two fasciculi, and Mr. Hall will add a translation of the text and an introduction.

The recommendation was adopted by the Meeting.

A communication was received from Babu Radha Nauth Sickdar, being an abstract of Meteorological observations taken at the Surveyor General's office for the month of April last.

Mr. H. F. Blanford read a paper on the subject of Dr. Bronn's work on the laws of development of organised beings.

Mr. Blanford stated that the work, a brief notice of which he proposed bringing before the Society, was written by Dr. Bronn in 1855, in answer to a series of prize questions proposed by the French Academy of Sciences in 1853-4. Dr. Bronn's work was adjudged as successful and crowned by the Academy in 1857 and the work itself published shortly after. Its object was to ascertain the laws of the development of organised beings in time, a question which the recent publication of Mr. Darwin's work had rendered one of general interest, and the work possessed this great merit as evidence in the discussion provoked by Mr. Darwin, that having appeared long before the publication of Mr. Darwin's views, it was unbiassed in its conclusions by any controversial spirit.

The objects of Dr. Bronn's work differed in so far from those of Mr. Darwin's, that the former sought simply to determine the formal laws expressing the nature of the sequence of organisms in time and the relation of that sequence to the parallel sequence of geologic changes, while the latter endeavoured to solve the higher problem of which these formal laws are merely consequences, *viz.* the *modus operandi* of the cause to which the succession of varying organisms in past times is due. Dr. Bronn's objects bear the same relation to Mr. Darwin's as those of Kepler and Copernicus, the discoverers of the laws of the Heliocentric Planetary System did to Newton's, the discoverer of gravitation.

Of the two parts into which Dr. Bronn's Essay was divided, *viz.* the exposition of the laws of development; and the proving of these laws by the comparison and analysis of tabular evidence, only the first could be noticed in the brief space of a single lecture. Mr. Blanford's object was simply to bring to the notice of the Society, the general results at which Dr. Bronn had arrived, and would refer

those who might wish to enter in detail into the question, and satisfy themselves of the soundness or unsoundness of Dr. Bronn's views, to the original work, which had been published in German, French and English, the latter translation by the Ray Society of London.

The two fundamental laws laid down by Dr. Bronn as having regulated the sequence of organisms from the earliest period to the present time were:

1. That there had been the operation of an independent producing power or force (Kraft) progressive in intensity and in its sphere of operation.

2. That the results of this power or force had been limited by, and dependant upon, the nature and changes of the external conditions of existence, such as climate, habitat, food, &c.

With respect to the first law, a clear idea of the meaning of progression could only be gathered from a consideration of the whole range of organized beings, and the evolution of general propositions concerning form, organization, and habits of life. In this way, it was shewn that the criteria of higher types as compared with lower were:—

Higher.	*Lower.*
Bilateral symmetry of form.	Quadrilateral or circular symmetry of form.
Few homologous parts.	Numerous homologous parts.
Organs various, specialized to discharge one or few functions, concentrated, and enclosed.	Organs few, fitted to perform various functions, dispersed, and superficial.
Habits terrestrial.	Habits aquatic.
Breathing air.	Breathing water.
Food, (in the case of animals) vegetable.	Food, (in the case of animals) animal.

With respect to the second law, the conditions of existence might be considered under two heads, viz. as:—*inorganic*, which bore reference to terrestrial phenomena, such as temperature, climatal zones, the composition of the atmosphere, and the distribution of land and sea; and *organic*, which included the supply of food, a consideration which had been developed to an extent unanticipated by

Dr. Bronn in Mr. Darwin's well known chapter on the "Struggle for Existence."

The hypothesis to which we had to apply these conditions was, that of an originally fluid globe, cooling by radiation, until a solid crust had formed, upon which the greater part of the water had condensed in the form of seas, while the atmosphere contained a larger proportion of aqueous vapour and carbonic acid than at present.

The excess of carbonic acid was subsequently fixed in the form of limestone, and eliminated, especially during the coal period, by the luxuriant vegetation which abstracted the carbon stored up in the coal formed of its remains. The carbonic acid since converted into coal and limestone had been calculated by Brogniart and Bischof to amount to 6 per cent. of the entire atmosphere, or one hundred times its actual proportion; and although it is probable that it never reached this amount, and that much of it was evolved from the interior of the earth through volcanic vents, contemporaneously with its absorption by the vegetation of the epoch, still, it had been proved by the experiments of Daubeng and Regnault, that a proportion of 5 per cent. of carbonic acid was by no means injurious to ferns, and that provided sufficient oxygen were present, animals could live without apparent inconvenience in an atmosphere containing half its volume of the former gas. The surface of the earth being then in such a condition as to support animal and vegetable life, we might expect, according to Dr. Bronn, the following series of phenomena, which, ranged in parallel columns exhibit the historic interdependence of the organic and inorganic kingdoms.

1. The simultaneous appearance of plants and animals, to sustain a proper relation in the components of the atmosphere,	1. When by condensation and chemical absorption the atmosphere became fitted to support life.
2. An universal and continuous change in the fauna and flora of the earth,	2. As the temperature universally and continuously diminished.
a. The primary fauna and flora were universal and tropical,	*a.* The temperature of the earth's surface was likewise uniform and tropical, until,

b. becoming subsequently diversified according to climate.

b. the internal heat being diminished by radiation, the climate became differentiated in different zones.

3. New forms of life could not have arisen from those preceding them, but were provided for by a new creation. (Schöpfung). The assumption of specific and generic centres, is therefore unnecessary and improbable.

3. The new stations formed were not always in connexion with those previously populated.

4. As the older forms disappeared, in consequence of the cooling of the earth and the formation of continental areas, they were continuously replaced by new forms with but a slight variation in the intensity of the producing force.

4. The cooling of the earth's surface and the extension of continental land areas proceeded gradually and equably.

5. The general character of the first fauna and flora was entirely different from that of the present day, the passage being, however, gradual throughout.

5. The physical condition of the earth's surface was likewise originally very different from that of the present day, and the passage gradual.

6. Organisms became more varied and respectively adapted to more diversified conditions of life.

6. In consequence of the above change, stations became more numerous and varied.

7. The appearance of most plants and animals was conditional on the previous fulfilment of the conditions necessary for their existence, as regard nourishment, habitat, &c.

7. The Earth, having become peopled with such plants and animals as depended solely on each other and on the purely terrestrial conditions, was, by their existence, rendered habitable for succeeding races.

8. The absolute number of species, genera, and families increased with the differentiation of

8. The differentiation of the requisite external conditions proceeded continuously, but espe-

external conditions.

9. The tendency of all successive changes may be termed terripetal. The first population of the globe was almost exclusively pelagic. Land animals succeeded, and increased most rapidly both in numbers and in perfection of organization.

10. The higher and more perfect plants and animals are, so are the conditions requisite for their existence more complicated and numerous. The more perfect animals could not exist without the less perfect. And thus a necessary consequence of the progressive development of the earth's surface, was a gradual higher development of the organic world as a whole, as well as of its subordinate divisions, and while the organic world tended more and more to the formation of the existing higher types, the latter tended to increase in a more rapid ratio than the less perfect. Meanwhile many of the less perfect either simply disappeared or were replaced by more perfect compensating forms.

11. There are also some special cases in which the progression of the organic world towards a higher degree of development,

cially characterized the close of the carboniferous epoch and the commencement of tertiary times.

9. Simultaneous and parallel with these changes was the diminution and sub-division of watery areas and the formation of continental, as distinguished from insular divisions of the land area.

10. The external conditions of existence became more varied and fitted for the existence of higher organisms.

either generally and systematically, or specially from embryonic types, appears to have progressed, independently of any apparent external causes, and in accordance with the operation of some independant internal law, except in so far as there is a necessary reciprocal relation between the laws of development of the organic and inorganic world, which could only be definitely expressed if we knew the nature of the power or force which gives rise to new organisms.

In commenting on the above, Mr. Blanford remarked that although the hypothesis of a cooling globe and an universal equable temperature in early geologic times had been rejected by Sir Charles Lyell and some other eminent authorities, there were many important facts, such as the existence of a coal flora within the Arctic regions in a great measure identical with that of the temperate zone, and the wide distribution of generic and specific types in Palœozoic times, which gave much probability to the hypothesis upon which Dr. Bronn's theoretical conclusions were based.

These views were stated necessarily at much disadvantage before the Society, as time would not permit of even an abstract of Dr. Bronn's proofs of the laws above enunciated, by a review of the geologic record, which could be the only test of their truth or falsity. With respect to the third of Dr. Bronn's secondary laws, viz. that new stations were frequently isolated, and consequently that their faunas and floras were necessarily of independent origin, it appeared to Mr. Blanford that both the fact and inference were pure assumption, and neither proved by the author in the subsequent part of his work, nor indeed very capable of historic proof. Many of the now isolated stations, such as the islands of Polynesia, had been shewn to be very probably mere remnants of former widely extended stations; (in the case cited, by Dr. Hooker on botanic

grounds and by Mr. Darwin on geological grounds;) and even were it granted, as it might be theoretically, that such isolated stations may occasionally have been formed, until we can ascertain the period at which they were first populated, and can assert that no possible accidental transport of eggs, seeds, &c. would account for that population, the inference drawn by Dr. Bronn would be by no means legitimate.

In some other points, it appeared that Dr. Bronn had laid too much stress upon negative evidence as e. g. in the ninth of the secondary laws, but as this had no important bearing on the principal object of the paper, viz. a comparison of Dr. Bronn's laws with Mr. Darwin's theory of natural selection, it need not be further alluded to.

Setting aside the assumption of independent faunas and floras, as unproved in any case and at variance with the tendency of our present knowledge, the laws evolved by Dr. Bronn were stated to be in close accordance with the requirements of Mr. Darwin's theory. With respect to the formal portion of Dr. Bronn's first fundamental law, (i. e. the fact of progression, apart from any hypothesis of a force,) very little had been said by Mr. Darwin; his only reference to it being to the following effect, viz.:—the higher forms have their organs more distinctly specialized for different functions; and as such division of physiological labour seems to be an advantage to each being, natural selection will tend in so far to make the later and more modified forms higher than their early progenitors, or than the slightly modified descendants of such progenitors.* This view appeared to be identical with that taken by Dr. Bronn in the majority of cases, as enunciated in Nos. 7, 8, 9 and 10 of his secondary laws. In No. 11, indeed something more is indicated, viz. a progression of type, independent, or apparently independent of external conditions, and referred somewhat vaguely to an unknown force; but this was scarcely necessary, and the phenomenon of progression according to embryonic types, the progression from general to specialized forms, which had been admitted by Agassiz, Owen, Carpenter and others, as having obtained in past times, was perfectly and most simply explained by Mr. Darwin's theory.

* Origin of species, p. 336.

Dr. Bronn's second fundamental law, the correlation of the development of organized beings, with that of the external conditions of life, and the multiplication of varieties and species as these conditions became more varied, formed one of the fundamental requirements of Mr. Darwin's theory.

The chief point on which the two authors were at issue, was that of the origin of new forms. On this subject, Dr. Bronn did not enunciate any theory, and in the expression of his formal laws, referred vaguely to an undefined force. He denied, however, the possibility of their origin by descent, with variation, from pre-existing forms, as well as their origin by spontaneous generation from inorganic matter, and regarded that by immediate act of creation repeated for every new species, as inconsistent with the tenor of our knowledge of all natural operations. It was difficult therefore to understand how and upon what, the hypothetical force could be supposed to act, nor was this anywhere suggested in the essay. The objection by anticipation to Mr. Darwin's views, rested as it appeared, solely on the assumption of isolated stations before alluded to, and if this be rejected as unsound, there appeared nothing in Dr. Bronn's laws at all irreconcileable with Mr. Darwin's theory. For the rest Mr. Darwin had suggested a *vera causa* and it remained for the naturalist and geologist to say how far it was sufficient to account for the facts.

Some discussion arose after the lecture was concluded.

Dr. Kay remarked, that the way in which the subject had been treated, appeared to him calculated to produce serious confusion of thought. There had been a perpetual vibrating between two entirely distinct inquiries ; the search into *forms* and the search into *causes*. A great deal of fallacious reasoning was owing to the neglect of this distinction. Morphology was a deeply interesting study ; but it gave absolutely no information about the causes of the differential characteristics observed in analogous species of plants and animals at successive epochs. In examining such species it was natural to use such words, as *advance, progression*, &c. ; but these terms simply mean that the species of a later era are found to differ in certain ways from those of an earlier era. The morphological progression proves nothing as to the existence of an œtislogical connexion between the

successive stages. It is simply a historical fact that there is an advance in the observed forms. But to state a fact is not to account for it, and Moliére's physician added nothing to science when he averred that medicine cured because it possessed a *vis medicatrix*. All present were aware that theories such as Dr. Bronn's or Dr. Darwin's had a far wider and deeper interest than they would have simply as scientific speculations, because they touched on questions relating to man's spiritual nature. That nature enabled man to look upward to the eternal, and downward to the endless variety of cosmical phenomena. Would any similarities of structure between man and other contemporary or palœozoic species bridge over the chasm placed between him and them by the possession of that spiritual nature? If it be said that the power of ulterior development had existed from the date of the primal monad,—this would only increase a billion-fold any difficulties that may be supposed to lie in the received theories of creation;—for, whence came this monad? It must have been created. And what a marvellous creature! to hold shut up within it the numberless forms of all the species that have arisen in the world through countless ages, along with all the laws of their successive development, each one involving such marvellous adaptations to all other portions of the Kosmos!

He would add an expression of his hearty concurrence with two remarks made by the lecturer:—*viz.* where he spoke of the rashness with which his author theorized on the early geological periods; and where he stated his belief that Dr. Bronn's assumption of a mysterious "Kraft" or power was neither legitimate nor very intelligible.

Mr. Blyth rose, as the friend of Mr. Darwin of more than a quarter of a century standing, to advocate his theory. He expatiated upon the vastness of geological periods, as amply sufficient for bringing about the present order of things in the organic kingdoms, by the operation of Mr. Darwin's principle of Natural Selection. The immensity of the lapses of past time he illustrated by comparing them with the profundities of space, and by the computed distances of sundry astronomical objects. He also argued a far higher antiquity than is generally supposed for the existence of the human being upon this planet, as testified by the discoveries of Dr. Lund in certain low caverns in Brazil, more than twenty years ago, and abundantly by

recent discoveries in various regions: more especially he referred to certain tumuli in Scania, where flint arrow-heads or spear-heads were found together with the bones of extinct mammalia, and associated also with human remains, the skulls of which indicated them to belong to the hyperborean type of mankind, being similar to those of modern Esquimaux; an important fact, which tended, as he thought, to connect the epoch of those remains with the glacial era of Agassiz, or at least with the time when the Rein Deer and the Musk Ox roamed over what is now Britain. But he maintained that however ancient may be the remains of this hyperborean race in modern Scania, perhaps one of the present American types of humanity in the New World, still, for various reasons adduced, we must look to the tropical regions of the major continent for the aboriginal habitat of the human being; countries of which the palœontology is almost utterly unknown. Mr. Blyth then adverted to the incompleteness of the geological record as insisted upon by Mr. Darwin; and touched upon some other points, which the lateness of the hour prevented his dwelling upon.

Mr. Blanford briefly replied to remarks which fell from Dr. Kay, that he had not professed to enter upon the subject of causation at all; but only upon the study of forms as indicating the direction which causation had taken.

The interesting discussion was closed by the Chairman, stating that the thanks of the meeting were due to Mr. Blanford for laying before them the views of Dr. Bronn. He observed that a comparison had been made by Mr. Blanford between the progress of this new or newly-revived theory of the mutability of species and the establishment of the theory of universal gravitation. But he would remark that in the establishment of the theory of gravitation there had been two grand stages, the second of which was far longer and more laborious than the first. The first was the conception of the law, the second was its verification. In the second, as well as the first Newton did a vast deal himself, but it had been the work of the last 200 years to complete the demonstration, so long as nearly 100 years after Newton the celebrated Clairant had been staggered by an error in the moon's motion, which at first he could not explain on Newton's theory, and went so far as to suggest that the law varied partly as the inverse square and partly as the inverse fourth power of the dis-

tance. So lately as the time of Laplace similar difficulties had presented themselves, which his sagacity alone had removed. But now such perfection had been attained that as the instruments of observation and the method of calculation are from time to time improved, the smallest variations detected in the motions of the heavenly bodies are explained, and the theory of gravitation, as applicable to the minutest particles of matter, fully established. He added that in this new theory of the mutability of species Mr. Darwin seems to have taken the first step in striking out a bold generalization. But the more laborious and lengthy process of testing his law has yet to be gone through, and when completed as satisfactorily as that of gravitation, he (the Chairman) for one would believe in it as a law of nature.

With reference to remarks which fell from Mr. Blyth regarding the incompleteness of the geological evidence, he recommended to his notice two papers in *Fraser's Magazine* for June and July, by Mr. William Hopkins of Cambridge, well known as a first rate mathematician and geologist. He thought these papers were among the most thoughtful and convincing replies to Mr. Darwin's whole theory that he had read.

A vote of thanks was then passed to Mr. Blanford for his lecture.

The Librarian submitted his usual monthly Report for October last.

LIBRARY.

The following books have been added to the Library since November last.

Presented.

Journal of the American Oriental Society, Vol. VI. No. 2.—BY THE ORIENTAL SOCIETY.

Burges's Trans. of Surya Siddhanta.—BY THE AUTHOR.

Report on the Survey operations in the Lower Provinces, for 1858-59.—BY THE AUTHOR.

Oriental Christian Spectator for September and October 1860.—BY THE EDITOR.

Journal of the Statistical Society of London, Vol. XXIII. Part III.—BY THE SOCIETY.

Proceedings of the Zoological Society of London, Pt. II. of 1860.—By the Society.

Ditto, of Royal Society of London, Vol. X. No. 39.—By the Society.

De Sacy's Arabic Grammar, Vol. I. Pt. II.—By the Author.

Willmet's Lexicon Linguæ Arabicæ Niebuhr's Voyage en Arabie, Vol. I. Pt. II.—By A. Sconce, Esq.

Ditto, descriptions del' Arabic Schultens Harriri, Vol. I. Pt. II.—By the

Williams F. F. Guide to Indian Photography.—Report on the Teneriffe. astronomical experiment of 1856 addressed to the Lord Commissioner of the Admiralty, London.—By the Lords Commissioners.

Monthly notices of Royal Astronomical Society of London, Vol. X. Part III.—By the Society.

The Life of Rajah Radhakanta Deva Bahadur.—By the Editors.

Sabda Kalpadruma in series, No. 1.—By the Editors.

Report on the result of the Administration of the Salt Dept. 1858-59, Bengal Govt.—By the Bengal Govt.

Oriental Baptist for November 1860.—By the Editor.

Calcutta Christian Observer for Nov. 1860.—By the Editors.

Trans. of the Bombay Geographical Society, Vol. XV.—By the Society.

Bengali Translation of Mahabharata, Pt. II.—By the Editor.

Selections from the Records of Government of India For. Dept. No. 28, By the Government.

Memoirs of Royal Astronomical Society, Vol. XXVII.—By the Society.

Exchanged.

Zeitschrift der Deutschen Morgenlendischen Gesellschaft, Pt. VIII.

Athenæum, for August, 1860.

London and Edinburgh Philosophical Magazine, No. 132, for September, 1860.

Purchased.

The Literary Gazette, Nos. 112 to 115.

Comptes Rendus, Nos. 6 to 9 Tome 51.

Revue des Deux Mondes, Tome XXX. for 15th August and 1st September, 1860.

Annales des Sciences Naturelles, Tome XII. No. 56, 1860.

Journal des Savants for July and August, 1860.

Revue de Zoologie, Nos. 7 and 8, 1860.

The Annals and Magazine of Natural History, Vol. VI. No. 33.

Flugels die classen der Hanefitischen Rechtsgelehrten.

Foncause Buddhar.

Capt. Raverty's Gulshan-rah—Afghan Poetry and Prose.
Ditto. Dictionary of the Pushto or Afghan language.
Ditto. Grammar, Ditto. Ditto.

For December, 1860.

At a meeting of the Society held on the 5th Instant—

A Grote, Esq., President, in the chair.

Presentations were received—

1st. From Major Hollings, a baked clay fac-simile of Sanscrit inscription on a stone pillar in the Behar Fort.

2nd. From the Bombay Geographical Society, the 25th Vol. of their Transactions.

3rd. From Mr. W. S. Seton-Karr, Secretary to the Government of Bengal, forwarding, on behalf of the India House, certain copies of the Memoirs and Reports of the Royal Astronomical Society.

4th. From the Academy of Natural Sciences at Philadelphia, a copy of the proceedings of the Academy for 1860.

The Secretary announced the publication of the Shell catalogue, a copy of which was laid on the table, price fixed at 3 Rs. a copy.

The following gentlemen who were proposed at the last meeting were balloted for and elected ordinary members.

F. Cooper, Esq. C. S.

Moulavie Abdool Luteef Khan Bahadur, Deputy Magistrate and Deputy Collector, 24-Pergunnahs.

Baboo Gooroo Churn Doss, Deputy Magistrate, Jessore.

D. H. Macfarlane, Esq., Calcutta.

The following gentlemen were named for ballot at the next meeting.

J. C. Erskine, Esq. proposed by Sir Bartle Frere and seconded by Captain W. N. Lees.

Lewis Jackson, Esq. C. S. proposed by Mr. Atkinson and seconded by Mr. Cowell.

William Thompson Dodsworth, Esq., Surveyor, Ganges Canal, Dehra Dhoon, proposed by Colonel Waugh and seconded by Major Thuillier.