

the density of the forests in each State is portrayed by five shades of colour.

I must not end my notices of some of the labours of our scientific brethren in the United States without expressing my admiration of the spirit and the manner in which the Government and people have cooperated in making known the physical and biological features of their country, and my conviction that the results they have given to the world are, whether for magnitude or importance, greater of their kind than have been accomplished within the same time by any people or government in the older continents. How great would now be our knowledge of the climate and natural features of India and of our Colonies had the excellent Trigonometrical Survey of the one and the territorial and Geological Surveys of the others been supplemented by Reports such as those to which I have directed attention !

On the motion of Mr. De La Rue, seconded by Sir James Alderson, it was resolved—"That the thanks of the Society be returned to the President for his Address, and that he be requested to allow it to be printed."

The President then proceeded to the presentation of the Medals.

The Copley Medal has been awarded to Professor James Dwight Dana, of Yale College, Newhaven, United States, for the numerous, varied, and important contributions to Mineralogy, Geology, and Zoology with which he has enriched science during more than fifty years. Professor Dana's first published paper bears the date of 1823, while the year 1877 finds him, as ever, vigorously at work.

Commencing his career with the inestimable advantage of a sound training in mathematics, physics, and chemistry, one of Professor Dana's earliest writings is an essay upon the connexion of electricity, heat, and magnetism. He then turned his attention to mineralogy; and, after exhibiting his thorough study of both the crystallographic and the chemical aspects of minerals by the publication of a large number of separate memoirs, he produced a systematic treatise on mineralogy, which at once took the place it still holds among standard works upon the subject.

In geology, the diversity and importance of Professor Dana's labours are not less remarkable. Not only have multitudinous detached essays, embodying the results of wide and accurate observations in all parts of the world, and on all classes of geological phenomena, proceeded from his pen, but his 'Manual of Geology,' of which a new edition appeared two years ago, is at once a most clear and comprehensive statement of the present state of geological science, and a complete, though

necessarily condensed, monograph of the geology of North America ; and, it may be added, few treatises on this branch of knowledge show so thorough and practical an acquaintance with all those sciences which are auxiliary to geology, or so extensive and profound a study of the phenomena presented by the existing condition of the globe, from the knowledge of which every rational attempt to reconstruct the past history of the earth, upon the data afforded by its rocks and their organic contents, must start.

As naturalist to the United States Exploring Expedition, which made a circumnavigatory voyage, under the command of Captain Wilkes, in the years 1838 to 1842, Professor Dana enjoyed unusual opportunities for zoological investigation ; and his remarkable works on the Zoophytes and the Crustacea observed during the voyage testify to the admirable use which he made of those opportunities. Nor has Professor Dana confined himself to the merely descriptive side of zoology ; but, drawing general conclusions from his vast store of accurate observations, he has published views on classification and on questions of general morphology of much originality and breadth of view.

The Medal was received for Prof. Dana by the Hon. Edwards Pierrepont, United States Minister. The President, in delivering the Medal, expressed his assurance of the esteem and regard in which Prof. Dana was held by the Royal Society, not less for his own scientific achievements than for the liberal aid he has always rendered to other investigators.

A Royal Medal has been awarded to Mr. Frederick Augustus Abel, for his physico-chemical researches on gunpowder and explosive agents.

Mr. Abel's career as a contributor to chemistry commenced about 30 years ago. Between 1847 and 1865 he contributed a number of papers to the Chemical Society, which were published in their Journal : some of the investigations were made in conjunction with other chemists ; among these were the action of nitric acid on cumol (1847), and researches on strychnine (1849), when the composition of that alkaloid was finally established. They were followed by papers relating to metallurgy (copper) and analytical processes, one of which, on the application of electricity to the explosions of mines, may have led to his various works on explosives, on which the claims of Mr. Abel for the distinction of a Royal Medal mainly rest. So far back as 1863 he directed his attention to the study of gun-cotton in consequence of the development of its manufacture in Austria for artillery purposes, and in that year communicated to the British Association a report on the preliminary results arrived at by his experiments on the Austrian process, and the products furnished by it.

In 1866 a memoir was sent to our Society, which was published in the

Phil. Trans. vol. clvi. p. 269, "On the Manufacture and Composition of Gun-cotton." In this paper, as the result of a long series of experiments, made with great accuracy, the conditions were laid down for its uniform manufacture and purification; and the true nature of gun-cotton (trinitro-cellulose) was finally established by an exhaustive series of analytical and synthetical experiments.

This paper was followed by another in 1867, published in the Philosophical Transactions, vol. clvii., entitled, "On the Stability of Gun-cotton," which was considered worthy of being made the Bakerian Lecture for that year. This memoir details the results of four years' extensive experiments on the effects of light and heat on gun-cotton, and upon the protective action of water at low and high temperatures. It will be recollected that the uncertain stability which had been characteristic of gun-cotton was conclusively traced to minute quantities of unstable substances remaining in the fibre, even after the most careful purification by the methods hitherto known, and the efficiency of simple measures for securing the stability of gun-cotton was established. This led ultimately to the development of a system of manufacture of gun-cotton which permitted of its ready manufacture in a high state of purity (pulping).

Mr. Abel did not, however, confine his attention to gun-cotton; and, indeed, in 1864 had sent in a paper to the Royal Society, which was published in the 'Proceedings,' vol. xiii., on "Some Phenomena exhibited by Gun-cotton and Gunpowder under special conditions," in which the behaviour of these substances when exposed to high temperatures in rarefied atmospheres and in different mechanical conditions was described.

In 1869 a memoir, entitled "Contributions to the History of Explosive Agents," was printed in the Philosophical Transactions, vol. clix. In this memoir is discussed the influence of more or less strong confinement and other mechanical conditions under which the *detonation* of such compounds and mixtures was developed. It will be recollected that some striking results were obtained in the examination of the behaviour of explosive compounds when exposed to *initiative* detonations of different character.

These phenomena were more fully discussed in a second memoir, published in the Philosophical Transactions for 1874, vol. clxiv.; it includes an exhaustive investigation of the transmission of detonation from one mass of gun-cotton, fulminates, and nitro-glycerine to other distinct masses in the open air, and also through the agency of tubes. The causes of interference with the transmission of detonation-force, and the development of detonation as distinguished from explosion, were clearly discussed. The influence of dilution by solids and by liquids on the susceptibility of explosives to detonation, and also the velocity with which detonation is transmitted by different explosive agents under various conditions, was

carefully studied. Some important results were obtained by the comparison of the behaviour of the liquid nitro-glycerine and the solid pulped and compressed gun-cotton devised by Mr. Abel. Among other things, the detonation of gun-cotton when thoroughly saturated with water, the transmission of detonation to distinct masses of gun-cotton enclosed in receptacles in which the space between the masses was filled up with water, and, further, the value of water as a violent disruptive agent (as in shells) when it was caused to transmit the force generated by the detonation of very small quantities of gun-cotton, which it surrounded, were established.

The last memoir published in the Philosophical Transactions, on "Fired Gunpowder," is a joint production of Mr. Abel and Captain Noble; and as the merit of the investigation, which has occupied the authors for some years, is divided, I do not dwell particularly upon it, except as affording evidence of the continuity of Mr. Abel's researches in physico-chemistry, which places him at the head of all other workers in the line of research which has mainly engaged his attention, and which has been productive of practical results of the greatest importance to this country.

[The Medal was received by Mr. Abel.]

A Royal Medal has been awarded to Prof. Oswald Heer, of Zurich, for his numerous researches and writings on the Tertiary plants of Europe, of the North-Atlantic Islands, North Asia, and North America, and for his able generalizations respecting their affinities, their geological and climatic relations.

It is mainly to Prof. Heer's labours that we owe those great advances made of late in our knowledge of the Miocene, Pliocene, and Post-Pliocene floras of Central Europe, which establish upon broad but safe grounds the close analogy existing between the vegetation of these epochs and that of the present period in Eastern North America and Eastern Asia. To Prof. Heer also we are mainly indebted for the remarkable discovery that a rich and varied arboreous vegetation, strikingly similar to what now obtains in temperate and subtropical countries, once extended to the Arctic Circle and far beyond it—a fact of which no adequate explanation has been found, and the importance of which, in relation to all questions as to the former geological and geographical conditions of the northern hemisphere, cannot be overestimated.

Prof. Heer's youthful studies were directed to botany and entomology. His scientific authorship commenced in 1836; and the early bent of his mind towards the higher problems of natural science is evinced by one of his very first memoirs, being 'Sur la Géographie Botanique de la Suisse,' published in 1837. His earliest work on fossil plants was upon those of the Rhone valley, published in 1846, since which period he has been uninterruptedly and indefatigably engaged on the comparative study of recent and fossil plants and insects—describing and illustrating them with

a completeness and exactitude that have been thoroughly appreciated by geologists and botanists, and appending to the systematic descriptions of them geological and climatic considerations, remarkable alike for their caution and significance. Amongst his numerous works his 'Flora fossilis Helvetiæ,' 'Flora Tertiaria Helvetiæ,' and 'Flora fossilis Arctica' are conspicuous examples of well-directed labour and great learning; while the number of his minor works on various branches of biology testify to a life spent in successful devotion to science.

During Prof. Heer's long and laborious career he has been conspicuous for the liberal aid he has given to other investigators, and for the disinterested spirit in which he has worked out the collections brought by the government and private expeditions of various European nations from the northern and arctic regions. In particular, we are beholden to him for the labour he has bestowed upon our own Arctic collections, made during the last fifteen years, from that of Belcher to that of Nares, and especially for his elaborate and exhaustive memoir on the Miocene flora of Bovey Tracey, published in the 'Philosophical Transactions,'—labours all the more praiseworthy from being, for some years past, pursued in a recumbent posture, to which grievous bodily ill-health has confined him.

The Medal was received for Prof. Heer by M. Henri Vernet, Consul-General for Switzerland, to whom the President acknowledged the Society's obligations to Prof. Heer for his elucidations of the Geology of England and of the Flora of the Bovey-Tracey Coalfield, published in the Philosophical Transactions; and on behalf of the Society expressed his hope that Prof. Heer might soon be restored to health.

For the Davy Medal, now for the first time awarded, Prof. Robert Wilhelm Bunsen and Gustav Robert Kirchhoff, both Foreign Members of the Society, in recognition of their researches and discoveries in spectrum-analysis, have been selected.

The method of spectrum-analysis, as established by these two eminent men, must rank among the most important extensions of our means of investigating the properties of matter. Before that discovery, the chemical constitution of matter was examined solely by the study of the changes which take place within the narrow range of cases of which we can grasp and weigh the substance under investigation; but the tests employed in spectrum-analysis have no necessary dependence upon the distance of the material from the observer. It has enabled us to see, not only further, but deeper; for, on the one hand, it has led to the detection of many of the chemical constituents of masses distant from our planet, and, on the other hand, it has enabled us to discover many constituents of terrestrial minerals which had escaped detection until our ordinary methods of analysis were guided by the more refined tests afforded by the spectrum-analysis.

The Statutes relating to the election of Council and Officers were then read, and Dr. Allman and Mr. Dunkin having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were collected, and the following were declared duly elected as Council and Officers for the ensuing year :—

President.—Sir Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D.

Treasurer.—William Spottiswoode, M.A., LL.D.

Secretaries.— { Professor George Gabriel Stokes, M.A., D.C.L., LL.D.
 { Professor Thomas Henry Huxley, LL.D.

Foreign Secretary.—Professor Alexander William Williamson, Ph.D.

Other Members of the Council.—Frederick A. Abel, C.B., V.P.C.S. ; William Bowman, F.R.C.S. ; Frederick J. Bramwell, M.I.C.E. ; William B. Carpenter, C.B., M.D., D.C.L. ; William Carruthers, F.L.S. ; William Crookes, V.P.C.S. ; Prof. P. Martin Duncan, M.B., P.G.S. ; William Farr, M.D., D.C.L. ; Prof. William H. Flower, F.R.C.S. ; Prof. G. Carey Foster, B.A., F.C.S. ; John Russell Hind, F.R.A.S. ; Lord Rayleigh, M.A. ; Vice-Admiral Sir G. H. Richards, C.B. ; Prof. Henry J. Stephen Smith, M.A. ; Prof. Balfour Stewart, M.A., LL.D. ; Prof. Allen Thomson, M.D., F.R.S.E.

The thanks of the Society were given to the Scrutators.

The following Table shows the progress and present state of the Society with respect to the number of Fellows :—

	Patron and Royal.	Foreign.	Compounders.	£4 yearly.	Total.
November 30, 1876.	4	46	253	258	561
Elected			+ 8	+ 9	+ 17
Deceased		— 3	— 12	— 11	— 26
Since compounded . .			+ 3	— 3	
November 30, 1877.	4	43	252	253	552