

of debt and difficulties. He struggled on, however, a martyr to rheumatism and suffering from a complication of internal disorders until he was struck down in the spring of 1786. Some time before his fatal illness he had formed the resolution of marrying the widow of his predecessor so soon as his circumstances should permit: on his death-bed he carried out this project, bequeathing to his wife such property as he had been able to acquire. Two days afterwards (May 21, 1786) he died at the age of forty-four.

The eleven years during which Scheele lived at Köping were fruitful in investigations of the highest importance in every department of chemistry. In that time he discovered molybdcic, tungstic, and arsenic acids among the inorganic acids; and lactic, gallic, oxalic, citric, malic, mucic, and uric among the organic acids. He also discovered glycerin, determined the nature of Prussian blue, and prepared hydrocyanic acid. He demonstrated that plumbago is nothing but carbon associated with more or less iron, and that the black powder left on the solution of cast-iron in mineral acids is essentially the same substance. He determined the chemical nature of sulphuretted hydrogen, discovered arseniureted hydrogen, and invented new processes for preparing ether, powder of algaroth, calomel, and *magnesia alba*. He made numerous analyses of air by absorbing the oxygen with a mixture of iron filings and sulphur. He concluded that "our atmosphere contains always, though with some little difference, the same quantity of pure or fire air [oxygen] viz. $\frac{3}{5}$, which is a very remarkable fact; and to assign the cause of it seems difficult, as a quantity of pure air [oxygen] in supporting fire, daily enters into a new union; and a considerable quantity of it is likewise corrupted or changed into aerial acid (carbon dioxide) as well by plants as by respiration; another fresh proof of the great care of our Creator for all that lives."

Scheele's greatest work, however, is unquestionably his treatise on "Air and Fire," which appeared in 1777 with a preface by Bergman, who, according to Thomson, superintended its publication. This elaborate essay shows Scheele at his best and at his worst; it testifies to his genius as an experimentalist and to his weakness as a theorist. No one can read this, or indeed any other of Scheele's memoirs, without being impressed by his extraordinary insight, which at times amounted almost to divination, and by the way in which he instinctively seizes on what is essential and steers his way among the rocks and shoals of contradictory or conflicting observations. No man was ever more staunchly loyal to the facts of his experiments, however strongly these might tell against an antecedent or congenial hypothesis. Had Scheele possessed that sense of quantitative accuracy which was the special characteristic of his contemporary Cavendish, his work on "Air and Fire" would inevitably have effected the overthrow of phlogistonism long before the advent of Lavoisier. His memoir is essentially an essay on oxygen, of which he was an independent discoverer, in its relations to life and combustion. It is perhaps idle to speculate on the causes which prevented his clear recognition of the full truth. It may have been that he was essentially a *préparateur* like Priestley, and that quantitative chemistry had few attractions for him; it is far more probable that the character of his work was determined by the circumstances of his position, by his poverty, his lack of apparatus, and his want of assistance. As it is, it remains one of the most remarkable circumstances in the history of human knowledge that a man working under such adverse conditions in a small village on the shore of a Scandinavian lake should have been able to change the entire aspect of a science.

It was stated by Crell, the editor of the well-known *Neue Entdeckungen* and *Annalen*, in which many of Scheele's papers first appeared, that the great Swedish

chemist was invited to this country with the offer of an easier and more lucrative position than that which he had at Köping; but that his partiality for Sweden and his love of quiet and retirement delayed his acceptance of the offer until a change in the English ministry put a stop to the negotiations. Thomson, the author of the "History of Chemistry" in mentioning this circumstance, expresses his doubts as to its truth, and states that he made enquiries of Sir Joseph Banks, Cavendish, and Kirwan, but none of them had ever heard of such negotiation. Indeed the circumstance is intrinsically improbable. "I am utterly at a loss," says Thomson, "to conceive what one individual in any of the ministries of George III. was either acquainted with the science of chemistry or at all interested in its progress. . . . What minister in Great Britain ever attempted to cherish the sciences, or to reward those who cultivate them with success? . . . If any such project ever existed, it must have been an idea which struck some man of science that such a proposal to a man of Scheele's eminence would redound to the credit of the country. But that such a project should have been broached by a British ministry, or by any man of great political influence, is an opinion that no person would adopt who has paid any attention to the history of Great Britain since the Revolution to the present time."

T. E. THORPE.

WERNER VON SIEMENS.

ERNST WERNER SIEMENS was the eldest son of Christian Ferdinand Siemens and Eleonore Deichmann; he was born in 1816 at Lenthe in Hanover, where his father was engaged in the business of agriculture and forestry.

From his very childhood the subject of this memoir learnt the lessons of self-control and responsibility, for owing to his mother's delicate health and his father's occupations, the care of his younger brothers and sisters devolved on himself and his sister Mathilde; in these younger days he also learnt tact, and his father taught him that difficulties had to be faced and overcome, and that duties must never be avoided.

In 1823, a few months after the birth of his brother William (whose lamented death occurred here nine years ago), the family removed to Menzendorf near Lübeck, in the Grand Duchy of Mecklenburg. In the Gymnasium of Lübeck Werner was educated up to his eighteenth year, when, by the advice of his father—who with rare prescience saw in Prussia the nucleus of German Unity and Empire—he went to Magdeburg to volunteer for service in the Prussian Army. For three years he studied in the Military School of Berlin, and in 1838 received his commission as a lieutenant in the artillery, and returned to Magdeburg; he was soon transferred to the Technical Division of the Artillery at Spandau, and afterwards to Berlin.

In July, 1839, his mother died, and six months afterwards his father; and then, at only twenty-three years of age, he became the veritable guardian of his younger brothers and sisters.

In 1842 he took out a patent in Prussia for electroplating and gilding, and having established a factory in Berlin for putting his invention into practice, he urged his brother William to devote his attention to the subject. This the younger brother did; and the story of his enterprise and success in this country then and ever since has been told by Dr. William Pole in his most interesting biography of him; to this volume and to the works of Dr. Werner von Siemens, the first volume of a translation of which has recently been published by Mr. Murray, we are indebted for much of the information contained in this short notice.

In 1844 the young artillery officer was appointed to the important post of Superintendent of the Artillery workshops, and in 1847 he became a member of the commission then instituted for introducing the electric telegraph into Prussia. Next year his military duties called him to Kiel, where in conjunction with his brother-in-law, Prof. Himly, he protected that port against the attack of the Danish fleet, by means of submerged mines connected with the shore by cables, at once the precursor of the submarine cable and the torpedo. In the summer of 1848, as commandant of Friederichsort, he built the fortifications for the protection of the harbour of Eckenförde, which afterwards became so celebrated. In the same year he was recalled to Berlin in order to erect a line of telegraph from Berlin to Frankfort-on-the-Maine, the first electric line laid in Germany, and with this his official military career terminated, and he devoted his attention altogether to those scientific discoveries and



inventions which have made the name of Siemens a household word in every region of the globe.

In 1874 Dr. Werner Siemens was elected a member of the Royal Academy of Sciences of Berlin, and the speech he made upon that occasion enables one to understand and appreciate his connexion with physical science. He was professionally connected with the application of science, which unfortunately left him but little leisure for those purely scientific investigations to which he always felt specially attracted. He says, to quote his own words in the speech just referred to, "My problems were generally prescribed by the demands of my profession, because the filling up of scientific voids which I met with presented itself as a technical necessity. I will only here mention cursorily my method of measuring high velocities by means of electric sparks, the discovery of the electrostatic charge of telegraph conductors and its laws, the deduction of methods and formulæ for testing underground and submarine cables, as well as for determining the position of faults occurring in their insulation,

NO. 1207, VOL. 47]

my experimental observations on electrostatic induction, and the retardation of the electric current thereby, the conception and realization of a reproducible basis of measurement for electrical resistance, the proof of the heating of the dielectric of a condenser by sudden discharge, the discovery and explanation of the dynamo electric machine. I think I may claim that many of my technical contributions are not without scientific value, among which I may mention the differential regulator, the manufacture of insulated conductors by pressing gutta-percha around them, telegraphic duplex, induction and automatic recording instruments, the ozone apparatus, and measuring instruments of different kinds. I had the honour of seeing these recognized by receiving from the Berlin University the distinction of Doctor of Philosophy, *honoris causa*."

The reply to this speech was made on behalf of the Berlin Academy by Prof. du Bois Reymond, the Secretary of the Physical and Mathematical Section, and some of the words he then spoke will show how Germany appreciated one of her ablest sons, one whom we also may claim, for when Werner Siemens was born, the King of England was Elector of Hanover. "By appropriating such a scientific form as yours, my dear Siemens, no Academy need be untrue to the laws of its foundation. Yours is the talent of mechanical discovery, which primitive people not improperly described as divine, and the cultivation of which constitutes the ascendancy of modern culture. Without having yourself worked with your hands in practical mechanics, you have reached the highest point in that art as creating and organizing head. With clear view and daring mind you soon grasped the great practical problems of electric telegraphy, and thus secured to Germany an advantage which Gauss, Wilhelm Weber, and Steinheil could not have procured for it. Your labours were for electricity what Fraunhofer's were for light, and you are the James Watt of electro-magnetism. Now you rule over a world which you created. Your telegraph lines surround the globe. Your cable ships navigate the ocean. Under the tents of nomads using bows and arrows, through whose hunting grounds your messages pass, your name is mentioned with superstitious awe."

This poetical description is fully justified by the great undertakings that have been carried out by the Siemens firm. The Indo-European telegraph, 2750 miles in length, passes across Europe, through a part of Russia to Tabreez and Teheran in Persia, and thence to India. But for the international character of the firm this work could probably never have been accomplished. But with Mr. Carl Siemens in St. Petersburg, Dr. Werner in Berlin, and Mr. William in London, to carry out the necessary negotiations, the tender was accepted in June, 1869, and the work was completed in December of the same year. Since then eighteen cables of a total length exceeding 21,000 miles have been constructed at their Woolwich works and laid in the Atlantic by the *Faraday*, by the firm of Messrs. Siemens Brothers and Co., Limited, of which firm Dr. Werner von Siemens was Chairman and Mr. Alexander Siemens is the Director in London.

In a single line of the speech just alluded to Dr. Werner refers to the dynamo machine. On this machine the whole supply of electricity for lighting, transmission of power, and other large purposes is dependent; and it is interesting in this connexion to note that the only rival to the electric light for large effects is the regenerative gas lamp invented by Dr. Werner's youngest brother, Mr. Frederick Siemens, the inventor, with Sir William Siemens, of the regenerative gas furnace.

Dr. von Siemens was a Knight of the Prussian order *pour le mérite*, an honour conferred only on those who have been distinguished for their services to science and industry. The honorary degree conferred upon him by the University of Berlin, and his membership of the

Royal Academy of Sciences of Berlin, have already been referred to. Dr. von Siemens was a member of many learned societies, and only in the spring of this year he was elected one of the sixteen honorary members of the Institution of Civil Engineers. The late Emperor Frederick III. of Germany conferred upon him the patent of nobility in 1888, and the present Emperor has expressed his sympathy with his sorrowing widow and family.

Dr. Siemens was unfortunately one of those attacked during the influenza epidemic, and although he recovered from it, it left him weak, and he has since been ailing more than once. A work on which he has been spending his spare moments was an autobiography, giving reminiscences of himself and of the firm of Siemens and Halske. This was published in Berlin a fortnight ago. On Tuesday, the 6th inst., Dr. Werner breathed his last at half-past six in the evening, just within a week of completing his seventy-sixth year. It may truly be said of him that, although he has passed from us, his life's labours will ever endure, having left an indelible mark on the world's progress.

The funeral took place on Saturday. The London, Belfort, Vienna, and St. Petersburg factories of the firm of which the deceased was a member, sent officials and workmen; the many thousands following the hearse, and the respectful attitude of the bystanders in the streets through which the funeral procession passed testifying to the regard in which he was held. The Emperor William was represented by Prince Leopold, the Empress Frederick by Count Seckendorff, and the German Empire by Chancellor Caprivi. Science and art and industry, the City of Berlin and the town of Charlottenburg were represented by deputies and deputations, all combining to do honour to one esteemed of all. E. F. B.

NOTES.

WE are glad to announce that Sir Archibald Geikie has undertaken to write the Life of Sir Andrew C. Ramsay, his predecessor in the Geological Survey. Sir Andrew Ramsay spent nearly the whole of his scientific career in the service, so that the record of his life and the story of the progress of the Survey are closely bound together. This is the third member of the staff of the Survey whose memoirs Sir Archibald Geikie will have written, the two others being Edward Forbes (whose Life he wrote in conjunction with the late Prof. George Wilson) and Sir Roderick Murchison. Sir Archibald joined the staff under Ramsay, and grew into the closest relations of friendship with him.

WE regret to have to record the death of Mr. H. T. Stainton, F.R.S. He died on December 2 at the age of seventy. He was indefatigable in his study of entomology, to which he made many important contributions. His chief work is "Natural History of the Tineina," in four languages, with many plates. His "Manual of British Butterflies and Moths" is also well known. Mr. Stainton was one of the founders of the *Entomologists' Monthly Magazine*, and remained to the end of his life one of its editors. He was for many years secretary of the Ray Society and of the Zoological Record Association, and one of the secretaries of Section D of the British Association. From 1848 he was a Fellow of the Entomological Society, of which he was at one time president; and from 1859 he was a Fellow of the Linnean Society, of which he was at one time vice-president. He was elected a Fellow of the Royal Society in 1867.

THE Chemical Society held a special meeting on Tuesday, the anniversary of the death of Stas. A paper, prepared for the occasion by Prof. J. W. Mallet, F.R.S., on "Jean Servais Stas, and the measurement of the relative masses of the atoms of the chemical elements," was read and discussed.

NO. 1207, VOL. 47]

THE new Victoria buildings of University College, Liverpool, which include the Jubilee Tower, were formally opened on Tuesday. Lord Spencer, as Chancellor of the Victoria University, took part in the ceremony. At a banquet held in the evening, Mr. Bryce announced that the Queen, out of certain funds belonging to the Duchy of Lancaster, had been pleased to bestow upon the two great Lancashire Colleges a sum of £4000, to be applied in some permanent form, such as might be agreed upon by the authorities of the Colleges, particularly the principals, to commemorate the event of that day, and Her Majesty's interest in the growth of the institution.

ON Monday, at Merchant Taylors' Hall, Dr. William Anderson presented the prizes in connection with the City and Guilds of London Institute for the Advancement of Technical Education. Afterwards, addressing the students, Dr. Anderson called attention to the extraordinary advantages enjoyed by students of the present day in comparison with those within the reach of students of the past generation. In nearly all towns men and women were improving their knowledge in almost every branch of art and science to which their necessities or their inclinations led them. He had come to the conclusion that the aids given nowadays to manufactures and commerce were absolutely indispensable if England was to hold her own, and to overcome the difficulties which high-priced labour, the restrictions of the Legislature, and the interference of trade organizations imposed.

DR. T. JEFFREY PARKER, F.R.S., of Dunedin, Otago, New Zealand, who is now in this country, will read a paper on the cranial osteology, classification, and phylogeny of the Moas (*Dinornithidæ*) at the Zoological Society's meeting on the 14th of February.

THE committee appointed by the Board of Agriculture to inquire into the plague of field voles in Scotland have declined for the present to recommend the adoption of the plan lately carried out in Thessaly by Prof. Loeffler, who claims to have got rid of voles in that district by feeding them with prepared bait containing the germs of mouse typhus. It is thought that Prof. Loeffler may not have attached sufficient weight to other causes which have doubtless operated to reduce the swarms of voles in Thessaly, such as the heavy rains which on the low ground would flood the holes and runs of the mice. The chairman of the committee, Sir Herbert Maxwell, and the secretary, Mr. J. E. Harting, with the sanction of the Board of Agriculture and of the Treasury, are about to proceed to Thessaly for the purpose of taking evidence there and reporting.

A NEW edition of M. Alphonse Bertillon's important book on "Identification Anthropométrique" will be published in January. The book has been entirely recast and considerably enlarged. It is the result of ten years of observation, and has been prepared, not merely for the anthropometric service directed by the author, but for all who desire to have a proper comprehension of man's physical qualities. In addition to the copies intended for the use of the penal administration of the French Ministry of the Interior, a small number of copies will be reserved for persons who may desire to subscribe for them.

ON the evening of Thursday the 8th instant a deep barometric depression advanced upon our north-west coasts, and proceeded with considerable rapidity in a south-easterly direction, completely traversing Great Britain, as far as Dover, and travelling throughout its course at the rate of about 36 miles an hour. Its passage was accompanied by gales and by heavy rain or sleet, with severe snowstorms on the east coast. This disturbance passed away to the eastward, and was followed on Saturday by a fresh depression which appeared in the north-west, causing a strong gale in that district, and heavy squalls in most other parts. The changes of temperature were very