OGDEN NICHOLAS ROOD.

OGDEN NICHOLAS ROOD, Professor of Physics in Columbia University, New York, died at his residence in New York, on Wednesday, November 12, of pneumonia, after an illness of but a few days. He was at the head of the Department of Physics, and the senior officer in the faculties of the university.

Professor Rood was born in Danbury, Connecticut, Feb. 3, 1831, and was the son of Rev. Anson Rood, a Congregational clergyman, and Aleida Gouverneur (Ogden) Rood. He entered Yale College in 1848 as a member of the Class of 1852, but did not remain longer than one year, subsequently entering Princeton College, where he graduated in 1852. The autumn of this year he spent in New Haven, pursuing scientific courses of study as a graduate student, in the Department of Philosophy and the Arts, of Yale. Although his name appears upon the college catalogue as a member of this department for the two college years 1852–3 and 1853–4, he spent but a portion of this time in New Haven. During several months in the early part of 1853 he was at the University of Virginia, acting as assistant to Professor J. Lawrence Smith. Later in the same year he was for some months in New York, as the assistant of Professor B. Silliman, Jr., who was in charge of the Chemical, Mineralogical and Geological Department of the Crystal Palace, in that city. His scientific tastes had already declared themselves at this time, and his earliest contributions to this Journal were two papers, which he had read before the Berzelius Society of Yale, and which, even thus early, foreshadowed the direction his later studies would take. The first was "On the *Paramecium aurelia*," and gave an account of the microscopic study of the organism. The second was "On a method of exhibiting the Phenomena of Diffraction with the Compound Microscope." Both were published in 1853.

The four years, from 1854 to 1858, were spent in Europe at the universities of Munich and Berlin, in the further prosecution of his scientific studies. On his return to this country, in 1858, he accepted the position of Professor of Chemistry and Physics in Troy University, which he occupied until 1863, when he resigned. The institution had been suffering from lack of resources, and finally ceased to exist. Not long after this he was elected Professor of Physics in Columbia College, entering upon his duties early in 1864. This position he continued to hold during the remainder of his life.

Professor Rood was a born investigator, full of enthusiasm for scientific studies, with an uncommonly clear perception of

the principles involved in physical phenomena, and a keen intuition of the experimental conditions and methods leading to discovery. He was especially apt in the use of simple means for the study of the problems which interested him, often reaching results of great importance and novelty by the skillful combination of pieces of the most ordinary materials, such as are found in the physical laboratory. While apparently caring little for the exhibition of mechanical expertness, or for the attainment of mere elegance of design or finish, he possessed constructive faculties of a high order, in the adaptation of an apparatus for the purpose he had in view. Many of his most striking researches were conducted with scarcely any use of the standard instruments of the laboratory, his experiments being carried out with means improvised for the occasion, and gradually developed to greater and greater elaboration, as new suggestions came to him in the course of the work. In many cases this resulted in notable improvements of familiar apparatus, and the production of instruments of unexampled sensibility, and the attainment of a degree of precision far beyond anything hitherto reached. Excellent examples of this are seen in his improvement of the horizontal pendulum, by which he was enabled to detect and measure changes of dimension in solid bodies as small as the ten millionth part of an inch; in his modification of the Sprengel pump, by which he was able to carry the exhaustion to degrees almost unlimited, and to measure tensions as low as the four hundred millionth of an atmosphere; and finally, in the last research of his life, in which, by the use of an electroscope of the most elementary simplicity, he succeeded in measuring resistances of hundreds of thousands of megohms, and detecting peculiarities of insulating bodies hitherto unknown.

After entering upon his scientific career Professor Rood displayed great activity, and was a frequent contributor to this journal, where most of his papers were published. The number of titles of his communications is about seventy, not counting various minor contributions and notices. Though many of them are quite brief, they would be sufficient, in the aggregate, to form a volume of several hundred pages. The number and variety of these papers forbids anything like a full enumeration here, but some of the more characteristic may be briefly mentioned. While at Troy University he devised certain adaptations of the compound microscope for measuring the angles of crystals, and indices of refraction; studied the stauroscope of Von Kobell, and made new applications of it; observed the singular contraction of the muscles caused by contact with rapidly vibrating bodies, resulting in

a kind of temporary cramp similar to that produced by electric shocks; made many experiments upon the best forms for elongated projectiles, and demonstrated the superiority of American rifled firearms, and American marksmanship; devised a method of producing stereographic pictures by hand; discussed Dove's theory of luster, and devised many new experiments for producing it; studied the practical application of photography to the microscope, and showed how it might be used to determine the character of the minute markings upon diatoms.

The years from 1864 to 1869, after his settlement at Columbia College, were comparatively uneventful so far as publication was concerned, doubtless owing to the great demands of his new position. But, shortly after, a series of valuable researches was begun, and, throughout the rest of his life, contributions appeared in rapid succession. During this period he investigated the nature and duration of the discharge of a Leyden jar connected with an induction coil, and determined with an accuracy hitherto unattained the duration of the bright spark from a jar of small capacity. This work was resumed later, and he showed that the bright spark lasted for a period not longer than forty billionths of a second. He also, in connection with this research, studied the question of the amount of time of illumination necessary to vision, finding that a duration of four billionths of a second was sufficient for distinct vision. The experience gained in these experiments led him to study the character of lightning, using for the purpose a rotating card-board disk, which in his hands proved an efficient instrument of measurement in many applications. He thus, for the first time, determined the duration of the flashes, finding an average value of the five hundredth part of a second, but subject to great variations. He also showed the multiple character of the flashes, and that they often terminated in a single isolated discharge of so short duration as to be, in comparison with the others, practically instantaneous. In this period also were carried out the experiments with the horizontal pendulum, and the Sprengel pump, already referred to, and later the work upon the measurement of high resistances.

He had at intervals been much interested in the study of color, and made many experiments in the measurement of the intensities of colored lights. His first efforts in this direction were made by the help of the rotating disk, in a comparison of the gray from the black and white sectors of variable proportion, so adjusted as to have the same apparent brightness as the object studied. His skill in experimenting enabled him to make consistent observations, and he obtained valuable quantitative results. This subject was a favorite one with him,

and he recurred to it again and again. He was ultimately fortunate in discovering, in 1893, a novel and original photometric method which is independent of color, and which depends upon the shock which the retina receives when one illuminated surface is quickly withdrawn and replaced by another of different brightness. The flickering effect thus produced disappears when the two lights are of equal intensity. This idea he further elaborated later, and in 1899, he published in this Journal an article upon the Flicker Photometer, with a more complete description, and showed by elaborate tests and verifications that the accuracy attainable with this instrument, in comparing differently colored lights, is about the same as for white, or like colors, in the ordinary photometer. He applied it also with great effect in the study of color-blindness, and brought out, with striking emphasis, the interesting fact that eyes supposed to be normal differ greatly in their perception of colors, and that it is rare to find two persons who agree in their color vision.

Another subject which received much attention from him was the study of the character of various complex colors, especially those of the different pigments, and he devised a system by which it was possible to express the composition of such colors by the proportion of certain standard colors in their make up, thus for the first time introducing definite quantitative methods in the study of color and color-contrasts.

The results of Professor Rood's studies of color for many years especially fitted him to write a treatise upon the subject, and in 1879 he published a volume entitled "Modern Chromatics, with Applications to Art and Industry" (New York, D. Appleton & Co.), it being one of the volumes of the International Scientific Series. To the title, in a later issue, were added the words, "Student's Text-Book of Color." This addition suggests the purpose and scope of the work, which was intended for the inexperienced student interested in the practical uses of color, as well as for those familiar with the principles of optical science. It is a happy example of clear and simple exposition, that is at the same time of a strictly scientific character. The book is full of interesting suggestions, and the results were carefully verified by innumerable novel and ingenious experiments which were original. It forms an indispensable hand-book for the artist, as well as for those interested in the practical applications of color.

It may be added that Professor Rood's work upon this book was greatly facilitated by his own experience as an artist. As early as his residence in Munich he had practiced painting in oil, and attained a high degree of proficiency. He had great skill in drawing, and became expert in painting in water-colors,

some of his pictures having been shown at the exhibitions of the Academy of Design in New York.

In 1865 Professor Rood was elected to membership in the National Academy of Sciences, which was founded two years before. He was therefore one of the senior members of the Academy, at whose meetings he often presented papers of great interest. He was a Fellow, and, in 1869, Vice-President, of the American Association for the Advancement of Science. He was also a member of the American Philosophical Society, and of various other associations, scientific and social.

At the Bicentennial Celebration of Yale University in October, 1901, the degree of Doctor of Laws was conferred upon Professor Rood "as a pioneer of American Science," an honor seemingly somewhat tardily bestowed. But it is understood that his aversion for public ceremonials and display, and possibly slight valuation of academic distinctions, had led him previously to decline similar honors on more than one occasion.

In his personal qualities Professor Rood was a man of strongly marked individuality. In figure and manner there was much of native distinction, while his countenance, often grave, even sombre, and piercing eye, conveyed the impression of great intellectual force and keenness. He had an unusual power of piquant and interesting conversation, which was displayed most agreeably in the company of congenial friends. His grave demeanor was often a mask for a vein of humor which was one of his strong characteristics, and which, if often mischievous, and sometimes rather grim, was not often misapprehended by those who knew him well. His detestation of shams and commercialism in science was intense, and his expression of it both frank and forcible. While apparently not greatly caring for general social activities, and in his devotion to his scientific occupations having somewhat the way of a recluse, he was most hospitable and cordial to his scientific friends, and did many acts of spontaneous and unexpected kindness, which revealed the warmth of feeling hidden beneath his reserve. To his younger colleagues especially he showed great friendliness, and his generous estimation of their work, and cordial appreciation, were most encouraging and helpful. To all such his departure leaves a permanent sense of loss, as it must to the university he served so long and honorably.

Professor Rood was married, in 1858, to Miss Matilde Prunner, of Munich, who survives him, with three daughters and two sons.

ARTHUR W. WRIGHT.