shoulder, though this may be due to a differing hardness of the chalk also.

If the country had been excavated over any wide extent of ground, before the rise of the sea level, as suggested above, had ponded back the rivers, especially during a period of great glaciation; the descent of snow and ice from the hill sides, would push much of the old river gravels into the water, when some would be relaid, but some might slide a short distance when near or just below the water level without much more disturbance than a moderate crumpling of the layers. I suggest this in consequence of the peculiar appearance and position of some of the gravels in the Wealden district, which are like, and at the same time unlike river gravels, without there being a doubt of their fluviatile origin. In the history of our superficial deposits, I look on those of the higher levels already described as preceding the Episode of the deposition of the Marine Glacial Gravels and the Chalky Boulder clay; but while some of those that follow may belong to the latter part of that Episode, all seem to be of subsequent date.

The gravel proper to the river Thames in the lower part of its course (or 20 miles on either side of London) form a broad belt of varying width, generally six or eight miles from North to South. All these gravels lie below the present 200 feet contour line (the highest, those at Wimbledon do not exceed 190 feet, up to which they nearly reach). The general average of the upper maximum range is 150 feet. All the gravels of the Thames proper are distinguished by a composition differing from those at a level exceeding 200 feet, in as much as they contain, in varying proportions according to locality, erratics or the pebbles and fossils of Northern origin, which have been washed from the Glacial gravels and clays which still line the Northern brow of its valley, and which may have occupied a small part of what is now within its present well marked area of denudation. Erratics are the most abundant and unvarying companions of the chalk flints, and tertiary pebbles, which form its Northern spreads of gravel. On the South, however, where the supply of materials from the chalk hills, and the Weald, by tributaries which do not pass through glacial beds, is very abundant, we find the erratics diminish in proportion, and frequently we find the gravels under the hills and near the outlets of streams almost free of erratics, though continuous stratigraphically with gravels full of them. This is the case at the mouth of the chalk valley at Croydon, and the extreme inland verge of the spread at Dartford Heath. The upper gravels of the Old Wandle at Norwood do not contain them, lying at an elevation above their range, and being of a previous age.

The very high patches of Kingston and Wimbledon have not yet been found to contain any mammalian remains or flint implements. But the high level gravels of Dartford do, as also do the high level gravels of Middlesex and Essex, yet though the unfossiliferous condition of the high level gravels West of Shooters Hill may be thought to separate them from those of Middlesex, Essex and the east, they do not appear to differ more than some parts differ from other parts of those spreads known to be fossiliferous, so that I class all these as one. The constitution of the material of the higher level gravels differs but slightly from that of the lower; the main difference being diminution vertically, *i.e.*, in the lower terraces, of the proportions of foreign pebbles, and in an Easterly and Southerly direction as the river gravels recede from the beds which yielded them, as well as to the susceptibility of some rocks more than others, to disintegrate by exposure.

Although the gravels of the higher terrace do not shew much evidence of glaciation during their deposition, yet I have seen at their base on Dartford Heath and elsewhere, detached masses of London clay of considerable size which could only, I think, have been carried by ice.

Below the level of about 100 feet O.D. on the Kent and Surrey side lies another terrace, whose continuity is broken. On the North side, however, the high level gravels have passed by gentle gradations, in some places without a break, down to the lower terrace, although occasionally a denuded space separates them. The difference on the two sides of the river, is the consequence of the gentle abandonment of the Northern part of the river bed for the Southern, the Thames has always shewn a tendency to hug the Southern hills and form a scarp.

It was mainly during the denudation of the Thames valley by itself and its tributaries that the present Wandle basin was formed, whose direction, Westward, differs from that of the Old Wandle which continued Eastward, from Croydon to Deptford. If the present Wandle, or that part of it which runs from Carshalton to the Thames be taken as the subterranean outlet representative of the direction of the stream of underground drainage in the chalk of the present day, it is probable that that drainage line has changed considerably since the old valley was cut by the stream from Merstham by Croydon and Deptford. The Ravensbourne too, which finds its outlet close to or actually at the line of the extinct river, was once, I have little doubt, one of its affluents, and this will appear the more likely if we remember that the Thames to which these streams flowed was reached at that early time at a point some distance further to the North than would be the case now. For the current of all the rivers of the district, running North or South, have tended to widen their channels Eastward, leaving the West, while that of the Thames and those flowing Eastward have left their older beds on the North, and run in newer and deeper ones on the South.

After the Darenth had cut its Valley down through the old bed of high level gravel at Dartford, it found the chalk still stretched across the present streamway from the East, in such strength as to necessitate its swerving from the straight line it had preserved between Farningham and Dartford; consequently it cut its channel round under the hills, which formed cliffs, by Stoneham, North End and Erith, where it joined the Thames.

During this period the sea must have been far away and the land high, with a good fall for the rivers, but after the Thames at this part of its course had cut its bed down to a depth about the zero of O.D., there was a change; this I ascribe to the depression of the land, until the sea advanced far up the old river valley, raising its flood-waters to a great height. If the river did not actually become estuarine at Erith I think it must have been very nearly so. At all events the waters were raised so high that the gravels of the Darenth accumulated in its bed, and sands and clays completely choked it (viz., the Erith and Crayford Brickearths), rising as high as to retouch the gravel on the higher terrace of Dartford Heath, &c. On the subsidence of this high water level which was accompanied by aggravated glacial conditions, and strong floods, the old bed by North End being blocked, the stream of the Darenth cut through and washed away the obstructing mass of chalk and established the present stream line at a deeper level than the old one by Erith.

The Thames after the last rise, excavated its bed at Erith for another 50ft., laying freshwater gravel which is there now. But after that depth had been reached, subsidence set in, the bed has become choked with sand, containing estuarine shells and tidal clay in layers, with peat, and forest growth, alternating. The depression continues still, as is shown by the deposit of Tidal clay over marginal banks of gravel sprinkled with relics of Roman occupation and more recent remains; as well as by the existence, many feet below the surface of the marsh, of the foundations of dwellings of Roman and mediæval construction.*

Flint implements are found at different levels over the whole district in positions which shew a great difference in their relative age and in the conditions under which they were deposited. They are found, some worn by longer or shorter travel with others apparently unworn, in the higher level gravels of Plaxtol, Bewley, and Chart Farm (Ightham); gravels which were deposited by a river, not the Medway nor the present Darenth, but by a former stream whose bed now lies on the line of the water-parting of both. Implements are also found at levels higher than

* See Journal of the Archæological Institute, Vol. xlii. p. 269, "Early Sites on the Thames Estuary." by F. C. J. Spurrell.

the last; some of which, from the fact that they are numerous in certain localities and present evident signs of having travelled, may have been deposited in patches of older river-gravels, much denuded, and at the present day difficult to make out. Other implements of related types were found scattered over the highest parts of the Greensand hills and the Chalk downs, which are much weathered by surface exposure but not collected in patches of river gravel, though some have been found in the masses of angular flints which have been derived from the clay-with-flints. Besides these there are implements whose differences of form and size place them under a category apart from the last, while their resemblance to certain implements from the caves of France and England, together with the situation in which they have been found, suggest another and perhaps later type and age. The high level gravel of the Thames between 200 and 100 feet O.D., contains implements very much worn, together with perfectly fresh ones, accompanied by abundant sharp flakes. The lowest gravel of the "Old" Darenth at Erith, also contains implements, and in the same deposit at higher levels and of a later period, abundant flint relics on the actual spots of manufacture may be seen, as also in similar situations elsewhere. This enumeration of positions in which implements are found, is intended to give my idea of relative age by the sequence. In the latest Trails [T.] also are found wasters and small implements, such as "thumb-scrapers" hollow scrapers, &c., resembling both those of the older deposits and those found on the present surface of the country. I have picked out flakes from the ancient rain-wash or warp, immediately covering those Trails, and also implements of flint, rudely chipped, never polished, of lengthened form and having frequently a peculiar and intentional turn aside in one part of them, which are found on the surface, but which differ from those found exclusively on the ground. Then we have unpolished and partly or wholly polished tools. The implements of the peat or forest bed of the Thames marshes are apparently of the polished types.

I find, therefore, that the surface deposits of the district, so far as they have been examined, exhibit evidence of an early and a continuous occupation of the country by man until now, and I see no cause to doubt that it was so occupied. Looking at the whole series of implements from the most ancient stratigraphically to the most recent, and carefully comparing the simplest and most homely series and that of the most elaborate and larger implements, I am unable to draw a sharp line of demarkation in time or type which wholly separates *palæolithic* from *neolithic* implements, that is, without doing violence to the series found, by ignoring intermediate varieties and omitting intentionally those which bridge over the line of separation. So gentle and almost insensible is the passage from one marked type to another, and so many types branch out from this onward passage, that it is rather from the abundance than the paucity of kinds that the difficulty in definition arises. Besides there is no evidence in the deposits of a cessation of the practice of flint chipping, on the contrary, all of them contain at the least, waster flakes and minor tools, which, there is no reason to doubt, are contemporaneous with the layers in which they lie.

The art of chipping appears to have been already perfected in the examples derived from our oldest deposits, and to have died out with the cessation of Gun flint manufacture once so largely carried on near Gravesend. As implements derived from a higher level may be, and are found in deposit at a lower level, so at the lowest levels of the Medway and the Thames, and in the latest gravels which form their present beds, the implements of all ages may lie side by side, some of them worn almost out of recognition and some still looking cleanly chipped; yet those which still appear newly chipped may have fallen down or been pushed by ice from beds older than those now being laid, whose contemporaneously included implements may be greatly abraded. The determination of relative age in types cannot then safely be made in recent deposits, but old types must be made out in old deposits which cannot contain late ones. Wear and rudeness of manufacture are no proof of age, and peculiarities of work and shape without the assistance of geological position are fallacious guides.

Part II.

It is not only to rivers, however, that so much and apparently such rapid denudation has to be credited, even with a rainfall much greater than at present. It is largely to snow and ice. Therefore a few remarks as to the evidence of their work is offered. I do not use the phrase "the glacial epoch" because any term implying a sharply defined time in which this district was ice-bound is inapplicable to the subject. Since the day the crests of our hills emerged from a sea covered with bergs, ice and snow have apparently held this county to the exclusion of a truly genial climate, and although it is not strictly glacial now, the improvement appears as if commencing but yesterday, compared with the long ages of cold preceding the remission.

But first it is necessary to say a few words as to the present mode of surface denudation.

The growth of plants and tillage, &c., by disturbing the soil at the surface, works it into a confused light mass, usually of a dark grey colour which is known as vegetable soil or humus, and which covers the ground. The action of wind and rain with frost is apparent enough, in tearing down rocks and washing them about, and this also contributes to the formation of vegetable soil. The finer particles are frequently left as flood loams on the low land beside streams, while the coarser are borne down by the current until checked by the sea.

But beside the loams deposited in broad sheets by overflows, there is a thin coating of loam found in every place suitable for catching it on any hill side or gentle slope, it is called *rainwash* and is the result of the gentle action of rain on the finest particles—rain so gentle as not to carry them away altogether. Over this soft stuff, during a heavier rainfall pebbles find their way occasionally, and in it is no sign of stratification. I wish to lay some stress on the fact that its accumulation is exceedingly slow. In districts where agriculture or traffic disturbs the soil the rainwash is coarse and stony, and this form of it may be well studied in places where a hedge or wall has stopped its descent; in this case too it is usually of a darker colour, not being fully oxidized and consisting of little more than vegetable soil moved bodily.

In *Pl.* i. *fig.* 1, I have given a section across half a valley, nearly 100 feet above the Thames at Milton Street, Swanscombe. Above the trail at "g" is a layer of "surface gravel" formed by the abstraction of the finer particles and decalcification of the trail, at the bottom, over-lying the gravel is the early rainwash, [Mr. Fisher's "warp"] passing insensibly up to modern vegetable soil. The lines I have drawn in it are exaggerated, but denote slight differences, mainly in the amount of dark vegetable matter staining the wash. The intrusive pebbles are comparatively scarce below, and extremely abundant at the surface. It is a very good example of the change from old rainwash to new. Where the old rainwash or rain-warp is but a few inches thick, the two are mixed by surface action and are indistinguishable, but whether seen at one spot or not, old rain-warp always covered trail once.

As to the nomenclature of the conditions I am about to discuss, a word is required in explanation. Mr. C. B. Rose, seems to have been the first person to consider the surface soils from the point of view of their formation. Mr. J. Trimmer, next took the subject up, and a sentence of his will best explain his view of the matter. Speaking of the soils below the surface or vegetable earth, he says, "I have named this deposit provisionally, the warp of the drift,"* "a name which is however not altogether appropriate, because although in low situations and on level surfaces it resembles the warp or sediment left by the tidal waters of muddy estuaries and is scarcely distinguished from modern alluvial deposits, yet in other situations far above the reach of existing streams, stones of considerable size are contained in it, and in the vicinity of mountain chains the large blocks or boulders which either strew the surface or are enveloped in this deposit appear to have been dispersed at the period of its formation. Its history is yet to be discovered. For some time after it had attracted my attention, I regarded it as the deposit left by the waters under which the drift was formed, as they gradually retired during the upheaval and dessication of the land; but in the course of my observations in Norfolk, I have met with indications of the denuded surface of the drift having become dry land before this warp was spread over it." Mr. Trimmer published several papers on the subject and one especially on the district I am considering.†

Mr. Osmund Fisher next took the matter up. He retains the word "warp" which he also believes to be "a deposit from waters returning to a state of tranquility." But he separates the finer from the stony warp or deposit of Trimmer, by giving the latter a distinctive name. He says "It is well known that the surface of the subjacent stratum (to the Warp), wherever it is of a soft nature, such as sand, clay, gravel or chalk is worn into furrows and hollows, sometimes into pits and pipes, ... as far as my observations extend, I find that cylindrical pits and pipes are generally confined to soluble

* He also called it "The Erratic Warp."

† J. Trimmer, Journal Agric. Soc. VII., 465, see also J. Trimmer' Q. J. G. S. VII. and others.

beds and that the normal form of the cavities in clays, sands and gravels is that of troughs and furrows," then "for the sake of a name I shall call the materials which fill these furrows the Trail." This transported or re-arranged material he says produced warp, and *the* trail was the product of glaciation of the surface and belonged to "one" period.*

In this paper the word "*Warp*" will be qualified as rain-warp or rainwash, to distinguish it from true warp or the settlement from troubled waters.

"*Trail*" is the material filling troughs and hollows, a substance dissociated wholly from the beds whence it was derived. *Underplight*,† is the term I shall use for the rocks and beds forming the folds and sides of the hollows, which have been pinched, crumpled, and squeezed, into sheets and ribbons, sometimes projecting into the trail but still united to the parent rock from which they are in process of separation, and to which they still obviously belong. The various minor curves, distortions and puddlings of the stratified beds beneath are included in this "*underplight*." It is necessary to make this distinction because of the importance of distinguishing the position of fossils and flint implements, whether they fell *down* into the glacial mud or were squeezed *up* into it from below.

Thus, *Underplight* is the result of the mechanical movement of ice or thawing soil over the land.

Trail is the re-arrangement of the detached and comminuted rocks after the thawing of the ice.

Rain-warp or older rain-wash is the finer stuff separated from the trail, leaving the coarser part behind as surface gravel.‡

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* See Rev. O. Fisher, Q. J. Geological Soc. 1866. Geol. Mag. 1866, &c., &c., also a letter in Nature, July 5, 1877, &c.

I am greatly indebted to Mr. Fisher in this study, but I was originally induced to examine the subject by Mr. J. Trimmer's remarks.

† Plight, pleat, a folded condition.

‡ The discovery of stones by the abstraction of the enveloping sand and clay, is the cause of the popular notion that "Stones grow," an

It is certain that the conditions depicted in my figures are not now being produced here, and that the cause which formed them has ceased to act. In the endeavour to explain these appearances, I find that the marks left by the movement of true landslips are of no assistance. The settlement of sea cliffs or those of artificial cuttings are not comparable with them, nor have the sections I have made, or been able to examine, in the slipping material, presented the peculiarities under consideration. The contortions of the neighbouring Boulder clay, of Glaciers, and of those so famous in the Cromer Cliffs, are altogether different. I do not think that the sliding of bogs or sheets of "vegetable spongy matter," full of water (Dr. Coppinger's soil cap) *without* the aid of intense frost capable of producing the effect. There is, however, in our neighbourhood, one situation in which the soil creeps and slips now, viz., on the steep hill sides formed of stiff clay, such as Shooter's Hill.

The clay contracts in summer, shewing deep and long cracks. When winter arrives these are filled with water and the whole surface clay becomes saturated with it. A frost expands the crack and the whole substance of the soil, thus pushing the clay a little down hill and forming a roll or fold. A thaw fills the widened crack with water and the process is repeated. Then a little pond is formed behind the ridge and its greater volume increases the leverage of the expanding mass of ice and adds its extra weight of water in the fissure when thawed. We can see that these alternate acts of freezing and thawing may produce resemblances to my figures, but it must be remembered that the modern action is different to the ancient, and that it is confined to clays and steep hill sides. Moreover, in the sections I have cut through the modern folds, the pleatings of the parent rock are absent.

Therefore I suppose, *Firstly, that the folds or Underplight, with the puddled sludge or Trail, may have resulted from the heavy pressure of a superincumbent mass of snow on a soil in a condition capable of yielding, and frequently repeated.*

It is a familiar fact that the ground softens beneath the winter snows, and that plants grow beneath them. Long before the heavy sheets of Arctic snow are melted, and even when they do not disappear, the ground beneath is softened.

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opinion held by many who should know better, but the disentanglement of the stones by the rain is too slow a process for some minds to perceive, they see more stones but they don't see less clay.

The thick sheets of snow in the Arctic regions do not rest on the surface soil uniformly, but leave in places "a clear space, one or "two inches high, over a large area, leaving ample room for the "lemmings to run about and free space above the dwarf Arctic "plants, with an uniform temperature many degrees higher than "the atmosphere;" which Sir G. Nares explains by evaporation. (See Sir G. Nares' Voyage of the *Alert*, i. 225).

Dr. Kane explains the formation of this air space. "The first warm "snows of August and September falling on a thickly pleached "carpet of grasses, heaths, and willows, enshrine them in a non-"conducting air-chamber, so that they retain their vitality, "beneath from six to ten feet of snow. The frozen subsoil "does not encroach upon this narrow zone of vegetation. I "have found in midwinter, in this high latitude of 78° 50′, the "surface so nearly moist as to be friable to the touch."—(E. K. Kane, 2nd Grinnel Expedition, i. 2 67.)

Sir E. Belcher and other travellers frequently allude to the greater warmth beneath the snow.

Inasmuch then as the thaw proceeds, when the soil is still covered with six feet or more of snow, it is certain that the weight of the snow must greatly influence the soil already unstable, and in circumstances where its surface cannot be hardened by drying. Consequently in cases where the snow lies in irregular masses, some young and some of several years' growth, great inequalities of pressure must occur to vary the motion of the soil, even where hills and dales are not marked features of the country.

The following extracts are given in support of this. Nordenskiold, (in the voyage of the *Vega II.* p. 62) mentions that at a time when the spring was still in progress in Siberia, "At many "places, on the Tundra, the grassy sward had been torn up by "the ice, and carried away, leaving openings sharply defined by "right lines in the meadows, resembling a newly worked off "place in a peat moss."

Sir G. Nares (Voyage to the Polar Sea, 1875, Vol. i. p. 114) says "In the evening 25th August, I ascended a hill on the north "side of Discovery Harbour, a height of 1,200ft. by aneroid, it "was the worst ground for walking over that I ever met with. "The level plots were cut up by the frost into large clods like a "deeply ploughed field with cross ridges, the whole was covered "with a smooth carpet of snow," as Autumn was just commencing, "which while hiding the irregularities from sight was "not solid enough to bear one's weight. It was, however, "extremely gratifying to find (when the snow melted) a loamy "soil, with abundant sorrel, willow, saxifrages, and grasses, "instead of hard limestone and gravel plains."

Lieut.-Col. Godwin Austen, *apropos* of this subject (see Q.J.G.S. xl. 612) and of our own neighbourhood, speaks of the formation of frozen snow beds on the higher grounds, "such as those "patches of ice many square acres in extent that can be seen at "the present day on the wide level *plateau* of the Chang "Chingmo in Thibet, that is to say, solid ice not more than "twenty feet thick, with a flat but much broken surface, and with "a wall-like margin in most places. These I noticed lasted "until the winter snows began again, and in warm summers they "may almost disappear." . . . . "Such snow," he continues, "and such frozen snow beds, would have quite sufficient force "to act on the surface of the country, wearing it down to the "even beautiful curves it now presents."

Secondly, there is another means of explaining the formation of underplight and trail.

That of the intermittent flowing, by its own weight, of a soil undergoing a thaw or regelation (*regelare, to thaw*), *that is, in a viscous state, or one of unequal coherence.*

In Arctic lands where the subsoil is frozen permanently, the surface soil is thawed for a certain depth only. In the act of freezing again, the expansion of the ice separates the fragments and layers of rock ; on the liquefaction of this ice the small fissures are occupied by a larger quantity of water than before. The widening of the minute fissures in the rock having been increased by the ice, permits the water of the thawing snow to fill the fissures instead of running off until the soil is almost fluid. In the valleys of the Aniui, where the vegetation is comparatively rich, Wrangell mentions that "the snow appears to melt only to form "fresh ice beneath the covering of mould," not flowing off as water. (Wrangell trans. : by Sabine p. 51).

When the surface is bared the sun converts the whole to mush or sludge, which partially flows from the upper ground to the lower, leaving the rock nearer to the surface ready for the next thaw to attack it.

Sir E. Belcher says that "Buckingham Island is belted from the "first base of this elevated range (200ft. above the sea) by a low "marshy slope of frozen mud, thickly covered with tufts of "grass. This mud is the result of the *débris* during the summer "thaw, which appears to lose itself in the sea, distant from the "elevated land about a quarter of a mile." Having reached the "highest mound" of this elevation, he continues, "At the time "we commenced operations here, the soil was well frozen, the "ground betrayed no symptoms of weakness and it was partially "snow-clad; but as the power of the sun increased towards "noon, the snow about me disappeared, the instrument legs sank "deeper into the soil, the levels shifted and frequently required "re-adjustment; yet still the temperature as exhibited by a "thermometer protected by the sun simply indicated 7° below "freezing (Fah.) As noon passed, the soil in all the hollows or "small water-courses became semi-fluid, at the edge of the "southern bank, the mud could be seen actually flowing, "reminding one more of an asphalt bank in a tropical region, "than in our position in lat. 77·10. N. The entire aspect of our "immediate position, and beneath, presented the features of a "newly-drained lake, the lower land conveying its fluid mud to "the sea. The soil, a dark-brown ferruginous clay, resulting "from the disintegration of clay ironstone, black and glazed by "exposure to the sun and cracking into compartments, impressed "on my mind the probability that a continued series of hot days "would materially change the outlines of my present position, "converting it possibly into a similar slope to that exhibited "beneath. Even where I stood the temperature was 25°." Flowing soil is alluded to as occurring in other places, (Sir E. Belcher, Arctic Voyage, i. p. 306.)

N.B.—The preceding extracts are the result of an extended search· though so meagre. In the printed accounts of the more recent Arctic travels, notices of the action of ice and frost on the soil are almost wholly confined to the evidences of glaciers having covered the land, and to studies of perched blocks, *roches moutonnés*, and the direction of scratches and travelled rocks, as if in these were comprised the whole study of "*Glaciation*." So completely is this the case, that even in the "Arctic Manual" issued by the Admiralty, with instructions as to what to observe, as suggested by the Royal Society, and prepared for the expedition of 1875, no attention is directed to the subject of my enquiry, nor in the "Manual" can I find a single quotation bearing on the matter. This has not produced increased knowledge in the matter; and I conclude that the subject was considered unimportant both then and by subsequent English and American writers.

Under the general spread of vegetable soil it is common to find a thin layer of fine loam, its colour is usually a clear yellow, brown or red. It is generally a homogeneous loam. Looking at a section of it made across the line of its descent, it is occasionally seen that wavy lines of a slightly different colour and texture pass across irregularly, incontinuous and not perfectly horizontal, these consist generally of washes of slightly different materials, a little more sand alternating with a little more clay being the usual cause of the difference. These irregularities give the deposit a wavy lenticular character and shew that it is the dry land wash of rain as distinct from a deposit laid under water; it contains occasional pebbles irregularly placed. This material is known generally as virgin in contradistinction to vegetable soil. It is by some called "Warp," which if used should be qualified.

As each recurrence of glacial denudation obliterated the evidence of former ones on dry land, we cannot expect to find signs of earlier ones except under peculiar circumstances (as in the Darenth Brickearths), and this obliteration has especially affected the rain-warp, the last deposit of which has almost everywhere lost its distinctive character. (*See Pl.* i. *fig.* 1.)

Beneath this loam is found a layer of soil consisting commonly of stony blocks derived from the broken and weathered masses of the stratified rocks, with softer clays and sands all mixed up together.

At first view these particles appear confusedly mixed, and it is perfectly clear that they are not water laid. Most of the particles are so arranged that their long axes are far from horizontal or shewing "bedding" as would have been the case had they been laid by water. There are two ways of looking at this layer, if so it may be called, which will resolve the apparent confusion into a regular structure.

In the most suitable places for studying it, as in the softer rocks of the pleistocene period, if a vertical section be made in the direction of the slope of the ground, the stratified layers below will be observed to be bent with pear-shaped curves and folds, the upper portions of which folds and curves are inclined and bent in the direction of the lower ground, this is underplight. (See figures at the parts marked U.P. The appearance has been well named "festooned." (*Fig.* i., ii., iii., v., ix., &c., *Pl.* i.) In a section taken at right angles to this the resemblance to festooning gives place to what is commonly called "contorted" (*Fig.* iv., vi., viii., &c., *Pl.* i.) because the regularity is not so apparent, though of course they are interchangeable terms, and sections at angles less than right diminish the distinction.

As exhibited in the latest fit of glaciation, the direction of these folds is always *across* the inclination of the surface of the ground at present. The length of these folds is various, and direction sinuous. At Erith I have been able to trace a wave or ridge over 50 yards in length. where the surface was being cleared to get at the Brick-earth, its line was irregular but continuous.

In Greenstreet Green, Darenth, gravel pit, lengthened longitudinal ridges of gravel, parallel with the valley, may be traced in the bottom of the pit, which could only have been formed by the descent of masses from the hill side, so also at Pratt's bottom, &c.

Usually, however, the length, either originally or from subsequent interference, is very much shorter and in curves of small diameter, which when cut through in a right line parallel to its general extent, give the appearance of gullies running in the opposite direction.

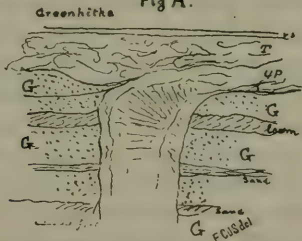
It is a distinctive feature of these earth folds that they all extend at right angles to the direction of the surface drainage. Where either in or through the latest layer of trail and across the folds of underplight, marked channels are found to have been excavated, in accordance with the present inclination of the surface and the direction of its drainage, they are of later date and indicate the gradual resumption of the reign of rain as we have it now.

The "hammer headed" masses of chalk or underlying rock are the result of the passage of a later mass of ice over the fold, flattening it out; the "hammer heads" are not caused by lines of underground drainage, to which they are transverse in general.

True lines of underground drainage may be found in the case of folds whose direction is so much inclined to the vertical as to receive at their upper lips the surface drainage, and conduct it back to the bottom of the fold, where if the rock be soluble it forms pipes (*see Pl.* i. *fig.* 5.)

Pipes were never produced by the same means which produced Trail and Underplight, the tendency of which was to obliterate them. Pipes were either pre-existing or subsequent to the latter events. In the case of pre-existing pipes, the contents of which have been bent over and carried away horizontally, the relationship is obvious, as in the accompanying cut (in the upper gravel sheet at Greenhithe). But true piping of a subsequent date is very difficult to determine.

Fig A.



NOTE.—In this figure the radiant lines shew the cracks in the loam of the core due to flexure.

In soluble rocks, especially chalk, the removal of the lime has assisted in letting the loose gravels down, the line which separates the chalky trail from the decalcified trail is mostly sharp and easily distinguished however; I think that this solution of the lime has had little or nothing to do with the cause of the peculiar forms exhibited in the curves and outlines which I figure.

True gullies or lines of drainage on the glaciated surface may of course have been developed, but they distinctly present peculiarities. Sometimes long troughs of slight inclination and of semi-circular transverse section may be found. The peculiarity is observed that though there is gravel, sand, and loam in them, shewing they once contained bedded deposits, now the contents are somewhat conformable to the outline of the section. I take it that these have been restricted gullies between blocks of ice or in frozen ground, which carried streams in summer and which got choked in the normal way. When the choked rivulet was overridden by ice, the overlying mass would weigh down into the soft central part and the pressure would become radial, squeezing down the upper middle part, and squeezing up the lower deposit at the same time, while arranging the pebbles in accordance with this pressure, viz., placing their longest axes at right angles to the resistance, which in a semi-circle would be vertical at the sides, and approaching the horizontal towards the bottom. This action would extend to the re-arrangement of the pebbles in the parent rock if it were gravel (see figure). As the gully at Erith (*Pl.* ii. *fig.* 2), extended between two valleys, excavated since, and therefore later in age, it does not belong to the latest fit of glaciation, but is a good example, as it is covered by trail, &c.

The effect of pressure on the pebbles and stones both in the trail and underplight, is to place their flat surfaces parallel with the surfaces forming the folds and festoons. In my drawing I have not always been able to indicate this, but it is to be understood as the regular appearance in every case.

It usually happens that the festooned layer or underplight is so arranged as to present the folds nearly upright, or so little inclined as to make the nearly vertical position of the folds and their constituent pebbles and fragments a conspicuous feature, but occasionally examples may be found where the inclination of the ground is such that the folds approach the horizontal and frequently incline downwards, this is determined by the amount of the slope. In the chalk it is common to find blocks of flint raised on end, and I have seen instances in which the blocks having been pushed against each other were arranged perpendicularly, the flat surfaces separated by intervals very much less than would have been the case had they been merely turned on end. The folds are complete and multiplicate where vertical, less easy to trace where horizontal, and unrecognizable as folds when the inclination is great, they are so long drawn out in the latter case as to appear on casual inspection to be water laid, thus it was I believe that Mr. Trimmer and others were led to suggest the "Cataclysmal dip" beneath the ocean. The contortions of the Underplight here are the result of steady movement, a flow or push in certain directions in accordance with the slopes on the surface of the land, the amount of slope determining the direction being often very slight. The areas within which the latest flows operated being generally small, they can in most places be defined by the observations of the directions of the folds. The trail and wash above the underplight contain no sea shells or marine organisms, but consist of the *débris* of a land surface. The underplight is not due to floating or shore ice; the presence of the latter may have caused some of the disturbances in the deeper gravels of another age, but the arrangement of these is totally different from the U.P. and the bottom layers shew none of the regular characters of the latter. The layers of Warp and Trail and U.P. being of terrestrial origin and repeated, are not of "one period" only, and consequently the phrases "The Warp" and "The Trail" are inexact. Inasmuch also as they are found from more than 800ft. at Crowborough Beacon, the Chalk downs over Oxted, &c., to nearly zero of O.D. I cannot reconcile their presence with one or many cataclysmal dips beneath the sea.

The masses of dirty snow when melted, covered the flat lands with a deep layer of sludge and confused gravel.

Some of this latter gravel appears in the festoons and underplight, but it must not be regarded as having formed them, only as remaining on the surface from the thawing of previous dirty masses of ice, and so becoming included in the next crumpling of the surface. In the neighbourhood of rivers this product of glaciation accumulated in great sheets of gravel, shewing something of aqueous arrangement even before it reached the bed of the river, which was the result perhaps of ponding back or *débacles*. This appearance in our district is not perceived at an elevation above 20 feet O.D. near the Thames.*

When light clays and sands had been deposited in channels in gravel, the gravels sometimes got pushed into the more yielding soil (*Pl.* i. *fig.* 6) and in the case of gravel containing sand and clay in layers, which has been piped through by the dissolution of the chalk beneath, the over-riding of the heavy masses has pressed the layers of differing hardness out of their normal shape in such a manner as to crush in the sides of the pipe, frequently contorting the edges of the layers *upwards*, and often pushing portions of the clay and gravel some inches into the core of the pipe, thus contracting the pipe, keying the core and hardening it so that after the ice has passed away and the solution of the chalk had continued to let down the gravel, a cavity was formed below a certain point, the roof of which was the result of the above-mentioned compression. These cavities are common, most are small but some are large, on Dartford Brent I saw one in which twenty men could have found standing room, and I heard of another into which a cart was backed. I would suggest that it

*It is a question whether the slightly washed sheets of gravel which overlie the latest Trail on the foreshore of the Thames are not of a modern date, inasmuch as the *Trail* and Underplight beneath them can certainly be traced under the Tidal mud deposits for twelve feet at least below T.H.W. mark; and I have seen the two latter in particular, under the Tidal mud at Erith, Swanscombe, Northfleet, Higham, and other places on the river.

might be possible to employ the piping as a measure of the time since glaciation (*Pl.* i. *fig.* 10).

Attention was called to such caverns at the British Association meeting at Norwich in 1868, by Dr. John Evans, and by Mr. T. V. Holmes of some at Caterham, in the Proc. Geol. Association, IX. Vol.

The masses of ice and snow enclosed blocks of stone which were undoubtedly the means of tearing up underlying rocks when the resistance was sufficient. By this means rocks would be denuded when not plastic. Large pieces of hard Greensand and Wealden rocks were dislodged and moved away without much effort, thus far in no instances have I yet found any scratched or crushed.

Flint pebbles of the Eocene beds are often found scratched or crushed, however, as are pebbles and flakes of river gravels ; (the pitting of Eocene pebbles from reciprocal pressure aided by the penetrating effect of sharp quartz grains on the altered surface of the pebble has assisted this). Masses of the Oldhaven pebble beds are often found to have been moved *en bloc*, perhaps solidified by ice at the time; where the edges of the blocks grated against each other, the pebbles are splintered in lines more or less vertical.

I saw an instance at Swanscombe of the passage of a mass of stones over a large flint block in the chalk, too large to move, from which two passing stones had separated flakes, each stone carrying away a flake with it to distances of 18 and 6 inches respectively before the movement was arrested.

There is, therefore, no reason why rocks should not be found having glacial striæ of this glaciation.

The product of the glacial destruction in the district South of the chalk, differs slightly from that in the North. The trail is found filling up the smaller valleys to a greater extent with a confused mass of rubbish, much resembling "spoil," except that it is still more confused, this is from subsequent shifting often, streams having cut away the lower part and permitted re-settlement, good examples may be seen in the heads of the valleys, between Maidstone and Westerham and along the Chatham and Dover Railway cutting, especially that exposed on the East side of Boro' Green Railway bridge. Glaciation has produced in the Weald, under the greensand escarpment, large spreads of what may be likened to Boulder clay, and as in the case of Boulder clay, the surface weathering has removed the finer material, leaving thick layers of angular and half-worn fragments of rock and pebbles. Near Shipbourne, this clay extends over a considerable space, and may be met with in a homogeneous condition, resembling Till, to a depth of at least eight feet below the surface and I believe even deeper. I think that the lower part of this may be of a very early date.

Besides the layers or coverings of trail and underplight, over the whole country side which I have been describing hitherto, there are signs of underplights and trails of earlier date, but similar in kind.

On hill tops and at their very apices masses of ground disturbed by land ice may be found, which have suffered so much from subsequent denudation as to make it evident that they are not of the latest glaciation I have already described, and this observation will be strengthened by the frequent inability to perceive an accordance between the direction of the folds and the present inclination of the ground.

Along the crest of the chalk downs, masses of tertiary pebbles may be found which have been so worked up as to present perfect confusion in their lower parts as if by shore ice.

In some, near the surface, the pebbles are pitted, scored, and crushed even to sand and powder; it is easy to find, however, instances where the pit has not received the impress from the pebble which at this moment lies nearest to it, shewing later movement, while above this is red loam and festoons of a later date, whose contortions are wholly unconnected with the changes beneath, and must have been produced by different causes.

Such a condition of the pebbles is well seen on the actual summit of the chalk crest, 2 miles N.E. of Limpsfield Church. When the chalk escarpment extended further South, a mile or more, the Darenth stream ran at its foot.

There can be no doubt that the Darenth extended much further Westward than now, for it is clear as Mr. Topley has remarked,* that there is a distinct relation between the gravels of Limpsfield common and those of the present Darenth valley. The spread of the above mentioned flint pebbles once extended Southward with the chalk, and contributed to form the gravel of Limpsfield, for remains of them in the crushed form, as sand and fine spicules, may be found in parts of the above mentioned gravel, sorted out and slightly waterworn. The main mass of the Limpsfield gravel is much disturbed, and it is impossible that the pebbles could have reached Limpsfield from the downs in the present state of the escarpment and the contour of the ground. The retreat of the chalk escarpment is largely due to surface glaciation, there may be seen an accumulation of coarse surface trail, mingled with shattered blocks of flint crushed out of the chalk, at the sides of the lane leading from the hill above to Titsey.

At Knock Mill by Kingsdown, is a large mass of tertiary pebbles lying on chalk against Thanet Sand, these have been worked up apparently beneath water. In a section I lately saw, 25 feet deep, there was about midway down a layer of level wash, and signs as if it had all been disturbed by shore ice. Two festooned layers parted by red loamy sand, from 8 to 24 inches deep (land warp), may be distinguished in neighbouring places, the uppermost layer may be traced over the sheet of clay with flints into which it has trailed festoons of pebbles. (*Pl.* ii. *fig.* 9.)

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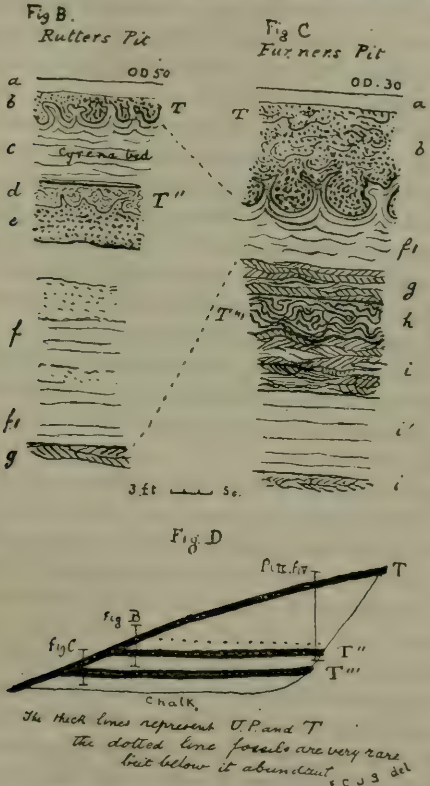
* Weald.

In the Brickearths of the Darenth, between Dartford and Erith, beneath the wide spread of the underplight and trail of the latest or surface glaciation, traces of disturbance in the deposits filling the abandoned bed of the old river may be seen at Crayford; some feet down (*Pl.* ii. *fig.* 4), confused trail may be seen as it was arrested while coming down the cliff or river bank, it may be followed deeper into the stream as irregular masses of tumultuous gravel, representing the trail on land, which by their weight have in places denuded the soft strata. This descent of trail, as gravel from the hill above may be traced about 450 yards to the west of this section, where the torn chalk and contorted gravel and sand may be seen. (*Pl.* ii. *fig.* 7.) The trail or flowing soil on reaching the Old Darenth River was not always washed away as gravel, but its appearance in the river bed is somewhat different to that on land, due to the increased freedom of its motion in the stream-bed. Its power of pushing up the sand and gravel over which it passed was greatly reduced, and consequently its U.P. there is very slight. The stuff is to all appearances a boulder clay, and differs from the underlying soils by the mode of mixture of its component parts and its differing constitution, which can be traced to the variations in the strata composing the river banks. It is formed mostly of gravel opposite those that are gravelly, and of clay and sand opposite those of chalk, and consists obviously of scrapings from a land surface. In both kinds, chalk in fragments is found in it, but the finely ground chalk has apparently suffered partial solution, and some of it has since accreted into soft cretaceous masses. In the central and other parts of the stream the current was powerful enough to sweep the boulder clay away into gravel, but in others it may still be recognised even as far from the cliff as 300 or 400 yards, differing in composition and colour (grey) from the gravels and sands. Nowhere is the layer very thick; three feet is the maximum I have seen.

This description of the clay applies to the layer I have marked as *T.* i. in *Pl.* ii. *fig.* 4, and also in the accompanying cuts. In the left hand figure the T. ii. (the *T.* i. of the Plate) overlies gravel, the squeezing up of which is usually less marked than this. In the right hand figure,



from Slade's Green, is shewn a remnant of a crumpled layer, the U.P. of a trail I have marked *T.* iii., and which I have taken to be the same layer as that shewn in *Pl.* ii. *fig.* 7, coming down the cliff. The layers of glaciated landscrape or boulder like clay, for the trail does not look like boulder clay until it is found in the stream way, may have been more numerous than the three above-mentioned, but I have not found evidence of any others during a long period of attention given to the subject.

In the annexed cuts, the letters are in a sequence, and it will be seen that in *Fig.* C., a considerable denudation has removed the layers *c*, *d*, *e*, and *f*, of *Fig.* B, together with *T.* ii., while *T.* iii. comes in, in a stratum not attainable at present in Rutter's pit.

The upper or latest layers of Trail, represented in *Pl.* ii. *fig.* 4. as [T.] and in most of my figures, is not found in its boulder clay stage, as it was formed when all the present surface of the Brick-earths was dry land. Since the deposition of *T.* ii. and *T.* iii., which are nearly parallel, and generally conformable with the layers of Brick-earth, a great denudation had occurred, and the latest, *T.*, cuts the others off after the manner represented in *fig.* D., which diagram is an ideal section of this part of the Old Darenth beds, shewing the denudation which has cut off *T.* ii. and *T.* iii., and the different slope of *T.* compared with the others.

The upper or [T.] trail has cleared large quantities of the fossil-bearing layers away, and deposited them in the gravels now lying in the Thames bed ; from which fragments of bone, tusks and large molars of Elephant are occasionally dredged in a condition which clearly shews their origin.

At Erith, large masses of Thanet Sand, Oldhaven, and Woolwich shell beds with London Clay have been pushed over the cliff edge. [Some of the great blocks of stone may be seen now]. Mr. Tylor* expressed a difficulty in accounting for this, and Mr. W. Whitaker† speaks of it as a landslip. But I see no difficulty in

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* Quaternary Gravels, Q. J. G. S., XXIV.

† W. Whitaker, Memoir of the Geological Survey. The London Basin.

accounting for the matter by the action of land ice; because the Woolwich shell beds are found to the South on the hill-top above, and traces of their passage may be detected along the whole interval between the two places, which is marked by a shallow depression; as the London clay once capped the same spot, it is that which is now found among the Brickearths.

About a mile and a half westward is still a small outlier of London clay, and traces of its degradation may be detected in several places as trail, over the pebble beds and Thanet Sand on Northumberland Heath, on its course towards the Thames. It often presents the appearance of a blue clay, sometimes yellow, full of slickensides, and occasionally contains crushed masses of chalk, the nodules of which are hard. It is this which Mr. Tylor in his description of Erith brickpit above mentioned has called rolled chalk, and has described as mixed with clay, and resembling Till or Boulder clay, which it does; but the rolled appearance is I think produced by solution of the edges. In a section I had made in Mr. Petman's nursery garden there was—

Made soil and v. s.	1ft. 3in.
Trail of Eocene pebbles	— 8in.
Clay, yellow and blue, with chalk	3ft. 0in.
A pan of tufa, formed from dissolution of chalk	— 6in.
Oldhaven pebbles	

In the Uphall pit at Ilford I saw formerly several well marked masses of true boulder clay—undoubted in that situation—enveloped in brickearth, and as at Erith, London clay remanié was also observed.

The heavy mass of trail on its arrival at the edge of the river doubtless broke down the cliff and thus produced the landslip of Mr. Whitaker, but whose origin is glacial. On tracing some of these heavy masses of disturbed strata further up the bed of the river, they are seen to contort the Brickearths and gravels at a lower level than the last layer of disturbance I mentioned, and I have no hesitation in assigning it to an earlier fit of glaciation than that one. I have drawn attention some time ago to a faulted and overturned mass of pebble beds at the top of the southernmost face of the Great Ballast Pit near Erith Station, and I think that it may be referred to one of the earlier glaciations (*Pl.* ii. *fig.* 1). It lies between two slight valleys of unequal depth, and at a point which, before the present excavation extended so far, constituted their place of junction. The mass of eocene sands and pebbles has been pushed from some point a few yards southward, a depression behind the mass now filled with at least 12 feet of rainwash or loam, shews that a large mass of ice must have cut rather deeply into the earth. I do not think that this was done by shore ice.

Having now shown recurrence in land glaciation as I take it, and given some evidence as to its great destructive power, I am in a position to consider the present condition of the dry valleys of the chalk.

It has been asserted and generally accepted that the dry valleys of the chalk have been hollowed by subaerial agencies, similar to those which produced the clay with flints, I think this an insufficient explanation; doubtless they have been the seat of subterranean drainage determined by joints and lines of weakness (see ante) but if the dissolution of the chalk by chemical agency had any considerable share in their excavation we ought to find in their bottoms, clay-with-flints; and whole unfractured flints, like those at the base of that clay on the upland, in a very much greater quantity, proportional to the greater quantity of the chalk dissolved; but it is not so, no clay with flints enveloping perfect blocks of flint is there.

It is certain that these valleys for an immense period of time have not been open water-courses any more than at present, nor could water course on the surface of the chalk. It remains then to account for much of their formation by another method. After the evidence I have given, it will I hope be clear that in these as in all valleys, ice must have sometimes collected, and the surface being frozen and impervious, the ice-laden and tumultuous floods of summer would have a scouring power even greater than water. There can be little doubt that the glaciation was not merely annual but sometimes of long continuance, and if actual glaciers or ice rivers did not occupy the valleys, they must in certain situations have got completely choked with ice and chalk débris. The pressure exerted by this was of course great, and much greater when there was a thaw, from the ponded water; consequently in certain situations, as at the sharp bends in valleys it was exerted on the elbow or projecting ground round which the valley wound. In such situations then we find the required evidence in the distorted and crushed chalk and other strata. Take for instance, an instance near Weight's Farm, when the chalk [seen in a pit] has been crushed and moved over itself, leaving spaces between the blocks, while the layers of flint may be seen crushed to dust, this is visible to a depth of 20 feet.

But there are so many situations where this effect may be observed that it is not necessary to enumerate more. A similar cause dislocated and folded the Oldhaven beds in the Erith ballast pit, at a spot where two unequally deep valleys joined, before referred to. In the elbow of the pebble beds, where the Bromley station, L. C. D. R., stands the pebbles have been deeply pitted, as usual in a normal state, but besides that, they have been moved or rotated past each other in a horizontal direction, as shewn by the scores and scratches impressed on them, and this I think has been caused by the horizontal pressure from the blocked stream way, which running North from Keston to Southboro,' turns sharply Southward for a few yards before joining the main stream of the Ravensbourne running from Hayes.

The dry valleys are often found deeply filled with flints weathered, not waterworn, and whitened by long exposure to the surface oxidation, and having that slight smoothing of the edges, which is the result of chemical solution of a minute part of the silica. They are the same in appearance and condition as those found covering the upland, and as they lie in a tumbled irregular mass, are generally as clean as if they had been hand-gathered off the fields, and shot out of a basket. Good sections of such gravel may be obtained at Green Street Greens, Darenth, and Cray, as well as elsewhere. There may be observed in them, however, layers which contain an admixture of fine sand and clayey gravel, evidently the result of a flush of water which has flowed over the gravel. Generally these layers of loam and sand are thin, but at Longfield, on the South side of the valley, they may be seen of some thickness, as brickearth, clean stones, then brickearth, clean stones again lying on chalk. (See *Pl.* ii. *fig.* 10.)

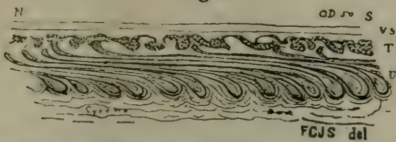
As I have said, the stones are clean and only fine material lies between them, shewing that something must have filled the interspaces, otherwise the light loams and sands washed over them would have penetrated the interspaces and solidified the mass much more. I think it extremely probable that snow or snowy chalk filled the spaces into which the finer materials could not penetrate at the time of flowing.

These alternate layers of sandy loam seem to tally with the intervals between the severer fits of glaciation.

The rain washed the fine mud from the clay-with-flints leaving the stones on the surface, where they accumulated loose and unattached to the soil, then came a time when the rain was replaced by snow, which enveloping them, scraped off the stones, carried them into the valleys, and thawing, left them there; then again a period of rain which washed the upland clay from the flints, which a return of snow and ice trailed subsequently into the valleys.

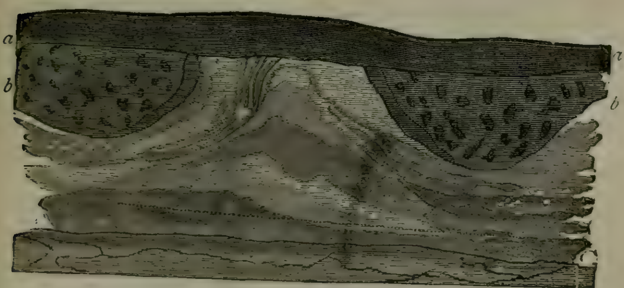
This repetition may be observed, but it may not have been and probably was not the whole series of the above mentioned occurrences, and in the period in which we are living the rain is washing the fine mud and sand away from the clay, leaving the stones lying thickly on the surface, perhaps to be raked off by snow some day in the future.

Fig. E.



In this sketch from Rutter's Pit, Crayford, the scale, natural, is three feet to one-tenth of an inch.

I reproduce here a figure from a paper by the Rev. H. M. de la Condamine from the Quarterly Journal of the Geological Society (by permission of the Council), Vol. VI. p. 441. It was made in 1850, when the railway was in construction, from a point just East of the railway bridge at the station, Blackheath, such early sketches of "drift" are interesting.



7 feet by 15 feet.
a.a. He calls "alluvium."
b.b. Hollows filled with "drift" and consisting of pebbles chiefly.
The Eocene beds below are shewn contorted.

EXPLANATION OF THE FIGURES.

The figures are confined to West Kent. The scale (natural) is appended to each, every division being equal to one foot.

Abbreviations.

- V.S. Vegetable soil or humus.
- R.W. Old rain-warp or rain-wash.
- T. Trail.
- U.P. Underplight.
- G. Gravel.
- S. Sand.
- Ch. Chalk.
- B. Bull-head or chalk rubble.
- P.E. Pleistocene brickearth.

PLATE I.

Figure I.—At Milton Street, Swanscombe.

„ II.—South of Dartford. The lower bands of flint are distortions of the chalk itself, the upper those of the Bull-head.

„ III.—Festoons. At Slade's Green, Erith.

„ IV.—A section at right angles to the last—united at the line in the middle forming one section.

„ V.—South of Dartford.

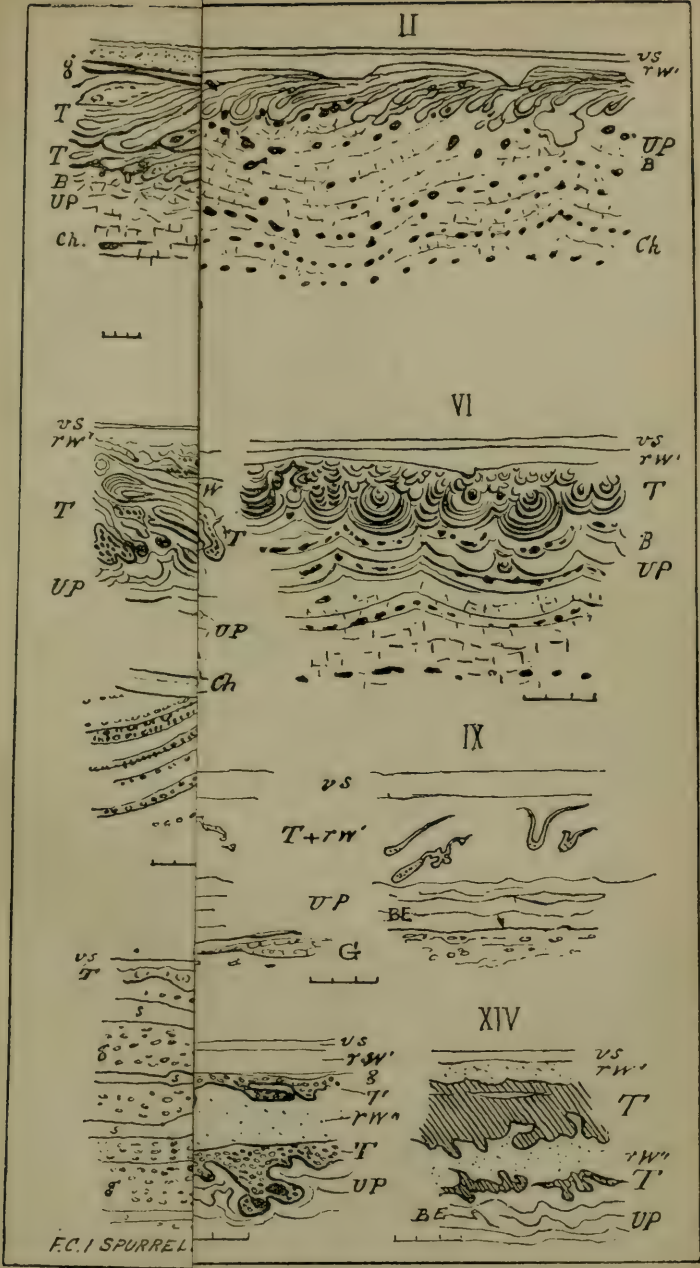
„ VI.—At the junction of the loop and main lines of railway at Dartford. In the chalk.

„ VII.—The gravel at Dartford Heath, with brickearth lying in a gully or channel, shewing the pressure exercised from the higher ground on the left. The brickearth is that belonging to the uppermost layers at Crayford.

„ VIII. and IX.—At Dartford Brent, sections at right angles at the same spot, below is the gravel of the general spread of that place, above disturbed layers of brickearth, then warp or old rain wash which has been re-disturbed by trail, undisturbed rain warp overlies it.

„ X.—Gravel of the South side of Dartford Brent, shewing a gall or pipe with disturbed seams and a cavity, taken in 1867.

„ XI. and XII.—Two sections, one at Darenth and the other at Gravesend. They are excavations in the chalk originally shallow—perhaps made by small streams, over which fine sand and pebbles lay, but the passage over them of ice and trail has contracted and distorted them. The necklace-like spots are pebbles, the other parts sand, in chalk. In the upper figure a band of chalk several inches thick is hardened by pressure and infiltration. (*x.*)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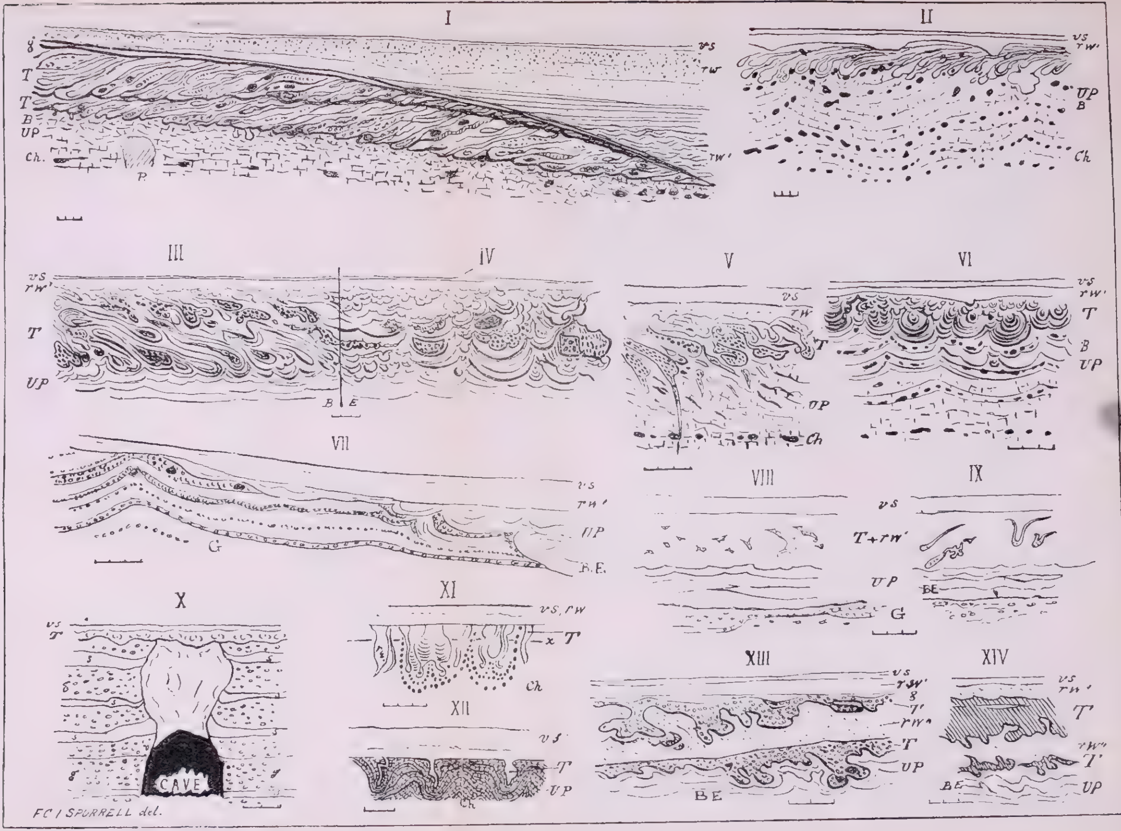
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Figure XIII.—At White's Pit, at the bottom of Colyer's Lane, North End, two well marked layers of trail of the latest fit.

" XIV.—Two well marked layers of trail on Dartford Brent.

PLATE II.

" I.—This section is about 15 feet in depth, but the disturbance extends to a depth of more than twice that distance; it is in the great sand pit at Erith.

" II*a*., II*b*.—Two sections of a gulley, 100 feet apart, in Oldhaven beds; the radiating lines shew the direction opposite to which the flat surfaces of the pebbles in the circumference are arranged, but in that part marked T, left after the pressure had ceased, they are confused.

" IV.—The surface gravel of the top of Shooters Hill, shewing the arrangement of the pebbles in relation to masses of clay. Evidence of a feeble Trail rests on the top of all.

" IV.—A section in the chalk pit adjacent to the brick-earth pit at North End, Crayford. In the lower, B.E., are the brick-earths with abundant fossils, and the old implement factory formerly described by me; at T1, is confused land rubbish or Trail, &c., with puddled clay over it. Above that are brickearths, which, a few yards off, are thirty feet thicker; they contain very few fossils. Over the last, at T, the remains of the latest fit of glaciation is shewn by festoons.

N.B.—As this section is 40 feet deep, the divisions of the scale are two feet each.

" V.—A section on the north-west side of Shooters Hill, shewing the capping gravel.

" VI.—A section in London clay, west of Eltham. Above the T is excavated the hollows of small rills or rivulets; pebbles lie in their bottoms, and rain-warp, &c., above.

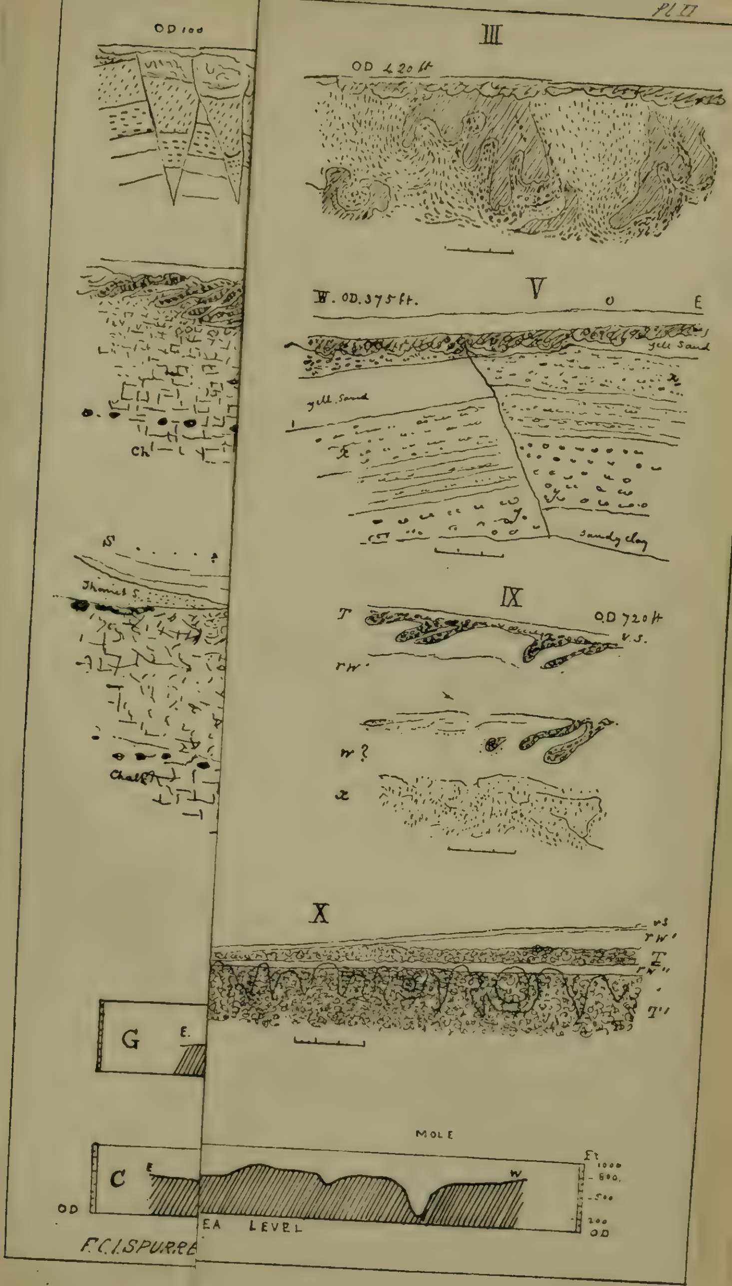
" VII.—A section of the lower part of the river bank of the Old Darenth river, at North End, Crayford, shewing trail of an early fit coming down the bank, the chalk is splintered and crushed, and in places has, in the indurated Bull-head, long and cross fractures. Some of the Trail is becoming swept into gravel. Above, rests some of the fossiliferous brick-earths.

" VIII.—Section in the gravel patch on the top of Strood Hill. T. of uncertain age.

Figure IX.—Two layers of Trail, Warp, &c., covering a very deep mass of confusedly arranged pebbles (Tertiary) at *x*. These latter are not disturbed so as to come under the classification of T. or U.P., Kingsdown.

,, X.—This section is taken from Longfield, Kent. The lowest layer T1. consists of almost clean flints, slightly smeared with clay, above is R.W., then T. of flint stones again with R.W. again; on the left is shewn a thick deposit of very clean flints. The irregular lines shew the margins of different colours caused by infiltration and peroxidation.

The two lowest figures represent sections taken along the crests of the North Downs, and the Lower Greensand ridge. The Greensand ridge is somewhat misplaced, having been shifted about one mile too much to the West. But allowing for this, the figures shew the relative positions of the river openings in the two ridges which are about five miles apart, the one south of the other.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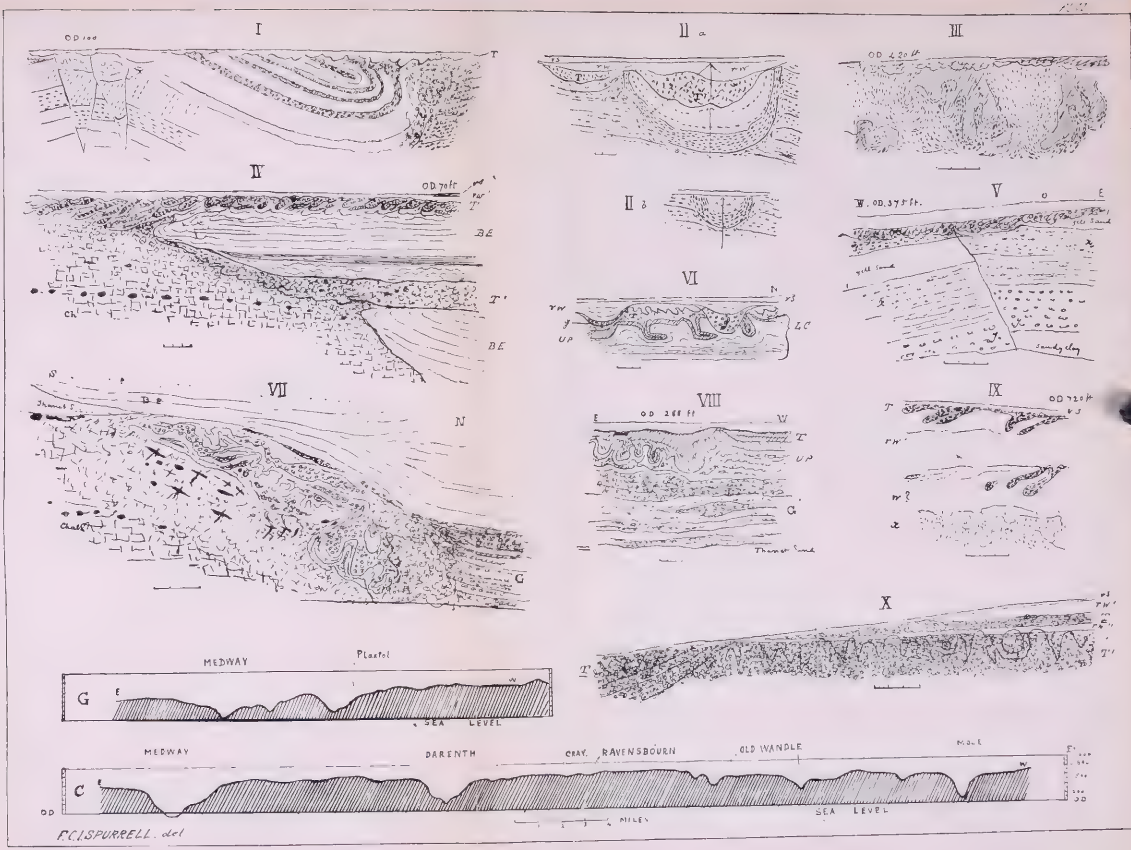
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RULES.

(*As amended at the Annual Meeting, 22nd February*, 1882.)

1.—The Society shall be called the West Kent Natural History, Microscopical, and Photographic Society, and have for its objects the promotion of the study of Natural History, Microscopic research and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s., in one sum. All subscriptions shall be due on 1st January in each year.

3.—The affairs of the Society shall be managed by a Council, consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admission as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and Auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of, the meeting shall resolve into a *conversazione.*

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.*

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Breese, Charles J., F.L.S., 1, Marquess Road, Canonbury.
Collingwood, Dr. C., M.A., B.M. (Oxon), F.L.S., &c., 2, Gipsy Hill Villas, Upper Norwood, S.E.
Glaisher, James, F.R.S., F.R.A.S., Dartmouth Place, Blackheath.
Jones, Sydney, 16, George Street, Hanover Square, W.
Vogan, James, Tauranga, New Zealand.

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Dewick, Rev. E. S., M.A., F.G.S., 2, Southwick Place, Hyde Park, W.
Jones, Herbert, Montpelier Row, Blackheath. (*Council*).
Knill, John, South Vale House, Blackheath.
Knill, Stuart, Ald., The Crosslets, The Grove, Blackheath. (*Council*).
Lubbock, Sir John, Bart., M.P., F.R.S., &c., High Elms, Hayes, Kent.
Smith, Frederick W., Hollywood House, Dartmouth Point, Blackheath.

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Allsup, W. J., F.R.A.S., East Mascalls, Old Charlton.
Baker. Brackstone, 8, Belmont Park, Lee.
Ballance, A. W., 3, Ashfield Villas, Lee Road.
Bayley, Henry, P. and O. Company, 122, Leadenhall Street, London, E.C.
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Bidwell, Leonard, 34, Lee Terrace, Lee.
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Camroux, G. O., 11, The Grove, Blackheath.
Camroux, G. F. M., 11, The Grove, Blackheath.

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Duncan, J. M., 32, Clarendon Road, Holland Park, W.
Edwards, Stanley, Kidbrooke Lodge, Blackheath.
Frean, G. H., The Orchards, Blackheath.
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Groves, William, Grove House, Shortlands, Kent.
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Guy, Albert L., 78, High Street, Lewisham.
Hainworth, H., Kirton, St. John's Park, Blackheath. (*Hon. Sec.*)
Harvey, J. H., Holbrook House, Lee.
Heisch, Charles, F.C.S., Holly Lodge, South Park Hill Road, Croydon.
Hicks, G. M., 5, South Row, Blackheath.
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THE FOLLOWING HAVE BEEN RECEIVED DURING THE SESSION 1885-6.

REPORTS, &c.

Croydon Microscopical and Natural History Club.
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Ealing Microscopical and Natural History Club.
Eastbourne Natural History Club.
East Kent Natural History Society.
Epping Forest and County of Essex Naturalists' Field Club.
Erith and Belvedere Natural History and Scientific Society.
Hackney Microscopical and Natural History Society.
Holmesdale Natural History Club.
Lambeth Field Club and Scientific Society.
Lewisham and Blackheath Scientific Association.
Liverpool Science Students' Association.
Manchester Literary and Philosophical Society.
New Cross Microscopical and Natural History Society.
Northamptonshire Natural History and Field Club.
South London Entomological Society.
South London Microscopical and Natural History Club.
Tunbridge Wells Natural History Society.

N.B.—The Library is in the Hall of the Mission School, Blackheath. Members can obtain or return books by personal or written application to the Rev. E. Waite, the Head Master; or on the evenings of the ordinary Meetings.

Note.—All communications should be addressed to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham S.E., and Post Office Orders should be made payable to Hugh Wilson.

HENRY HAINWORTH, } *Hon. Secs.*
HUGH WILSON, }

E. G. Berryman & Sons, Steam Printers, 84, Blackheath Road, Greenwich.

MEETINGS OF THE SOCIETY

FOR THE SESSION 1886-87.

Wednesday,	March	24
,,	April	28
,,	May	26
,,	October	27
,,	November	24
,,	December	15
,,	January (1887)	26
,,	February ,, Annual	23

THE CHAIR IS TAKEN AT 8 O'CLOCK.

THE MEETINGS ARE HELD IN THE HALL OF THE MISSION SCHOOL, BLACKHEATH.

E. G. Berryman & Sons, Steam Printing Works, Greenwich.

WEST KENT
Natural History, Microscopical and Photographic Society.

THE

PRESIDENT'S ADDRESS, PAPERS,

AND

Reports of the Council and Auditors,

FOR 1886-87,

WITH

RULES, LIST OF MEMBERS, AND CATALOGUE OF THE LIBRARY.

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OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 24th, 1886,

FOR THE SESSION 1886-87.

President.

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Vice-Presidents.

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Council.

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JOHN M. STONE, M.A.
F. T. TAYLER, M.B., B.A.

LIST OF OFFICERS

OF THE

West Kent Natural History, Microscopical, and Photographic Society,

Elected at the Annual Meeting, February 23rd, 1887,

FOR THE SESSION 1887-88.

President.

T. O. DONALDSON, M. Inst. C.E.

Vice-Presidents.

REV. A. JOHNSON, M.A., F.L.S.
W. G. LEMON, B.A., LL.B., F.G.S.
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J. JENNER WEIR, F.L.S., F.Z.S.

REPORT OF THE COUNCIL,

For the Session, 1886-87.

The Council beg to report that the Society at present consists of 104 members, viz., 6 honorary, 7 life, and 91 ordinary members, being 2 less than in the preceding year. They have to regret the death of Mr. Thomas Hooper, who frequently assisted at the meetings.

The accounts of the Honorary Treasurer have been duly audited, and shew a balance due to him of £10 5s. 1d. This debit balance is caused by the heavy expenses incurred in printing the Papers and the Report. The outstanding expenses mentioned in the last report have been paid. Notwithstanding the repeated notices sent to the members, the Council regret to state that there still remains an amount due for subscriptions, more than four times the sum owing to the Treasurer.

The ordinary meetings of the Society have been well attended, and several papers have been read and many objects of interest exhibited. The papers or abstracts thereof will be published with this Report, which will shortly be in the hands of the members.

The Field Meeting took place on the 10th of June, at Tunbridge Wells, and was attended by 34 members and their friends. Several members of the Tunbridge Wells Natural History and Antiquarian Society joined, and their Secretary, Mr. George Abbott, kindly acted as guide to some of the most interesting localities in the vicinity. They were also shewn a collection of wild flowers of the neighbourhood, exhibited at the Society's Rooms.

The Annual Dinner was held on the 26th June, at the "New Falcon" Hotel, Gravesend, and was well attended.

On the 9th October, the Annual Cryptogamic Meeting had the usual kind guidance of Dr. Spurrell. On this occasion the members were joined by a contingent of the Croydon and Erith and Belvedere Societies. The attendance was larger than usual, those present numbering about 25. After visiting the interesting ruins of the old abbey at Abbey Wood, they went through the wood, and although not so many species of fungi as usual were found, it is worthy of note that one of our members gathered a fully developed blossom of the wood anemone (A nemerosa), which usually flowers in April.

The members will hear with great regret that Mr. Hainworth, who has held the position of one of the Honorary Secretaries for ten years, finding that he is unable to devote sufficient time to the duties of that post, has given in his resignation; but the Council still hope to have his valuable advice and co-operation as one of their members. The Council feel that in making this announcement it is impossible for them to express how much the Society owes to him for his unfailing services during his long term of office.

They are happy to state that Mr. J. Morris Stone has consented to be put in nomination as one of the Honorary Secretaries, and they must cordially recommend him to the notice of the members, feeling that by his scientific qualifications he is admirably fitted for the office.

The Library has been extensively made use of during the past year, and the Council hope that additions to it by the members will render it still more valuable.

In conclusion, the Council earnestly request the members to introduce additions to their number, and would again call special attention to the amount outstanding for unpaid subscriptions. It is absolutely essential to the success of the Society that subscriptions should be paid when due; much unnecessary trouble would thereby be saved to our Honorary Secretaries, and the present and future prosperity of the Society greatly enhanced.

STATEMENT OF THE ACCOUNTS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL & PHOTOGRAPHIC SOCIETY,

For the Year ending 31st December, 1886.

RECEIPTS.	£	s.	d.
Balance in hand on the 1st January, 1886	5	10	11
Annual Subscriptions	47	15	6
Balance to Debit of Society on 31st December, 1886	10	5	1
	£63	11	6

PAYMENTS.	£	s.	d.
Expenses at Meetings and Lecture	5	7	6
Donation for use of rooms, &c.	6	5	0
Fee to Assistant	5	5	0
Subscription to Ray Society, 1886	1	1	0
Stationery, Postage, &c.	3	18	7
Journals	2	1	8
Insurance of Books	0	5	0
Printer's Bill	30	4	6
Soirée Expenses, 1885	9	3	3
	£63	11	6

Audited and found correct,

J. JENNER WEIR, ALFRED DEED, } *Auditors.*

18th February, 1887.

ADDRESS

DELIVERED BEFORE THE MEMBERS

OF THE

WEST KENT NATURAL HISTORY, MICROSCOPICAL & PHOTOGRAPHIC SOCIETY,

BY

The President, T. O. DONALDSON, Esq., M. Inst. C.E.

On the 23rd February, 1887.

THE Yellowstone National Park, in Wyoming county, is situated about the three rivers, the Yellowstone, the Madison, a tributary of the Mississipi, and the Snake river.

The active volcanic agency constantly going on, seems to be similar, in some respects, to the action in Iceland, and more especially to that in the North Island of New Zealand, although it has not yet arrived at the disastrous results which occurred at the latter place last year.

I have made some brief memoranda from a very interesting account of the Yellowstone region, published in "Stanford's Compendium of Geography," Part, North America, edited by Professor F. V. Haydon, Chief of the U. States Geographical Survey, and Professor Selwyn, Director of the Geological Survey of Canada.

The region of Yellowstone Park was repeatedly covered with lava in former times, and great ranges of mountains thrown up, and at the present time the numberless hot springs and geysers indicate that catastrophes may happen at any time from volcanic eruption.

The Geysers of the Yellowstone Park, varying in character, some with water and steam ejected simultaneously, others throwing up water only, and some mud, exceed in number and variety those of Iceland or in any other part of the globe.

It was not until 1864 that anything definite was known of this region, when Captain W. W. de Lacey, and a prospecting party, reached the *Lower Basin Geyser*, on the Madison River; but in 1870, an exploring party, with General Washburn, Surveyor General of Mentana, made a more complete survey of this district, and published the results in "Scribner's Monthly Magazine," and in 1871 and 1872, a complete survey was made, and at that period Congress appropriated it as a National Park for ever.

The park contains 3,500 square miles, the average height above sea level being about 8,000 feet, it is covered with snow for about nine months in the year, and sometimes with frost at midsummer. The "hot springs" are "omnipresent " among the dense timber, on the plateaux, in the valleys, " and even in the beds of lakes and rivers; with their " deposits they have floored whole valleys, as in the geyser " basins of the Firehole or Madison river; of all sizes, from " inches to acres; and all temperatures, from, tepid to boil- " ing; and at a dozen or more localities, are active geysers, " some fifty in number, throwing water, in extreme cases, " 200 feet in height."

They have raised mountains, as for instance, the White Mountain, at the top of which, at about 200 feet in height, is a broad terrace, with basins 150 to 200 yards in diameter, from which the boiling water, saturated with calcareous matter or, as stated by Mr. Langford, in Cassell's "Science for all," silicious, pours down the hill sides forming pools and terraces, whose margins vary from a few inches to six, or even eight feet in height, and in color vary from dazzling whiteness to yellow and red, the color becoming darker as the terraces are lower down, and the waters cool.

Near the head of the Madison river there are two valleys, of twelve and twenty square miles area respectively, the higher of which contains the greatest number of hot springs and geysers, there being eighteen geysers of great irregularity in periods of eruption; the valley is said to have a hard white silica floor, I should think it more probably calcareous.

Dr. A. C. Peale, in report of Geological Survey of the Territories, for 1872, gives description of following eight principal geysers; of which I simply give the height of jets.

Old Faithful ...	height of water	130 ft.			
The Beehive ...	„	178	... height of steam		193 ft.
The Giantess	„	39	...	„	69
The Castle ...	„	93	...	„	115
Grand Geyser	„	173			
Furban's Geyser	„	25			
Giant Geyser...	„	ceased operations.			
Grotto Geyser	„	40	with two openings, crossing.		

Many of the springs of the district are sulphurous, giving name to the district from its colour.

In the lower geyser basin, about ten miles down the river, of twenty square miles in area, the hot springs predominate; but of the geysers, the "Architectural" is the finest, the floor is of silicious deposit of various colors, with "innumerable masses of cauliflower-like and beaded silica standing out of the water," the crater is ten feet in diameter, some jets sixty or eighty feet in height, others thrown laterally to 30 or 40 feet; the action is intermittent.

There are some ten geysers at end of Thoshone lake, that are called the Union, alternately throws up water and steam.

At the Crater hill, on Yellowstone river, are some sulphur springs and mud geysers thrown up to a height of forty feet.

New Zealand:—In the geyser and hot spring district of the North Island of New Zealand, we find almost a repetition of the natural features of terraces formed by the boiling springs charged with silica existing in the Yellowstone park, in Colorado, the same dazzling whiteness, and brilliant pink and brown colours of the deposited steps of silica—or may it not be silicate of lime—also the hot sulphurous springs.

· As in former periods masses of molten lava were forced up, and volcanic ashes covered the Yellowstone park, it has last year occurred in New Zealand with destruction of human lives, and devastating a once exquisite scene.

The White Terrace, described by Mr. Froude as "a crystal staircase, glittering and stainless as if it were ice," with its stairs, about twenty in number, of from six to seven feet each in height, varying in width from forty to fifty feet, or more, with boiling water, saturated with silica, which it deposits and forms the terraces.

The Devil's Pool of boiling water, charged with sulphur, and with numbers of geysers on the plateau above, with the green hot lake below, with fountains and smooth floor of silica.

The Pink Terrace, and other terraces above with "rosy icicles and crystals in festoons, like creepers, and pools of ultramarine" (Froude), all resemble those features of the Yellowstone region.

This district was only recently known, the aborigines jealously guarding it from visits of strangers, like the Indians at Yellowstone Park.

About midnight of June the 9th, 1886, or morning of the 10th, there was a violent earthquake at Waira, with a terrific eruption at Tarawera, the high hill overlooking lakes Tarawera and Rotomahana, which suddenly became an active volcano, with flames rising 1000 feet, and a shower of red-hot stones, some of large size, and dust, grit, and cinders projected to a distance of eight miles, followed by a black cloud with suffocating smell; the lightning was caused by it to be of a blood red colour, then came a hurricane. Large quantities of scalding mud were thrown up which lies three or four feet in depth. All through the night the earthquakes continued, at Rotorna twenty-eight shocks were counted, at Opotiki, on the sea coast, seventy-three shocks. The whole country was covered with ashes, and fresh boiling springs threw up mud and water in countless places, for distances of six or seven miles to Wairoa and towards Ohinemetu, at which place the Maori Pah suddenly subsided fourteen miles; the mud extending further than the dust, covering an extent of country for an average length of from fifteen to twenty miles by seven miles, the depth varying with proximity to eruption and direction of wind. At Wairoa, six miles from Volcano, Macrae's Hotel was wrecked, the roof falling in by weight of mud and volcanic earth; Mr. Hazard, three of his children, and a nephew killed, and a tourist, Mr. Bambridge, was killed by the fall of the hotel verandah. Along the bed of the creek carrying the overflow of the Okaro lake into Rotomahana, there were four new craters similar to another of 400 feet in length in active eruption and throwing up scoria. The height of the hill before the eruption was 400 feet, but afterwards it increased to 550 feet or upwards, and that occurred in two days.

There was terrible destruction of property and human life, principally of Maories, over 100 in number, the country is devastated, and water supply destroyed by the ashes and sulphurous mud, causing great suffering to cattle and wild animals; even rats, &c., being found dead in multitudes; but it is hoped that the Volcanic cutritus will be favourable to vegetation.

Tongariro, 7,800 feet in height, is an active but intermittent volcano, generally throwing up hot mud, and with hot springs round crater, it is about 80 miles from seat of eruption. Ruapepu is another volcano now quiescent, about 10 miles from Tongariro, and further distant not a vestige of the Terraces now remains. They are replaced by large fumaroles throwing up mud and steam. The country round Rotomahana is slipping down into the lake, the seven volcanoes eating out the bottom of the lake. At the Devil's Chaldron a geyser now ejects a column of mud 600 feet in height. Miss Gordon Cumming writes: "Everywhere there is a deafening noise, sulphurous stench, and indescribable horror." I am indebted for much of the material of above account to the description of some of the exploring party headed by Mr. Stewart, Civil Engineer of the Rotorna Railway, who visited the district after the eruptions.

In text book of Geology, Dr. Geikie, LL.D., F.R.S., Director-General of the Geological Survey of Great Britain and Ireland, says that: " The origin of earthquakes can only " be conjectured. Sudden flushing into stream of water in " the spheroidal state, the sudden condensation of steam, " the explosion of a volcanic orifice, the falling in of the roof " of a subterranean cavity, or the sudden drop of deep-seated " rocks, subjected to prolonged and intense strain. In " volcanic regions the frequent earthquakes which precede " or accompany eruptions are doubtless traceable to explosions " of elastic vapours, and notably of steam.

Professor John Milne, of the Imperial College of Tokio, Japan, says that of the causes of earthquakes " The majority " are due to explosive efforts at volcanic foci. The greater " number of these explosions take place beneath the sea, and " are probably due to the admission of water through fissures " to the heated rocks beneath. Some earthquakes are " produced by the sudden fracture of rocky strata, or the " production of faults, this may be attributable to strains " brought about by elevatory pressure. Lastly we have " earthquakes due to the collapse of underground excavations."

I think that there can be little doubt that volcanic action forced up the ground at bottom of lake Tarawera, and that the water poured on to the molten mass below, and the enormous expansive body of steam from the water, let in by degrees, kept on the violent ejecting force, and destruction of adjacent land.

SOME INTERESTING POINTS
IN CONNECTION WITH THE DEVELOPMENT
OF THE CHICK.

BY

ERNEST CLARKE, M.D., B.S.

26th MAY, 1886.

On the surface of that part of the yolk which is uppermost of a fresh fertile hen's egg, is seen a small spot clear in the centre (*area pellucida*), surrounded by an opaque rim (*area opaca*). This spot is called the Blastoderm, and it is from this that the chick is developed.

As soon as the ovum has left the ovary of the hen, if it becomes fertilized by the male element, the process of segmentation begins in it even while it is passing down the oviduct. This segmentation is the gradual formation of cells, and by the time the egg is laid, two rows of these cells, and as soon as incubation begins three rows are seen at the blastodermic spot. It is these three rows of cells that become differentiated, and as we shall see in time, form the complicated structure called the chick.

First of all, a groove appears called the medullary groove, and the cells grow up on either side of this groove, fold over and enclose it, changing the groove into a canal, called the neural canal, and its length marks the length of the embryo. If we examine a specimen at this early date, we can distinguish three layers of cells, (the upper layer is called the epiblast, the middle layer the mesoblast, and the lower layer the hypoblast), the neural canal, the notochord beneath it, and the protovertebræ on each side. At each end of the embryo now appears a fold. A head fold and a tail fold, this is the commencement of the gradual separation of the embryo from the egg.

If we examine the embryo at the commencement of the second day, we see further progress in development.

The head end of the neural canal is enlarged, and forms the commencement of the brain on either side of it, in front two large lobes appear, the optic lobes; and behind these lobes two depressions, the auditory pits. The protovertebræ of which there were only a few at the head end of the embryo are increasing in number, and extending towards the tail end.

At this period the heart is really a part of the head, and lies outside the body, the body wall not being yet closed, and consists of a simple twisted tube, and in the living embryo you can see, with the naked eye, the regular pulsations of this simple heart which pumps the blood to all parts of the embryo, and over the blastodermic area.

Even at this period can be discerned the bifucation of the aorta, the main branch from the heart.

The development of the eye.—You have already seen how, at the commencement of the second day, the optic lobes are a prominent feature at the head end of the embyro.

This optic lobe is formed by the pushing out of the layers of cells by the optic vesicle, a process of the brain. The epiblast over the optic vesicle pits and this involution meets it; the pit becomes closed over, and the part thus separated is the lens, and the epiblast which closes over the pit becomes the cornea or external part of the eye. The anterior surface of the involution of the brain, the optic vesicle, which meets the lens becomes the retina, and the posterior surface, the pigmental layer of the choroid. By the walls of the vesicle coming into contact, and together forming a cup, the cavity of the involution from the brain is lost, and all that remains to show its connection with the brain is a stalk which becomes the optic nerve. One part of the retina does not close in, so that a fissure is left called the choroidal fissure, and through this fissure the mesoblast creeps in, and forms the vitreous humour, and the external and internal muscles of the eye.

The ear is formed by a pit, the auditory pit, and like the lens of the eye is an involution of the epiblast, or outer layer of cells, also, as in the eye this involution or pit closes over, but unlike the eye, there is no corresponding involution of the brain to meet this involution of the epiblast.

On examining the embryo at the third day, great advance in development is seen.

The blastodermic area is greater, the embryo now lies on its left side, the head has become flexed, and the single tube of the brain has become differentiated into three cavities, the fore, mid, and hind brain.

The basal pits appear, and as in the eye and ear are formed by a cupping of the epiblast, but this cupping unlike that in the eye or ear never closes.

The heart is now seen to have receded into the thorax, the throat closes, and a distinct neck appears.

The single cavity of the heart becomes divided by a partition, and thus two cavities are formed. The gut which is formed by the lower layer of cells or hypoblast is still open in its mid portion, but at the upper and lower end the hypoblast has closed over in front and so completed the tube, the extremities at each end being blind *cul de sacs*.

A diverticulum from the upper end of the gut or oesophagus forms the lung on either side.

Lower down, diverticula from the oesophagus form the liver, pancreas, and spleen.

The liver has two lobes, each lobe being developed from a separate diverticulum.

At the lower part of the thorax, the gut expands, and forms the stomach.

The protovertebræ which we have already noticed on either side of the neural canal become now differentiated, the outer part of each protovertebræ becomes the muscle plate, and from this all the muscles of the back, and finally of the body, become developed; and the inner part of the protovertebræ fuses with the notochord to form the body of the vertebræ proper, and the spinal nerves.

If we examine the embryo on the fourth day, we find the cranial flexure more marked, and the tail fold more prominent.

The cranial nerves appear. The genito-sexual apparatus which had begun on the second day, by the formation of the wolffian duct is now supplemented by the appearance of the wolffian body, which has the structure of the kidney, and is the temporary kidney of the chick, later on the permanent kidney is developed from it, and the excretory duct of the kidney, the ureter is developed from the wolffian duct as a diverticulum. In the same region the genital ridge appears, and this becomes the ovary. By the sixth day, if the chick is going to be a male, the ovary atrophies and disappears, and the testis appears on the outer side of the sexual mass. The wolffian body helps to form part of the testicle, and the wolffian duct becomes its excretory duct, the vas deferens. There is another duct called Müller's duct, on both sides, it disappears in the male, or at most leaves traces as some suppose in the testis; in the female it dwindles on the left side with the left ovary and disappears, on the right side it becomes the oviduct and opens into the cloaca.

The limbs first show themselves on the third day, as ridges on the side of the embryo, at the upper part for the fore limbs, and at the lower part near the tail for the hind limbs, these ridges as it were sprout out, and by the fifth day they have so far developed that the knee and elbow are discernible. I have seen movements of the limbs on the sixth day. During this time the spinal cord has been developing. We saw how the medullary groove closed in, and became the neural canal, the epiblastic cells that were shut in are differentiated into the spinal marrow. The neural canal is arched over by what becomes the bony arch of the vertebrae.

The mouth is formed by an involution of the face wall. This involution grows backwards till it meets the blind end of the fore gut, the partition disappears, and the mouth thus forms the upper opening of the gut. In the same way an involution at the tail end forms the arms, this involution grows back, and meets the blind termination of the hind gut, and the two merge together, and the clonca is completed.

The main artery from the heart dilates at its commencement, and forms the bulbus artenosus as early as the third day, it now becomes divided by a partition into two arteries, one the pulmonary artery, (going to the lungs), and the aorta. The heart which we saw had become bilocular is further developed, and each cavity is divided by a partition, thus four chambers are formed.

All the nerves of the body are developed from the mesoblast.

The bones of the head now appear, and on the sixth day, the beak appears as a minute white speck on the tip of the nose. All these changes advance gradually, and about the twentieth day, the beak of the chick is thrust through into the air chamber situated at the broad end of the egg, respiration then commences, and the lungs become further developed.

Although the air in the air chamber is constantly removed through the porous egg shell, in a very short time it becomes insufficient to supply the wants of the chick. The *besion de respirer* causes the chick to peck with its beak against the shell, and to break it, and it then steps out into the world.

NOTE.—This paper was illustrated by a large number of living and dead embryos in different stages of development. By placing the embryo on a "hot stage," the pulsations of the heart were shown under the microscope. The microscopical sections prepared by the author were magnified, and thrown on to a screen, by means of a micro-photographic apparatus and the electric light, very kindly lent by and manipulated by Mr. William Webster, jun.

DOMESTIC ANIMALS.

BY

J. JENNER WEIR, Esq., F.L.S., F.Z.S.

15th DECEMBER, 1886.

Part II.—Birds.

In my former paper on Domestic Animals, Part I., I dealt entirely with Mammalia, in this I shall confine myself to Birds.

As I before stated, there is not more than about one per cent. of the known species of Mammalia truly domestic, and it is even more startling to find that about one-tenth per cent. of the known species of birds is domestic.

There are between ten and eleven thousand species of birds known, and not more than eleven are domestic; but, if the Ostrich is included, the only one recently subdued to man's use, the percentage would be a little higher; in the enumeration I include two kept only as pets, and two kept only for ornament.

The following is a list of the species:—

DOMESTIC BIRDS.

Fringilline ...	Canary	*Anatine* ...	Swan, Goose, Duck, and Musk Duck
Columbine ...	Pigeon, Dove		
Galline ...	Peacock, Turkey, Fowl, & Guinea Fowl	*Struthine* ...	Ostrich

Of these birds, two, the Canary and Dove are kept as pets only; two, the Peacock and Swan, for their beauty; one, the Musk Duck, partly for ornament and partly for food; one other, the Pigeon, is kept partly as a fancy bird, partly for use as a carrier of messages, and partly as food; the Ostrich is kept for its feathers only ; and the five remaining, viz. : the Turkey, Fowl, Guinea Fowl, Goose, and Duck, are kept for food, their flesh and eggs both forming important articles of commerce.

The conditions necessary for a bird to become domestic are the same as those before-mentioned when treating of the domestic mammalia, but as most birds cannot be kept in by mere fencing, attachment to locality is even a more important factor than in the mammalia.

To repeat what I before stated, an animal to become domestic must possess at least three of the following qualities, viz.,

1st, Unimpaired fertility in captivity.

2nd, Plasticity of constitution, enabling it to live under widely different conditions of environment.

3rd, Attachment to locality.

4th, Attachment to persons or tameness.

5th, Usefulness.

Man in the domestication of birds has not only had to deal with a flying animal, but further, with a quality which is but feebly exhibited in mammalia, but exists largely in birds, viz., their migratory habits, no doubt this instinct has more than any other contributed the greatest bar to the domestication of numbers of species which would have been very welcome additions to the poultry yard.

I shall show in dealing with each domestic species seriatim, that migratory groups of birds have that species alone domestic, in which this instinct is absent, or at any rate existing in a minor degree and by domestication has been gradually eliminated.

All migratory wild birds kept in captivity exhibit marked uneasiness at the usual migratory periods, this restlessness causing them often to pine away and die.

Let me first draw your attention to a bird in which there may be said to exist feebly some of the qualities of a domestic bird, viz., the Eider Duck, a remarkable instance of a wandering bird which during the nesting season becomes comparatively tame, even allowing itself to be disturbed in its nest, and the valuable down removed, without forsaking the eggs, and even though thus robbed year after year; care being taken by the inhabitants of the islands it resorts to that it is defended against any other robbers; it is one of those rare cases in which man and bird may be said to have arrived at a tacit *modus vivendi*.

The Eider is a bird which man has seen no reason to attempt to domesticate, and even if he had attempted, failure would have resulted, it is a rover of the ocean and no food that man could have provided for it would have suited its constitution, but laws have protected it in the Scandanavian countries, especially during the nesting season, and happily its flesh is little relished as food; I lately heard that the eiders had, on the Coast of Norway, been protected to the extent of a close period extending over fifteen years.

My object in speaking of the eider is to bring before you an instance of a bird on the extreme verge of domestication, of a perfectly wild nature during the greater part of the year, in no way, in this respect, resembling the partially domesticated pheasants of our preserves, which, by being reared artificially, under common fowls in many instances, are domesticated during the early period of their lives, although the chicks so reared exhibit their wild nature, as compared with fowls, from their earliest exclusion from the egg.

I have chosen the eider duck as one of the duck tribe, because, through the Swan, a connecting link is formed with the perfectly domestic goose, duck, and musk duck; the swan in many cases is kept on large rivers and in swanneries, almost in a semi-wild state, in other instances it is kept in small pieces of water and is nearly as domestic as a goose, still the swan is not a bird that resorts at night to shelter provided by man, as the truly domestic birds of this group do to a great extent.

In the New Forest where foxes abound, it was always very interesting to me to see the geese coming home at night, and walking leisurely through a small opening into their closed shed, which was secured against their enemies at sunset.

The swan on the other hand is a very powerful bird, and is master of the situation, it is generally either floating on the water or at any rate very close to the edge, in its own element it would be more than a match for a fox or perhaps even a wolf, and as it needs no protection from man it is not provided with any by him.

The whiteness of the swan puzzled me for years, but by the aid of a theory propounded by Professor Meldola, I was enabled to see my way out of the difficulty.

The swan is lord of the lake, seeks no concealment, and can therefore exist, although as conspicuous a bird as can be imagined ; the advantage of the white color to the swan is this, that as it lives in cold wet places, often for many hours on the water, at all seasons of the year, the white color is precisely that which radiates the heat least, and, combined with the thick down under the feathers, retains in the most admirable manner, as much as possible, the natural heat of the living bird.

There is one curious point about the color of the swan, although it looks white, it is not an albino, but on the contrary an albino of the common swan is known to naturalists as *Cygnus olor immutabilis*, the legs of these birds are not so dark as those of the type, and the young are white from birth.

All the wild species of swan on this side of the equator are pure white, and they inhabit both the Nearctic and Palearctic regions, but the tame species is the only one in which the migratory instinct, if existent, could be eliminated, all the others are purely migratory birds, Bewick's swan breeding only within the arctic circle.

The old birds drive their young away when the latter are full grown, and even where several live on the same lake, each pair jealously ejects all intruders from its territory.

The greatest number of swans I ever saw together was on the Alstu Dam at Hamburgh.

It is instructive to notice that all the swans from the

Southern hemisphere have more or less black in their plumage, indeed, the well known black swan from Australia, has but the flight feathers of the wings white; but this bird inhabits sunny districts, and the dark color may be of more advantage to it in absorbing the heat from the sun, than the property the white species possess of retaining it; inhabiting, as the latter do, countries where the power of the sun is so much less.

The black swan is now bred so freely in England, that I feel almost inclined to think that it might be considered a domestic bird, if it remains fertile from generation to generation without the aid of imported birds, it should certainly be added to the list, but in a lesser degree, as it must be restrained from roving.

The swan, therefore, is a bird that has become partially domestic solely from its attachment to one locality, in which respect it differs from all the other species of the genus Cygnus.

The Goose has all the qualities of a perfectly domestic bird, it is attached to locality, tame, and useful; it is no doubt descended from the grey lag goose, the only species in which the migratory instinct, although existing, was capable of elimination; the very name, lag, is supposed by Professor Skeat, to have been derived from the fact that it remained in the British Isles to breed, that is, lagged behind its congeners, and even now it is reputed as still breeding in Scotland, it bred in England at the end of the last century, and at one time large numbers bred in the far country, where their young were captured and brought up in a more or less reclaimed condition with the tame birds.

All the other European species of Geese are migratory, and, therefore, could never have become truly domestic. There are few domestic birds which have varied so little from the wild species as the goose; white, and grey and white varieties are well known, and there is one variety from the Crimea, with the webs of the feathers much looser than common and incapable of flight, a tufted variety is also known.

A great many of the remarks on the goose apply equally to the duck. Out of the numerous wild species of these birds, the common duck is the only one that is not always migratory, many are permanent residents; even in the southern counties there are few pieces of water of any extent that the mallard does not breed on, several breed in Kent, Surrey and Sussex, and numbers in parts of the New Forest, although there are no large pieces of water there, but only small streams and marshy spots. If the eggs of the wild birds are hatched out in captivity, the offspring become at once domestic, all other species of our indigenous ducks must be pinioned, or they will certainly be lost. Some of the wild species, I have never known to breed in confinement, others, as the pintail, pochard and tufted duck, do sometimes breed when placed on fair sized pieces of water, and become tame, but their natural conditions of existence must be at least imitated, and I doubt whether a semi-domestic breed could be permanently established.

Still, I regard the ducks as a group that lends itself to a semi-domesticated condition more readily than most families of birds, and that perhaps their migratory habits have been the principal bar to their domestication of more species.

The Musk Duck is a South American species that certainly is now quite as much a domestic bird as the common duck; although allowed the free use of its wings, it remains attached to the homestead, and, unlike the common duck, it often may be seen sitting on the top of the farm house or buildings.

I have pointed out that unimpaired fertility in confinement is one of the necessary conditions of domesticity, the Musk Duck is very prolific, and although it belongs to a totally different genus to the common duck, it crosses freely with that species, and the hybrids are fertile. The musk duck is a native of South America.

I may remark that I know of no group of birds, in which, *fertile* hybrids are so often produced as in the duck order.

It will be seen that within the limits of the duck family, there is every link between the slightly reclaimed eider, which resorts to the breeding grounds in which it is protected, and in which nesting places are provided for its use, and the purely domestic duck, which differs from the wild species only in having stronger legs, weaker wings, more varied coloration and structure.

Before dismissing the duck tribe it may be well to draw attention to the Chinese goose which has a knob at the base of the bill, whether this is distinct, or has been obtained from a different wild species is an open question, at any rate it differs from any known wild species, and must have been domestic from a very remote period, this is also true of the common goose which is mentioned by Homer, and was anciently sacred to Juno.

The Duck order consists of 40 genera, and at least 180 species of these, but species belonging to four different genera are truly domestic, although many others, as the Mandarin and Summer Ducks, breed freely in captivity under favourable conditions.

The Galline birds are divided into 7 families, 76 genera, and nearly 400 species. Only one family, the Phasianidœ, containing 18 genera and about 80 species, has furnished the domestic birds, and each of these birds belong not only to different genera, but to different sub-families, the reason no doubt is that these four birds are attached to locality, whilst all the others are given to wandering, or are infertile under the conditions of domesticity.

The Pheasants stand somewhat in the same position in this family as the Eiders do among the ducks; there are now several distinct species in our preserves which seem to hybridize freely, the offspring being perfectly prolific, they are kept, by feeding, somewhat within the limits of the woods they are reared in, although, out of respect to the feelings of sportsmen, I can scarcely call them tame, they are far from being as shy as grouse or partridges; on the other hand they must have the run of woods, and are reared in captivity with great difficulty, and thus their domestication is barred; as aviary birds some of the species of allied genera, as the gold and silver pheasants, are sometimes kept for several generations by skilful ornithologists, but success is by no means certain. The common fowl, the most valuable of all domestic birds, is of Eastern origin, and is believed to be descended from the *Gallus bankiva*, the only one of the genius, containing four species, that has become domestic.

Without doubt, attachment to the homestead and great fertility, are the causes of this Indian species having been domestic for thousands of years.

Many of the breeds have had their nature and constitutions so altered by domestication, that they have lost their natural instincts; the Cochins for instance cannot fly, and seem to have but little left of the power of searching for food by scratching.

The other species, although sometimes breeding in captivity, soon die out from infertility, they are found wild in Java, Southern India and Ceylon respectively, all countries with an ancient civilization, so that there is every probability that attempts to domesticate them have been made without success.

The Turkey, although truly a domestic bird, requires a great deal more care to rear than the fowl; the date of its introduction into Europe is not well made out, but as it is an American bird, it could scarcely have been known before the discovery of that country.

Our common Turkey was originally from Mexico, and was derived from a species different from the North American *Meleagris galli-pavo*, but of late years it has been crossed with the latter, and the large birds now so common are hybrids, and many hybrids have been produced from crosses with the Guatemalan ocellated Turkey, *Meleagris ocellata*, a smaller species, this cross produces a most gorgeously coloured bird, but with a more delicate constitution and loss of size.

The Guinea Fowl although domestic, retains much of its wild nature, usually making its nest away from the homestead, in a wood or hedgerow, still it has become a genuine farm-yard bird, but it will not thrive confined as the common fowl in a small enclosure.

The Guinea Fowls are essentially African, about nine species of the genus are known, the British bird is *Numida meleagris*, but there is reason to believe that the bird domesticated in ancient times by the Romans was an allied species from Abyssinia, *Numida ptilorhyncha*, I cannot ascertain whether this latter species is still a domestic bird.

The Peacock is an Indian bird, and although tamer than the guinea fowl it retains many wild habits, it chooses its spot for nesting, and roosts in trees.

This bird is not domestic in an economic sense, but is kept almost entirely for its beauty, there are two races of peacocks, the common and the black-winged pea-fowl; there is also a distinct species from Java, kept as an aviary bird.

Pea-fowl have been domestic from a remote antiquity, and nearly three thousand years ago, King Solomon, the first naturalist of whom we have a record, imported them into Palestine clearly on account of their great beauty, it is instructive here to notice that although at the same time that wise monarch imported apes, no further progress has been made in the domestication of any of that order of animals.

The eight birds dealt with belonging to the Anatine and Galline orders, widely apart as these two divisions are, agree in several respects; they are all excellent for food, all produce their young perfect and clothed, capable of feeding themselves a few hours after being hatched, and none require to be confined, if granted entire liberty they do not desert the homestead; there is but one other domestic bird the Pigeon, in which this attachment to locality is not only equalled but greatly exceeded, these nine birds indeed are all that are domestic in the highest sense, all other species must be confined.

The Pigeons are a large and very peculiar group of birds, forty-four genera, and about three hundred and sixty species are known, out of this number but one is domestic in the highest sense, and one other is the well known Barbary Dove.

The common Pigeon is without doubt descended from the Rock Dove, a bird inhabiting cliffs and frequenting the same spot for life, this quality has been the cause of its early domestication, nearly all other Pigeons are migratory, or at least wandering in their habits.

The common Pigeon is tame, but shows very little attachment to persons, no doubt this tameness has been a further element in the domestication of the bird, the habits of some of the other species are very wild. My brother bred, in confinement, two young of the allied Stock Dove, but when nearly grown up they killed themselves by their endeavours to escape. A naturalist of considerable experience tells me that, in his experience, the young of wild birds, bred in confinement, are wilder than their tamed parents.

I do not regard the Pigeon as valuable food; the young, unlike the true food birds, are produced blind and naked, and the taste of the flesh is to me repulsive, indeed I never met with a person who was really fond of eating pigeons.

The eating of such birds as you see exposed for sale in Continental markets, for instance swallows, wrens, and robins, is on a par with eating pigeons, it is the cooking only that makes them tolerable, as is also the case with the most vulgar dish which appears, I blush to say, on English dinner tables, "larks," those sweet songsters.

Persons who eat Larks are as bad as Heliogabalus who had served up Nightingale's tongues.

The Ring or Barbary Dove is entirely a cage bird, although I have seen them released during summer when they had young, but if left at liberty when the period of migration arrived they would have been lost.

There are many other species of the Pigeon group which breed occasionally in confinement, of which fact there have been numerous instances in the Zoological Gardens, but I cannot find out that a true permanent domestic species other than the above has ever been obtained.

I have known imported wild species breed soon after their arrival in England, but their offspring were rarely, if ever, prolific.

The Passerine birds form more than half of the known species of birds, there are not far short of six thousand which have been described by naturalists, yet out of this large number but three appear on our dinner tables, viz.: the Ortolan, a species allied to the Yellow-hammer; the Wheatear, still captured, but in sadly diminished numbers, on the South Downs; and that blithe songster the Lark before adverted to, but all these administer to a depraved taste, and are rendered eatable only by the skill of the cook.

The Canary is, the Dove excepted, the only truly domestic cage-bird known in England, it belongs to the Finches, *Fringillidæ*, a family of Passerine birds, containing between seventy and eighty genera and more than five hundred species.

This bird is far more prolific in captivity than in the wild state, and the varieties of it are very numerous, it also produces mules freely with the Goldfinch, Greenfinch, Linnet, Siskin, and occasionally with the Bullfinch, Redpole, Purple Finch, and other allied Finches.

The origin of the canary is well known, it is undoubtedly the *Serinus canarius* of the Canary Islands, but the domestic bird is generally a Zanthous variety, those which are colored like the wild bird, termed by the fanciers, green, are but little valued.

The canary has been known as a cage-bird for at least 300 years; it is difficult to offer any explanation as to the reason it lends itself so readily to domestication, it is probable that as it inhabited so small a group of islands, its food might have been little varied, thus its requirements in this respect were easily imitated, its favourite food has even derived its name, if not from the bird, at least from the islands it inhabits, it was clearly not a migratory bird, or even a wandering bird, like most of the finches; its song is no doubt finer than that of other finches; but there was nothing in the color of the wild bird very attractive, like that of the Goldfinch or Bullfinch, of which a domestic race apparently cannot be obtained.

The Goldfinch will sometimes with great care be induced to nest in captivity, but the offspring are weak and infertile.

In India there are several species of small finches, of the genus *Munia* and allied genera, that are bred in captivity, I believe, but I cannot obtain any distinct information on the subject, and am not able to say whether a truly domestic race of any of these species has been developed. I judge, however, from the varied colors of some of the specimens I have seen, that this is probably the case, at any rate, parti-colored varieties of some are common, and pure white varieties of the common waxbill may be often seen.

The last bird to which I have to draw your attention is the Ostrich, this large bird is sometimes as much as eight feet high and three hundred pounds in weight; whether there is more than one species is doubtful, the egg and color of the skin differs in the northern and southern variety or sub-species.

The ostrich belongs to the very restricted group of Ratitoe of Huxley, birds without a keel to the breastbone, without webs to their feathers. The other genera are *Dromaius* (Emeu), one species; *Casuarius*, about ten species; *Rhea*, three species; and *Apteryx*, four species; altogether about twenty species of these singular birds are known, they are no doubt the remains of a far larger number which have become extinct, and their geographical distribution over the earth would lead to the same conclusion.

Struthio (ostrich) is an African and Asiatic genera; *Dromaius* (emeu), Australian; *Casuarius*, Australian, and the

Islands of the Austro-Malayan Archipelago; *Apteryx* is confined to New Zealand, and *Rhea* to South America.

Of late years ostrich farms have been established in South Africa, and a large number of young are reared for their feathers; I am glad to say that the feathers are not plucked from the living bird, but carefully cut off, if they were plucked the next growth would be of very inferior quality.

Large tracks of country have been enclosed for ostrich farming, but it is still questionable whether a permanent race of truly domestic ostriches will be established, or whether the breed will, after a few generations, die out; I have been informed that already the offspring of the domesticated birds shows a falling off in the plumage.

I place the ostrich as a domestic bird with some hesitation, because its permanent domesticity is not yet assured.

It will thus be seen that out of ten and eleven thousand species of birds, but nine are sufficiently attached to locality that they may be allowed full liberty, two others, in this country, are cage-birds—there may be others in India—and one of very recent domestication is kept in enclosed grounds of great extent

I do not doubt that most birds which seemed worth domestication have been subjected to trial, and without success, and I venture to state that, in my opinion, another truly domestic bird, by this I mean a bird as domestic as the four *Galline*, the four *Anatine*, and one of the *Columbine* will never be obtained.

ABSTRACT OF A PAPER

READ BY

REV. ANDREW JOHNSON, M.A., F.L.S.,

JANUARY 26th, 1887.

Note on a Hermaphrodite form of male Begonia.

IN the Summer of 1886, a Begonia of the Veitchii type produced an abnormal flower. From the centre of the staminal group sprang a single slender vertical style, rising well above the stamens, and carrying a well defined rotate stigma, which bore upon its surface a slight depression. It is to be regretted that the style was not sketched at this stage. Attention was at once arrested by an appearance so totally unlike the normal female organ (which, as is well known, consists of three styles, each bearing spiral branches), and the growth was carefully observed.

The substance of the style slowly dilated at a distance from the base of about one-third of its length, soon forming a small oval bag. This vesicle continued to expand in an upward and downward direction, the process continuing after the flower was plucked, and placed in water for the purpose of delineation. At length the downward extremity of the swelling reached the point of insertion, taking the flask-like form shewn in the enlarged drawing exhibited to the meeting. Whilst this expansion of the style was going on below, the flat stigma became more and more depressed, until it assumed the enfundibuliform appearance shown in the illustration. The inner and outer margins of the funnel were beautifully ciliated. There was no trace whatever of the inferior ovary of the normal Begonia flower, but the finished figure strikingly resembles that of the female organ of *Laurus nobilis* with its flask-shaped superior ovary.

RULES.

(*As amended at the Annual Meeting, 22nd February,* 1882.)

1.—The Society shall be called the WEST KENT NATURAL HISTORY, MICROSCOPICAL, AND PHOTOGRAPHIC SOCIETY, and have for its objects the promotion of the study of Natural History, Microscopic research and Photography.

2.—The Society shall consist of members who shall pay an annual subscription of 10s. 6d., and of honorary members. The annual subscription may, however, be commuted into a Life Subscription by the payment of £5 5s., in one sum. All subscriptions shall be due on 1st January in each year.

3.—The affairs of the Society shall be managed by a Council, consisting of a President, four Vice-Presidents, Treasurer, two Secretaries, and 13 members, who shall be elected from the general body of ordinary members.

4.—The President and other officers and members of Council shall be annually elected by ballot. The Council shall prepare a list of such persons as they think fit to be so elected, which shall be laid before the general meeting, and any member shall be at liberty to strike out all or any of the names proposed by the Council, and substitute any other name or names he may think proper. The President and Vice-Presidents shall not hold office longer than two consecutive years.

5.—The Council shall hold their meetings on the day of the ordinary meetings of the Society, before the commencement of such meeting. No business shall be done unless five members be present.

6.—Special meetings of Council shall be held at the discretion of the President or one of the Vice-Presidents.

7.—The Council shall prepare, and cause to be read at the annual meeting, a report on the affairs of the Society for the preceding year.

8.—Two auditors shall be elected by show of hands at the ordinary meeting held in January. They shall audit the Treasurer's accounts, and produce their report at the annual meeting.

9.—Every candidate for admission into the Society must be proposed and seconded at one meeting, and balloted for at the next; and when two-thirds of the votes of the members present are in favour of the candidate, he shall be duly elected.

10.—Each member shall have the right to be present and vote at all general meetings, and to propose candidates for admisson as members. He shall also have the privilege of introducing two visitors to the ordinary and field meetings of the Society.

11.—No member shall have the right of voting, or be entitled to any of the advantages of the Society, if his subscription be six months in arrear.

12.—The annual meeting shall be held on the fourth Wednesday in February for the purpose of electing officers for the year ensuing, for receiving the reports of the Council and Auditors, and for transacting any other business.

13.—Notice of the annual meeting shall be given at the preceding ordinary meeting.

14.—The ordinary meetings shall be held on the fourth Wednesday in the months of October, November, January, March, April, and May, and the third Wednesday in December, at such place as the Council may determine. The chair shall be taken at 8 p.m., and the business of the meeting being disposed of the meeting shall resolve into a *conversazione*.

15.—Field meetings may be held during the summer months at the discretion of the Council; of these due notice, as respects time, place, &c., shall be sent to each member.

16.—Special meetings shall be called by the Secretaries immediately upon receiving a requisition signed by not less than five members, such requisition to state the business to be transacted at the meeting. Fourteen days' notice of such meeting shall be given in writing by the Secretaries to each member of the Society, such notice to contain a copy of the requisition, and no business but that of which notice is thus given shall be transacted at such special meeting.

17.—Members shall have the right of suggesting to the Council any books to be purchased for the use of the Society.

18.—All books in the possession of the Society shall be allowed to circulate among the members, under such regulations as the Council may deem necessary.

19.—The microscopical objects and instruments in the possession of the Society shall be made available for the use of the members, under such regulations as the Council may determine; and the books, objects, and instruments shall be in the custody of one of the Secretaries.

20.—The Council shall have power to recommend to the members any gentleman not a member of the Society, who may have contributed scientific papers or otherwise benefited the Society, to be elected an honorary member; such election to be by show of hands.

21.—No alteration in the rules shall be made, except at the annual meeting, or at a meeting specially convened for the purpose, and then by a majority of not less than two-thirds of the members present, of which latter meeting fourteen days' notice shall be given, and in either case notice of the alterations proposed must be given at the previous meeting, and also inserted in the circulars sent to the members.

*** *Members are particularly requested to notify any change in their address to the Hon. Secretaries, Post Office, Lee Bridge, Lewisham, S.E.*

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MEETINGS OF THE SOCIETY

FOR THE SESSION 1887-88.

Wednesday,	March	2[illegible]
,,	April	2[illegible]
,,	May	2[illegible]
,,	October	2[illegible]
,,	November	2[illegible]
,,	December	2[illegible]
,,	January (1888)	2[illegible]
,,	February ,, (Annual)	2[illegible]

The Chair is taken at 8 o'clock.

The Meetings are held in the Hall of the Mission School, Blackheath.