known. I have myself seen a supposedly "secret" process which had been in print for many years and was doubtless known to all competitors. Temporary secrecy, pending applications for patents, is of course not objectionable, but permanent secrecy is wrong. The man who uses science in developing his industry owes something to science in return. In the long run, moreover, publicity regarding scientific investigations is profitable. With a liberal policy, each manufacturer would give out his own small contributions to science, and receive the results obtained by all others in return. The practise of secrecy, to use the common phrase, is penny wise and pound foolish.

I plead, therefore, not only for cooperation in pure research, but also for greater cooperation, for more reciprocity between investigation and industry. The application of science to human welfare is glorious; its selfish uses are at least not praiseworthy. The devotee of pure science and the technologist should seek to understand each other, and to realize that the conduct of research involves mutual responsibilities. We may not attain to our ideals, but we can surely move towards them.

To-day the thoughts of the civilized world are turned towards war, and all men are longing for the peace which must come, sooner or later. As one of our earliest poets has said:

> War ends in peace, and morning light
> Mounts upon midnight's wing.

That is true of material warfare, but we are engaged in a conflict which, fortunately, can never end. It is the war of intelligence against the inertia of ignorance, and it keeps intelligence alive. Ignorance will always exist; the unknown will always be vaster than our knowledge, but we may hope for many future victories, and fear no ruinous defeats. So long as science lives it must move forward, driven by a splendid discontent with our deficiencies. May we never be satisfied, and forever advance, safe in the conviction that every conquest of ours over ignorance means the greater welfare of mankind.

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THEODOR BOVERI[1]

WITHIN a single year after Weismann's death our science has suffered another severe blow in the loss of Theodor Boveri, who died in Wuerzburg on October 15 at the age of fifty-three years. Pioneer and leader in the fields of cytology and experimental zoology, his loss will be felt keenly in this country where he had so many friends and pupils and where his field of research has been so popular during the past two decades. Boveri's personal life was very simple, always devoted to his work, his family and the pleasure coming from a deep love for art and nature. A native of Bavaria, he studied first philosophy and later zoology in Munich. His doctor's thesis on the structure of the nerve fibers in vertebrates treated a subject to which he did not later return. For, encouraged by his teacher, Richard Hertwig, soon after receiving his degree he entered the field of cytological research. Here, following the example of his teacher, he combined practically from the beginning the morphological and experimental methods.

His very first work in this line proved to be a great success, securing to him the *venia legendi* as privat dozent in the University of Munich. A few years later, when only thirty years of age, he was called to Wuerzburg, to succeed Semper in the chair of zoology and comparative anatomy. Here he remained during the rest of his life with the exception of frequent trips to the zoological stations of southern Europe, especially Naples, where he was a regular guest. He also made a short visit to the United States. His reputation as

[1] Paper read before the Biological Club, Yale University, December 3, 1915. I am greatly indebted to Professor Wesley R. Coe for kindly revising the manuscript.

an investigator soon attracted scores of students to the quiet laboratory in Wuerzburg, many of them coming from this country. One of the first, Miss O'Grady, of Vassar College, became his faithful wife, the mother of his daughter and an efficient assistant in all his later scientific work.

It is hardly necessary to add that with his growing fame came numerous honors conferred on him by his university, where he held the highest office as rector magnificus in 1909, by his government and by learned societies. Among the learned societies which conferred on him their membership is the American National Academy of Sciences.

When Weismann resigned his professorship in Freiburg Boveri was called to succeed him, but declined. Later the directorship of the new research laboratory of the Kaiser-Wilhelm-Gesellschaft in Berlin was offered to him. He first accepted, worked out the whole organization and brought together the staff; but suddenly he declined again. Possibly he already felt that his health was no longer vigorous enough for such a change. When I saw him for the last time, two years ago, in Naples, he gave me the impression of a strong and healthy man, but within a short time a disease of the gall-bladder forced him to interrupt his teaching for a year. An operation performed in the first days of October could not save his life.

When Boveri entered the field of biological research in the middle of the eighties the science of cytology was just outgrowing its childhood. Only ten years previously the fundaments had been laid. After certain incidental observations, especially by A. Schneider and Auerbach, Otto Buetschli collected his results on the division of the cell, the maturation and fertilization of the egg and the conjugation of Infusoria in his classic work of 1876. From that time dates the knowledge of the karyokinetic division of the cell with all its consequences. At about the same time appeared O. Hertwig's classic work on the fertilization of the sea-urchin egg, making it clear for the first time that fertilization is the union of egg- and sperm-nucleus. Then followed one fundamental discovery after another. Strasburger soon applied the new facts to the cells of plants. Flemming (1882) worked out the details of the mitotic figure, introduced the term "chromatin" and discovered the longitudinal splitting of the chromosomes. Roux (1883) realized the theoretical importance of the new discoveries and pointed out the meaning of the mitotic division of the cell, anticipating practically all of the views of to-day. In 1884 Heuser for plants and Van Beneden for animals were able to prove that the separated halves of the chromosomes are distributed to the daughter cells. (The word chromosome was first introduced in 1888 by Waldeyer.) At the same time Naegeli (1884) developed his ingenious theory of the idioplasm, and soon Strasburger, Koelliker, O. Hertwig, Weismann pointed to the chromosomes as the seat of the material basis of heredity. Only one important step was still lacking, the full understanding of the process of fertilization. Mark (1881) came very near to making this discovery, but it was Van Beneden (1884) who proved that in fertilization the same number of paternal and maternal chromosomes are handed over to the cleavage cells. These discoveries were made on the eggs of *Ascaris*, studied previously by A. Schneider and Nusbaum, and which have since become one of the classic objects of cytology. One after the other followed in those days the discoveries, which elucidated the whole process; the meaning of the polar bodies (Buetschli, O. Hertwig, Giard, Mark); the parallelism between ovogenesis and spermatogenesis (Van Beneden et Julin); the theory of the reduction division (Weismann); the behavior of the polar bodies in parthenogenesis (Blochmann, Weismann and Tshikawa); the continuity of the germ-plasm (Nusbaum, Weismann); the individuality of the chromosomes (Rabl); and finally, in 1887, the foundation of experimental cytology by O. and R. Hertwig. This was the year when Boveri's first "Zellstudien" appeared.

Under the influence of Van Beneden's classic book, Boveri began by studying the sex cells of *Ascaris*. In his Zellstudien, I., 1887, he takes up the subject of the formation of the polar bodies. In harmony with Buetschli's discovery Schneider and Nusbaum had described the formation of the polar bodies in *Ascaris* as a regular mitosis, whereas Van Beneden and Carnoy insisted that it was a different process. Boveri proved that the former view is correct and was able to explain many discrepancies of these authors by discovering that there are two different varieties of *Ascaris* in regard to their number of chromosomes, called to-day univalens and bivalens. It is of interest to note that he expresses here the view that the recently discovered formation of a single polar body in parthenogenetic eggs may be explained by the assumption of a fertilization of the egg nucleus through the second polar nucleus. In 1888 appeared Boveri's Zellstudien II., dealing with the fertilization and division of the *Ascaris* egg. Here we find—besides many morphological details—his formulation of the theory of the individuality of the chromosomes, founded, as he freely recognized, by Rabl, and since one of the fundamental principles of cytological research. And he furnished important proofs by comparing the prophases of the division with the last telophases, and further by showing, that in cases of abnormal distribution of the chromosomes as many of them came out of the resting nucleus as had entered it. He was further especially interested in the mechanics of cell-division. He attributed a great importance to the special plasm surrounding the centrosome, the archoplasm (a theory abandoned later by him), and pointed to the importance of the continuity of the central bodies called by him centrosomes, already discovered by Van Beneden. And here we find developed also his idea, that the main importance of fertilization is the introduction of a centrosome into the egg. Starting from some abnormal cases, where a division of the cell is possible without a nucleus, he reached the conclusion that the centrosome is the dividing-organ of the cell. It is of importance to note that he emphasized even in this early paper (pp. 10–11) the necessity of experimental analysis of the phenomena of fertilization and heredity, recently inaugurated by the brothers O. and R. Hertwig.

To all these problems studied in *Ascaris* he furnishes a supplement in Zellstudien III., 1890, by applying the same studies on many marine invertebrates during a sojourn at Naples. For each of the objects investigated he could prove Van Beneden's law concerning the chromosomes in fertilization to be correct. Further he shows that in all these animals the reduced number of chromosomes is found even at the beginning of the maturation divisions in both sexes. The real reduction, therefore, must occur as early as in the oogonia and spermatogonia. It may be added here that during these years the complete parallelism of the cycle of male and female sex cells was definitely proven by the work of Van Beneden et Julin, Boveri, Platner and O. Hertwig, and that at the same time the problem of the reduction division was solved through Henking's idea of a conjugation of the chromosomes (the term introduced by Boveri), proved to be true by Rueckert (1891). As the final word of all his studies during these years may be regarded his article "Befruchtung" in Merkel und Bonnet's Jahresbericht, 1891, where he reviews the whole field in his keen and masterly way. It is of special importance that here were published the first figures of the process of diminution of the chromosomes, some years previously discovered by him in the cleavage cells of *Ascaris* and fully understood in its importance for the doctrine of the Keimplasma.

It has been stated already how keenly Boveri felt the necessity of applying experimental methods to the study of cytology. His first papers in this direction were published in 1888 and 1889. The latter especially gave a great impetus to our science, his famous report, "Ueber einen geschlechtlich erzeugten Organismus ohne muetterliche Eigenschaften."

The brothers Hertwig had succeeded in rearing fragmented eggs of Echinoderms up to the gastrula stage and had been able to fertilize enucleated fragments of sea-urchin eggs. Boveri conceived the very ingenious idea of using this method, to determine whether or not the hereditary qualities are transmitted in the nucleus. He therefore fertilized enucleated egg-fragments of *Sphærechinus* with the sperm of *Echinus* and raised the resulting larvæ to the pluteus stage. He believed he was able to prove that these larvæ exhibited only paternal characters. It is well known that the validity of this conclusion was attacked by Morgan and by Seeliger. It was not until 1896 that Boveri published, in *Roux's Archiv,* the full account of this work and answered the objections of his critics. To-day we know from the work of many observers that the question is not a simple one. But in this paper we find incidentally another discovery, taken up by Boveri much later; namely, the dependence of the size of the larval nuclei upon the number of their chromosomes.

It is well known that during this first decade of Boveri's work our science was revolutionized. In the years 1884–88, Wilhelm Roux had laid the foundations of the science of Entwicklungsmechanik and the brothers Hertwig had started their experimental work in cytology and hybridization. Soon Driesch (1891) imbued the new science with his philosophical spirit, while J. Loeb (1891) attacked similar problems from a physiological point of view. Soon Morgan, Wilson and Herbst joined these pioneers and this line of work henceforth made itself felt also in all of Boveri's.

After some smaller papers, dealing with experiments relating to the theory of mitosis, he published in 1899 a full account of the facts relating to the diminution of the chromosomes, long since discovered by him.[2] To make all the facts clear he had to give a full account of the cell-lineage of this worm, a line of work of the greatest importance since the discoveries of Wilson and Conklin in the early nineties (although the foundations of this line of work date back to the investigations of Rabl, Van Beneden and Whitman, as is well known). The facts were in harmony with the results of Zur Strassen, which had in the meanwhile been published.

[2] "Die Entwicklung von *Ascaris megalocephala* mit besonderer Ruecksicht auf die Kernverhaeltnisse," Festschr. f. C. von Kupffer, 1899.

The year 1900 brought the fourth part of the Zellstudien, with the subtitle "Ueber die Natur der Centrosomen." The thirteen years which had passed since the publication of the first fascicle had seen an immense accumulation of morphological and physiological facts regarding the various parts of the cell, especially the chromosomes and the centrosomes. The importance of these latter for the mechanism of cell-division was already recognized by Buetschli as early as 1876, in spite of the fact that he did not realize them as distinct bodies. Flemming made this discovery, the significance of which was realized, however, only when Van Beneden and Boveri had discovered the life cycle of these bodies and recognized them as permanent organs of the cell, and after Boveri had pointed to their important bearing on the theory of fertilization. Since that time a vast accumulation of knowledge concerning the centrosomes had been acquired through the work of Brauer, Coe, Griffin, Haecker, Heidenhain, Kostanecky, Lillie, MacFarland, Mead, Meves, Van der Stricht, Vejdovsky, Wilson and others. Boveri now deals with all the questions which had been raised, adding a series of new facts about the life cycle of the centrosomes in different objects. He discusses the question of the nuclear origin of the centrosome in the male sex cells of *Ascaris,* discovered by Brauer and confirmed by Boveri's pupil Fuerst. Then came the question of the persistency of the centrosome in non-dividing cells according to Heidenhain, and the centrosome theory of the basal bodies of ciliary cells as developed by Henneguy and Lenhossek. Great importance was attributed to the question regarding the phylogeny of the centrosomes, discussed at this time in connection with the discoveries in Protozoa by Buetschli, R. Hertwig, Blochmann, Schaudinn and Calkins. Further he deals with the rôle of the centrosome in the mechanism of cell-division, which had been discussed broadly from a physical standpoint during these years by Buetschli, Heidenhain, Rabl, Ziegler and Rhumbler, and defends his old earlier viewpoint. Then he refuses Fischer's destructive criticism of the methods of microscopical research; and finally tries to bring his views into accord with Morgan's discovery of the artificial astrospheres and Loeb's artificial parthenogenesis. Much space is devoted to the question concerning the relation of centrosome and centriole, a subject which is no longer considered of great importance. In connection with this paper may be mentioned his address before the Versammlung Deutscher Naturforscher und Aerzte 1901, "Das Problem der Befruchtung," where he again puts forward his centrosome theory of fertilization and endeavors to reconcile it with Wilson's new work upon the cytology of artificial parthenogenesis.

In 1903 Boveri published a preliminary report of his work upon multipolar mitosis, which investigation is, in the writer's opinion, the acme of his cytological work. Fol and O. Hertwig had discovered the simultaneous division of dispermic sea-urchin eggs into four cells. Driesch had separated these four blastomeres and raised stereoblastulæ from them. Boveri now uses this method for attempting to analyze the different qualities of the chromosomes in one cell. He demonstrated that the four cells derived from a tetraster-division may get every possible combination of the 3×18 available chromosomes; and that the distribution of normality or deficiency in the plutei raised from the isolated cells corresponds exactly to the probable content of the cells in regard to a complete or incomplete set of the qualitatively different chromosomes. These facts are to-day so well known to every biologist that they do not need to be exposed further. But it might be said that the full account of the work published in 1908 as Zellstudien VI., shows Boveri's analytical genius from its very best side; the reading of this work is a highly intellectual and esthetical pleasure. There may be incidentally mentioned here a short paper on the influence of the sperm on the larval characters of Echinids.[3] This paper based on hybridization experiments proves, contrary to the views of Driesch, that all larval characters are influenced by the sperm cell.

[3] Roux's Archiv, 16, 1903.

The same year Boveri reviews before the German Zoological Society the knowledge "Ueber die Constitution der chromatischen Kernsubstanz," a lecture that made a great impression on his hearers through his usual crystalline clearness and keen analysis. It is remarkable because he accepts here unreservedly the recently published hypothesis of McClung regarding the accessory chromosomes as sex-determiners; further, Suttons's analysis of the relation between the distribution of the chromosomes and Mendelian characters, a hypothesis which Boveri had conceived independently, but had not previously published, besides a brief remark pointing to his occupation with the subject. In this connection it might be said that it is characteristic of Boveri's work that important discoveries are mentioned in his papers occasionally, but not communicated *in extenso,* because he intended to work them out more fully later. So he always returns to his former observations after a great many years. Meanwhile there may have been done much work in the same line and ideas proposed from other sides, that he had himself in mind. And this often caused discussions about priority. So Boveri returned in 1905, in Zellstudien V., to his old discovery of 1889 that the size of nuclei in normal and merogonic larvæ of Echinids corresponds to the number of chromosomes they contain. The question of size relations between nucleus and cytoplasm had meanwhile become very important through the work of Gerassimoff (1902) and especially R. Hertwig (1903), who tried to base an analysis of many phenomena of cell-life on the assumption of a nuclear-plasmic relation. Boveri now had the ingenious idea of studying the relation between the number of chromosomes and nuclear and cell size by comparing the cells of Echinid larvæ experimentally produced with different chromosome numbers. There he had larvæ, called hemikaryotic, with the haploid number of chromosomes, obtained by artificial parthenogenesis (thelykaryotic) or by merogony (arrhenokaryotic); further, the normally fertilized, diploid or amphikaryotic larvæ, with the normal number of chromosomes, *i. e.,* twice as many as the foregoing, then diplokaryotic larvæ, again with twice as many chromosomes as the last, produced by artificial suppression of the first cleavage figure. Now by comparing these larvæ he found that the surface of the nuclei is proportional to the number of chromosomes contained in them; that the size of the cell is again proportional to both; and that the number of the cells in the same stage is inversely proportional. It does not need to be said that he discussed all consequences from these facts, in their different aspects. It is well known that these discussions are still going on, especially in connection with the work of R. Hertwig and his pupils and of Conklin.

The ever-growing tree of cytological research had meanwhile developed another flourishing branch. Henking had discovered (1891) the facts about the accessory chromosomes without understanding their importance. The studies of Montgomery and Sutton again revived in the beginning of the century the interest in these facts. McClung recognized in 1902 their importance for the sex-problem, and the work of Miss Stevens and especially Wilson brought the most surprising clearness. Boveri immediately became interested in these questions and suggested to some of his students lines of work in that direction. In 1909 he reported before the "Physikalisch-medizinische Gesellschaft" in Wuerzburg, where practically all his discoveries were first communicated, Miss Boring's work, discovering the very important *Ascaris* type of sex-chromosomes; further about von Baehr's work, who cleared up simultaneously with Morgan the interesting behavior of the sex-chromosomes in the male cells of aphids; further about Gulick's studies on the sex-chromosome cycle of Strongylids, especially important because he was the first to work out in detail the conception that sex-linked characters are carried by the x-chromosome; finally Baltzer's work about sex-chromosomes in female Echinids (which later had to be revoked after Tennant's work). Boveri himself studied the sex-chromosomes in hermaphroditism (1911) and succeeded, simultaneously with Schleip, in bringing the facts in harmony with the general conceptions; the object was the nematode *Rhabditis nigrovenosa,* which shows an alternation between hermaphroditic and bi-sexual generations.

The last years of Boveri's life gave to us three more papers in the general field of cytology, each one showing him still at the summit of his intellectual strength. The first, "Ueber die Charaktere von Echinidenbastardlarven bei verschiedenem Mengenverhaeltnis muetterlicher und vaeterlicher Substauzen" (1914), gives a very fine analysis of the relative importance of protoplasm and nucleus in the inheritance of characters. By comparing hybrid larvæ with different qualities of both (developed from giant-eggs, fragmented eggs, isolated blastomeres) he reaches the conclusion that the chromosomes are responsible for the characters of the larvæ (in agreement with Baltzer and Herbst and opposed to Godlevski). In the second paper, "Zur Frage der Entstehung maligner Tumoren" (1914) we find Boveri in a field at first sight far distant from his usual line of work. But only apparently. In his former analysis of the chromosomes in multipolar spindles he had already pointed to the possibility of explaining the sudden origin of malignant tumors and their behavior by the assumption that they originate from cells with abnormal combinations of chromosomes resulting from an occasional multipolar mitosis produced by some influence in the surrounding medium. As he believes that this idea, very closely connected to von Hansemann's cancer-theory, might be useful for further research, he works it out here in extenso and discusses its merits in regard to the facts of pathology. The third paper finally, and the last one published by Boveri during the summer 1915, deals again with a subject, discussed by him 27 years before, namely, the origin of Siebold's famous gynandromorphic bees from the Eugster hive. Boveri was able to secure the original material and to work it through in order to determine whether his old hypotheis of 1888 or those of Morgan (1905) or Wheeler (1910) was correct. By means of a very beautiful analysis he shows that his own hypothesis—fertilization of one nucleus after a premature division—is the only one in agreement with the facts.

It has already been said that Boveri's cytological work was always intermingled with studies in experimental embryology. His favorite objects, sea-urchin egg and *Ascaris* embryos urged him to work out problems in that line. There may be mentioned only two of his most successful pieces of work. One of these deals with the polarity of the sea-urchin egg. Selenka and Morgan were already acquainted with some of the facts, and the work of Roux, Driesch and Wilson had brought the discussion of egg-axes, regulation and equipotential systems, to the foreground. Boveri (1901) now is able to demonstrate morphologically the polarity of the sea-urchin egg—the well-known pigment ring—and to point out in a series of experiments how this preformed polarity explains all the previous results regarding the development of isolated blastomeres, fragmented eggs, deformed germs and larvæ with dislocated blastomeres.

The second series of experiments—partly done in connection with two of his students (Miss Stevens and Miss Hogue)—deals with the potency of the *Ascaris* blastomeres, studied especially with the centrifuging method and in cases of dispermia. His paper, "Die Potenzen der Ascarisblastomeren," in R. Hertwig's Festschrift, 1910, constitutes another high-water mark of his work. He mixes the plasmatic content of the eggs by centrifuging them and combines this in other cases with destroying one of the first blastomeres with ultraviolet rays. Then he follows with great accuracy the cell-lineage and reaches through a wonderful analysis the quite unexpected conclusion that in these eggs with strongly determinate cleavage nothing like organbildende Keimbezirke can be present, and that these eggs are very probably to be regarded as a "harmonious-equipotential system." In the same paper he gives an answer to another question, which had vexed him, since he first entered the field of cytology, namely, the cause of the diminution of the chromosomes in the somatic cells. By a most remarkable analysis he reaches the conclusion that the constitution of the protoplasmic surroundings is alone responsible for the process.

Besides all this closely correlated work, Boveri only once—with the exception of his doctor's thesis—entered a quite different field of research. The result was his paper on the nephridia of *Amphioxus,* one of the classics of vertebrate morphology (1892). His discovery of the protonephridia of that famous animal, as the result of logical thinking and consequent observation, is well known to every biologist as well as the phylogenetic significance attached to it. In his later years he returned but once to this subject, following Goodrich's discovery of the solenocytes, but always retained a special interest in all questions concerning the *Amphioxus,* encouraging also the work in this direction done by his assistant Zarnik.

The number of papers published by Theodor Boveri is comparatively small, only about forty. But of these there are very few which could be called unimportant, and a surprisingly large number of them constitute landmarks in the progress of our science. This is to be explained by his way of working and thinking. If his ability is to be characterized in a few words, one might say he was keen, philosophic and artistic. Keen, in that his piercing intellect immediately saw behind a minor observation its far-reaching consequences, and followed them patiently to the last detail. Philosophic, as he followed his discoveries and put them in their proper place within the science of biology with an exact logic, sometimes almost striving at dialectics, and with the spirit of clearness and order. And last, but not least, artistic. The construction of his ideas has an almost esthetical beauty. And at the same time he was a master of the language. If he talked before a learned society he succeeded, in spite of his calm, almost monotonous speech, to fascinate everybody, through the clearness and thoughtfulness of his words, as well as through the wonderfully refined diction. His papers are written in the same spirit; few scientific treatises have been better written. And where he could devote himself especially to the esthetic side of a paper, as in his wonderful Rector's address, "Die Organismen als historische Wesen" or in his necrologue on Anton Dohrn, he reached the state of literary perfection of a work of art. And these characteristics of his work were in full harmony with his personality. At first sight not remarkable, he immediately fascinated one through his eyes, flashing with genius. And those who knew him were aware how much the artistic side of life meant for him, who was more than an amateur in music and painting. He was not only a great scholar, but a noble, harmonious man. What he has been for our science may be said with the words that he himself dedicated to Anton Dohrn:

> Er brauchte ja nur um sich zu blicken, um sich sagen zu muéssen, dass er der Biologie einen Impuls gegeben hat, dem wenige sich an die Seite stellen können, und dass seine Tat und mit ihr sein Name leuchten werden in der Geschichte unserer Wissenschaft, weit hinaus, wo nur die hoechsten Gipfel noch sichtbar sind.

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ARTHUR WILLIAMS WRIGHT

Professor Arthur Williams Wright died at his home in New Haven, Conn., on December 19. He was born on September 8, 1836, in Lebanon, Conn., where his father, Jesse Wright, at one time a member of the Connecticut House of Representatives, served as justice of the peace, selectman and a member of the school board. Samuel Wright, who settled in Springfield, Mass., in 1639, was his earliest paternal ancestor in this country. His mother was Harriet, daughter of William Williams and a descendant of Robert Williams, who came to this country from England in 1637, settling at Roxbury, Mass.

He received his early education in his native town, preparing for college, under William Kinne, at Canterbury. His career as an undergraduate at Yale College was a distinguished one. He not only achieved notable successes as a scholar in mathematics and astronomy, his studies of predilection, and in Latin, but he was prominent in undergraduate social life. A life-long love for music naturally led him to identify himself with the musical organizations of his time, and a critical knowledge of music, including an enviable skill in performance, added largely to the pleasures of his later and more leisurely life.

After graduation he continued his studies at Yale, specializing in mathematics and science, and acquired the degree of Ph.D. in 1861. From this time until his retirement in 1906 his life was identified with Yale except for a period in 1868–9, when he studied at Heidelberg and at Berlin, and the three years 1869–71 during which he held a professorship of physics and chemistry at Williams College. In the last named year he returned to Yale as professor of molecular physics and chemistry.

One of Professor Wright's most distinguished services to his university, and indeed to the teaching of science in America, was the early recognition that the practise of combining professorships of physics and of chemistry had ceased to be either economical or possible. It was, therefore, under his stimulus and activity that the first Sloane Laboratory of Yale College, the first structure in the country devoted exclusively to the work of a physical laboratory in the modern sense—was designed and constructed. This was completed in 1883, and henceforth he devoted his time, until his final retirement, to instruction and various physical investigations there, although the title of his professorship was not changed to that of molecular physics until 1887. This Sloane Laboratory also contained the study and lecture room of Professor J. Willard Gibbs, whose contributions to physical sciences have made it celebrated for all time.

The greater portion of Professor Wright's scientific work found its first publication in the *American Journal of Science*. These contributions are not merely important; they are characterized by rare excellence of form and of clarity. A short review of these papers will prove of interest.

"On a Peculiar Form of the Discharge be-