PROF. SIR WILLIAM CROOKES, F.R.S.

BY THE LONDON CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

"Scientific men are very like paviors; they lay down stones for future generations to walk over, and wear out." Such is the prescient explanation of scientific research and pursuit of a new discovery, expressed by Prof. Sir William Crookes, F.R.S., the eminent British chemist. Science, although it possesses a bewitching glamor to its disciple, is yet a lonely occupation. Great ideas and possibilities of the hitherto unknown, dawn upon the mind of the chemist, only to be followed by years of patient investigation, ceaseless experiments, and repeated failures. When an epoch-making discovery bursts upon the world, not an evanescent thought is bestowed upon the years of protracted labor and intricate calculations that such a discovery has entailed. Sir William Crookes can relate many such experiences. When he discovered the new element thallium, he promptly set to work among other numerous experiments to ascertain its atomic weight—203.642. The figures were worked out as far as the first decimal point with comparative ease, but to determine the second decimal figure involved no less than two years of patient labor.

Sir William Crookes is a born scientist. He played with chemistry in his infancy, practised it during his youth—much to the discomfiture of his parents, whose goods and chattels suffered from the effects of his experiments—and has developed it ever since. He is now in his seventy-first year, having been born in 1832. At sixteen years of age he entered the Royal College of Chemistry as a pupil of the famous Dr. Hoffmann, and acquitted himself with such distinction that two years later he was appointed Hoffmann's assistant. In 1854 he obtained the much-coveted post of Superintendent of the Royal Meteorological Department of the Radcliffe College of Oxford, which post he subsequently relinquished in order to devote his entire energies to the pursuit of chemistry.

Although his work has been rigorously scientific, Sir William Crookes is gifted with a poetic imagination that has often enabled him to set forth tellingly in his papers the results he has attained. Once he has embarked upon a project, he knows no turning back. "To stop short in any research that bids fair to widen the gates of knowledge, to recoil from fear of difficulty or adverse criticism is," he considers, "to bring reproach upon science." He goes straight on, feeling his way with the utmost caution, exploring up and down, right and left, inch by inch, following his reason wheresoever it may lead him, even although occasionally it may prove a veritable will o' the wisp. It was this dogged perseverance which resulted in his discovery of thallium and its remarkable properties. The experiments with this new element were continued for a period of about eleven years, from 1862 to 1873, and throughout the whole of this time the study of the occurrence, distribution, and reaction of this substance was his paramount work.

Prof. Crookes's discovery of thallium, like Dr. Roentgen's discovery of the X-rays, was to a very great extent the result of an accident. He was engaged in the examination, by the spectroscope, of the residue which results from the manufacture of sulphuric acid, when his attention was attracted by a bright emerald-green line which asserted itself. This line had never been noticed before, and he consequently followed up its appearance, with the result that he succeeded in isolating a new metal which he called thallium. The first piece of this new element was placed on view at the Great Exhibition in London of 1861, and commanded universal attention. During the next eight years he carried out minute investigations of the many properties of this substance. It was in the course of his experiments to determine its atomic weight, during which, in order to obtain accuracy, he weighed it in a vacuum, that he discovered that even under these conditions the balance behaved in a most irregular manner. The metal appeared to be heavier when cold than when in a heated condition, and this phenomenon he explained as an "expulsion from radiation." He showed that in a vessel from which the air has been extracted, a body has a tendency to repel itself from another body which has a greater heat than itself. It was this observation of the anomalous behavior of thallium that led to his invention of the radiometer, which by the way he regarded as an apparatus for the direct transformation of light into heat, but which was subsequently perceived to be dependent upon thermal action.

He next devoted his attention to the discharges of electricity through highly rarefied gases, and to the development of the theory he had formed in the course of his previous experiments with thallium, of the existence of a "fourth state of matter."

The name of Crookes will forever be associated with his remarkable discoveries in connection with radiant matter and his evolution of the Genesis of Elements. The results of his researches in highly rarefied tubes caused him to assume the existence of matter in ultra-gaseous form, to which he applied the term of radiant matter. He explained the novel phenomena of phosphorescence, trajectory shadows, mechanical action, magnetization, and intense heat, possessed by matter in ultra-gaseous state. It was a remarkable discovery that stormed the scientific world, for it was of enormous range, as the discoverer conclusively proved by demonstrating that while some radiant matter was as stable as a chair, other forms were of the character of radiant energy. It was the fringe where matter and force appeared to merge into each other.

At first Prof. Crookes's thesis was regarded with skepticism by the scientific world, until the elaborate and numerous experiments of the discoverer proved unassailably convincing in the natural progress of events. But the times have changed, and we have changed with them since Crookes's discovery was first announced. What he originally termed radiant matter has developed into electrons—the separate units of electricity, which is as atomic as matter. Dr. Johnstone Stoney by his discovery of electrons not only established Prof. Crookes's earlier discovery, but successfully elucidated many problems which had previously defied solution, for a chemical ion consists of a material nucleus or atom of matter, which constitutes the greater part of the mass, and a few electrons or atoms of electricity. He demonstrated that all liberated electrons do not pass off in the form of gas, but act more in the form of a mist, are mobile, and are carried to and fro in currents of air, finally settling on the walls of the settling vessel if left undisturbed.

The mass of an electron, according to J. J. Thomson, is calculated at 1/700 part of a hydrogen atom, and as these masses start from the negative pole in a vacuum tube with a velocity of about one-half of that of light, naturally their heating, phosphorescent, and mechanical power is tremendous.

The course of time has proved that Prof. Crookes's thesis of 1879 was no wild chimera of the laboratory, but an indisputable fact which opened up a fresh untrodden field in scientific investigation. The existence of matter in an ultra-gaseous state, the existence of material particles smaller than atoms, the existence of electrons, the emanations from uranium, and the dissociation of the elements have now all been proved to be one homogeneous theory, by the remarkable discovery of radium and the experiments with this new element by M. and Mme. Curie, so that what was twenty-five years ago regarded as Prof. Crookes's dream, has at last been realized.

With regard to Prof. Crookes's researches concerning the Genesis of Elements, it is difficult to estimate adequately the value of his investigations in this direction to science. It was in 1883 that he commenced operations in his work which was attended with such momentous success. It was a laborious task, this inquiry of the nature and construction of the rarer earths, but by dint of repeated chemical fractionations he succeeded in dividing yttrium into distinct portions, which yielded different spectra when exposed in a high vacuum to the spark from an induction coil. At first these phenomena were regarded as due to the removal of impurities in the metal, but Prof. Crookes conclusively established his claim that they were the result of the actual splitting up of the molecule of yttrium into its fundamental constituents, and he provisionally concluded that the so-called simple bodies are in reality compound molecules. This discovery led him to advance the supposition that all the elements are derived by a process of evolution from the primordial matter or "protyle" as he called it.

In his presidential address to the British Association in 1898 he announced the discovery of yet another member of the rarer earths—monium or victorium. The spectroscopic examination of this showed the spectrum crossed by an isolated group of lines high up in the ultra-violet end, and the existence of which could be detected only upon the photographic sensitive negative.

The investigations of this eminent scientist have not been confined to a selected few of the many fields of chemical research, but to all its ramifications, with the result that he has bestowed incalculable benefits upon various manufactures. He discovered the sodium amalgamation process of separating gold and silver from their respective ores; he carried out numerous experiments with M. Moissan's method of the manufacture of diamonds, by which our very limited knowledge of the nature of this substance has been considerably extended; he is deeply interested in dyeing and calico printing, the manufacture of beet sugar, and the derivatives of anthracene, while he is one of the greatest authorities on sewage and artificial fertilizers. In 1871 he accompanied the scientific expedition to Oran; and in 1866, when the cattle plague caused such widespread alarm in Great Britain, he was appointed by the English government to report upon the application of disinfectants for arresting the scourge. Perhaps his most famous invention familiar to the lay mind is the Crookes tube, by means of which Prof. Roentgen was able to make his famous discovery of the phenomena of the X-rays.

Owing to his immense knowledge, he is naturally associated with the leading learned and scientific societies of Great Britain, the presidential chair of many of which he has occupied at one time or another. He has also made many valuable contributions to scientific literature. His best-known publications comprise: "Select Methods in Chemical Analysis;" "Manufacture of Beet-root Sugar in England;" "Handbook of Dyeing and Calico Printing;" "Dyeing and Tissue Printing;" "The Profitable Disposal of Sewage;" and "The Wheat Problem." In 1859 he founded the Chemical News, and in 1864 he became editor of the Quarterly Journal of Science.

He has received many distinguished awards in recognition of his many valuable contributions to science. In 1880 he received from the French Académie des Sciences their gold medal and a purse of 3,000 francs; in 1885 the Davy medal of the Royal Society of Great Britain was bestowed upon him. He is a Royal medallist, and his crowning recognition came in 1897, when he was knighted for his achievements by the late Queen Victoria.

Prof. Crookes is also deeply interested in psychical research and its attendant phenomena, by which he is endeavoring to effect some conjunction between psychical and physical waves. Marconi has forcibly demonstrated the presence and possibilities of ether waves, and this eminent chemist is attempting to establish the existence of brain waves. We hear a good deal about telepathy, by which one person can receive intelligence from another human being without speech. But what is a brain wave, or in more explicit words, what is thought? Prof. Crookes maintains that there are rays of perhaps 9,223,052,036,854,775,808 pulsations per second, which are capable of penetrating the most dense mediums without suffering any diminution of intensity, and capable of passing through unrefracted and unreflected light, finding a center in the brain in much the same manner in which sound vibrations are received.

In the course of his presidential address to the British Association in 1898, Prof. Crookes raised the alarming theory that in the near future the world would be faced with starvation, owing to the wheat supply being insufficient to meet the exigencies of the population. He drew attention to the small harvest of wheat at present received per acre of ground and the limited area of wheat-growing soil. The present receipt per acre is 12.7 bushels, and he pointed out that it might be increased by means of a moderate dressing of chemical manure. "Starvation may be averted through the laboratory," he explained, and his solution of the difficulty was to draw upon the inexhaustible quantities of nitrogen present in the atmosphere, and render it practicable to utilize it for fertilization. The artificial production of nitrate is within view, and by its assistance it will be possible to obtain as much as thirty bushels of wheat per acre.

The charm of Prof. Crookes's character is his honest, frank, and simple manner. He believes in the truth, and is kindly and courteous to all those who approach him. His laboratory is his haven, and therein he passes the greater part of his time among his retorts, spectrographs, test-tubes, and numerous other scientific appliances, and what he regards as much more important, his extensive library of works upon every conceivable branch of science.

An Exposition of Child Life.

A curious international exposition is to be held next fall in the Imperial Palace of St. Petersburg. The undertaking is called "The Child's World." According to the Russian Consul-General at New York, there will be a complete picture of child life from birth to school days—nourishment, dress, instruction, physical and moral education, and in fact all the surroundings of the early years of life.

The exhibits have been divided into five sections, as follows: Section 1 on scientific teaching will show the aids in teaching children by means of manuals, books, maps, and pictures. It will also show exhibits of the establishments for child education in all parts of the world.

Section 2 will be devoted to that which pertains to the physical development of children. In this section will be considered the care of the new-born, hygiene before school age and of school children, nourishment, children's playgrounds, and the like.

The third section is the industrial one, where there will be exhibits in nursery surroundings, furniture, lighting, heating, ventilation, beds and bedding, and children's clothing. In this section will be shown also the toys and games of children all over the world.

Section 4 will be the art section, in which child life in pictures, by artists of all schools, will be shown in oil, water colors, pencil drawings, and all methods of reproductive art.

Section 5 is the historic-ethnographical section, where there will be illustrations of historical events from the lives of child heroes, discoveries and inventions made by children, works and compositions by young artists and composers, and ethnological peculiarities in the lives of children of different nations.

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William Crookes.

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