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OF

IRA REMSEN

1846-1927

BY

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and
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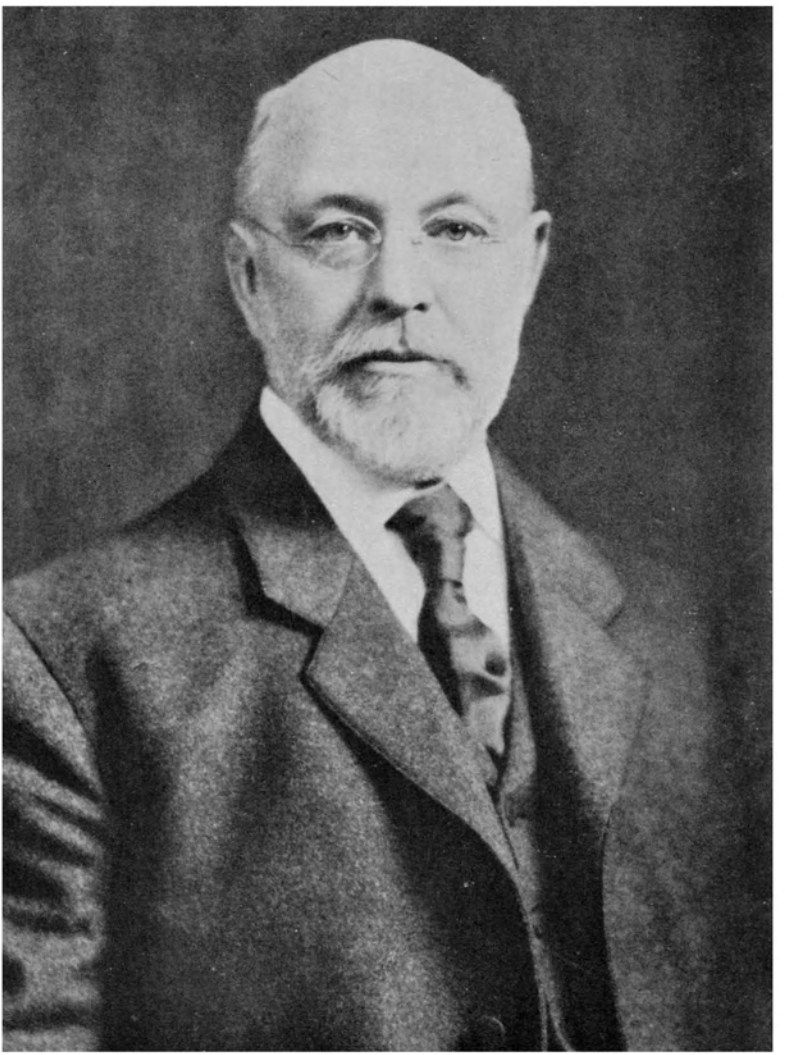

Ira Remsen.

IRA REMSEN [1]

1846-1927

BY WILLIAM ALBERT NOYES AND JAMES FLACK NORRIS

Two men, Ira Remsen and Wilhelm Ostwald, stand out during the last fifty years as great teachers and as founders of chemical journals which have had a profound influence on the development of chemistry. In these two respects their work is comparable with that of Liebig during the middle of the nineteenth century.

Ira Remsen was for many years the outstanding figure in American chemistry. When the history of the development of the science in this country is written, the fact will be evident that through his influence the serious study of chemistry and the output of new knowledge very rapidly increased. Much had been accomplished by a few gifted men in America before Remsen's day, but he opened up a life work in chemistry as a career to many, and developed a spirit of research that spread over the country.

He made it possible for a young man to be adequately and broadly trained at home, whereas Remsen himself and others who sought, at that time, to prepare themselves for work in chemistry had been forced to go to Europe. And what is equally important, he transplanted the "atmosphere" of the laboratories of the great masters—the spirit of hard work, the desire to learn and a love of chemistry.

Ira Remsen was born in New York City, February 10, 1846. His parents were both descended from the early Dutch settlers of New York and his mother had also Huguenot blood in her veins. For two years, from eight to ten, the boy lived in the country and had that intimate contact with nature which is impossible for a lad who spends his life exclusively in a city. A part of his early education was received in country schools. After further study in the public schools of New York City he entered the Free Academy, now the College of the City of New

[1] The first part of this Memoir is chiefly a combination of biographical sketches which appeared in Science, *66*, 243 (1927); J. Chem. Soc., *1927*, 3182 and J. Amer. Chem. Soc., Proceedings *1928*, p. 67.

York, where he studied Latin, Greek, mathematics, history and a very little science. He did well in Latin and Greek and it was doubtless during those years that he laid the foundation for that perfect command of accurate English which has made it such a delight to read his books and to listen to his lectures. His interest in science seems to have been awakened at this period by the popular, illustrated lectures given by Dr. Doremus at the Cooper Institute.

He did not, however, complete the four years of work required for graduation at the Free Academy. Many years later he received the bachelor's degree from the College of the City of New York, as of the class of 1865. He was accustomed to say, with some pride, that he was one of the few men who had received the rank of M.D. from the College of Physicians and Surgeons without having received the bachelor's degree. He also said, at one time, that he thought he was the only university president in America who had not completed a four years' college course.

After a few years in the Free Academy, Remsen's father decided that he should become a physician and apprenticed him to a doctor who taught in a homeopathic medical college.

Benjamin Harrow in his "Eminent Chemists of our Time" tells us that in one of his addresses Remsen recalled an incident of this time.

"While reading a text-book of chemistry I came upon the statement, 'nitric acid acts upon copper'. I was getting tired of reading such absurd stuff and I determined to see what this meant. Copper was more or less familiar to me, for copper cents were then in use. I had seen a bottle marked 'nitric acid' on a table in the doctor's office where I was then 'doing time!' I did not know its peculiarities but I was getting on and likely to learn. The spirit of adventure was upon me.

"Having nitric acid and copper, I had only to learn what the words 'acts upon' meant. Then the statement, 'nitric acid acts upon copper' would be something more than mere words. All was still. In the interest of knowledge I was even willing to sacrifice one of the few copper cents then in my possession.

"I put one of them on the table; opened the bottle marked 'nitric acid'; poured some of the liquid on the copper; and prepared to take an observation. But what was this wonderful thing I beheld? The cent was already changed, and it was no small change either. A greenish blue liquid foamed and fumed over the cent and over the table. The air in the neighborhood of the performance became colored dark red. A great colored cloud arose. This was disagreeable and suffocating. How should I stop this?

"I tried to get rid of the objectionable mess by picking it up and throwing it out of the window, which I had meanwhile opened. I learnt another fact—nitric acid not only acts on copper but it acts on fingers. The pain led to another unpremeditated experiment. I drew my fingers across my trousers and another fact was discovered. Nitric acid acts upon trousers.

"Taking everything into consideration, that was the most impressive experiment, and, relatively, probably the most costly I have ever performed. I tell it even now with interest. It was a revelation to me. It resulted in a desire on my part to learn more about that kind of action. Plainly the only way to learn about it was to see its results, to experiment, to work in a laboratory."

It is evident that Remsen learned very little chemistry in the homeopathic college but his preceptor evidently thought well of him and made him lecture assistant and quiz instructor in the college.

He soon revolted at the inefficient instruction, however, and induced his father to send him to the College of Physicians and Surgeons of Columbia University. In 1867, at the age of 21, he graduated and was supposed to be ready for the practice of medicine. In 1878, in an address before the Medical Faculty of Maryland, he said:

"Eleven years ago, in company with 90 others, I was proclaimed fit to enter the career of a medical man. My erudition in medical matters was exhibited in a thesis on the *Fatty Degeneration of the Liver,* a subject on which I was and am profoundly ignorant. I had in fact never seen a liver which had

undergone fatty degeneration, nor a patient who possessed, or was supposed to possess one; nor, I may add, have I had that pleasure up to this day."

"And yet Remsen got one of the two prizes offered for the best theses!"

After graduation he was offered a desirable partnership with a well-known physician but once more he refused to be guided by the wishes of his father and set out for Germany to study chemistry.

Liebig's name had attracted him to Munich and he had not learned that the great master had given up the direction of students some time before and had gone to the Bavarian University with the understanding that he could devote his time to his own studies and writing and that his duty should consist in giving a single course of lectures in inorganic chemistry. Remsen was forced to study with an able *Privatdocent,* Jacob Volhard. From him he received his first systematic laboratory instruction. Before that he had never performed the simplest analysis. Thorough training in analytical chemistry was, at that time, considered to be the only routine laboratory work necessary for the preparation of a chemist to begin research, and we may be sure that the fundamental basis for his career was well laid during this year of intimate association with Volhard.

During the summer of 1868, Wöhler made one of his friendly visits to Liebig and through Volhard, Remsen was introduced to him and arranged to go to Göttingen in the fall. There he began research work under the direction of Fittig and two years later received his degree of Ph.D. at the age of twenty-four. When we remember that Remsen spent only one year in the systematic study of chemistry and two years in research in earning his degree, we are tempted to question whether the long years of routine instruction which are required of young chemists today do not tend to dim that eager enthusiasm and repress the initiative so invaluable for a successful career.

It does not follow, however, that because Remsen did not take the varied courses of routine lectures which we expect of students today he failed to become very thoroughly acquainted

with the chemistry of his times. He once told me that during his stay in Germany he read the volumes of Liebig's *Annalen*—150 volumes had been published in 1870—until he was acquainted with all the important papers published in that journal.

The title of his dissertation was, "Untersuchungen über die Constitution der Piperinsäure."

The same year that Remsen received his doctor's degree, Fittig was called to the professorship at Tübingen and he asked Remsen to go with him as his lecture and laboratory assistant. He continued in this position for two years and in this way, for five years in all, he drank in the spirit of the German laboratories.

It was a fortunate time for the eager, enthusiastic young man. In 1858 Canizzaro had shown the importance of Avogadro's principle and laid the foundation for a system of true atomic weights. The same year, Couper and Kekulé extended Frankland's doctrine of valence to explain the structure of carbon compounds, and hundreds of professors and students were working together, after the model of Liebig's laboratory, in the fascinating world of organic chemistry.

It was at Tübingen, too, that a young Scotchman rang at the door one day and asked in broken German, for the "Vorlesungszimmer." Remsen answered, "Oh! I guess you want the lecture room." So there was begun the life-long friendship with Sir William Ramsay. Only a few months before his death, Sir William wrote to Remsen, "Well, I am tired and must stop. I look back to my long friendship with you as a very happy episode in a very happy life; for my life has been a very happy one." When Remsen helped with the plans of the Kent Chemical Laboratory of the University of Chicago, he provided few rooms for isolated students and he made the remark that students learn more from each other than from their teachers. When two such students as Ramsay and Remsen met, we can well believe that this was true.

During the two years with Fittig at Tübingen he did work which contributed something toward clearing up the confusion

about the structure of derivatives of benzene occasioned by the wandering of hydroxl groups when sulfonic acids are fused with caustic potash, a question of great importance at that time. The work was directly connected with his studies of piperic and piperonylic acids with Fittig, which formed the basis for his Doctor's thesis.

While at Tübingen he also undertook a study of the sulfobenzoic acids and demonstrated that both the meta and para acids are formed by treating benzoic acid with fuming sulfuric acid, the meta acid being formed in larger amounts. In an endeavor to secure the para acid in greater quantities, he oxidized a mixture of o- and p-sulfotoluene and discovered that the former resists oxidation by the usual mixture of potassium dichromate and sulfuric acid. Fittig had supposed that ortho compounds are completely destroyed by such oxidation. This discovery was the starting point for Remsen's Law that groups in the ortho position "protect" methyl, ethyl and propyl groups in derivatives of benzene from oxidation by chromic or nitric acid. This conduct of ortho compounds must have suggested the possibility of steric hindrance but Remsen was very careful not to express this in his papers and the discovery, later, that potassium permanganate and other alkaline oxidizing agents readily oxidize such groups, has shown that steric relations tell only a part of the story.

Remsen also showed that the sulfamides of toluene and other hydrocarbons are easily oxidized by the choromic acid mixture without hydrolysis, giving difficultly soluble acids which crystallize well and furnish excellent compounds for the further study of the law. As will be seen below, nearly all of Remsen's most important work in organic chemistry grew, directly or indirectly, from this beginning.

Remsen returned to America in 1872 and, after some delay, was appointed professor of chemistry and physics at Williams College. When he assumed his duties he found no laboratory and scant encouragement to teach science other than as a small element of general "culture" in an old-fashioned classical college.

As an illustration of the spirit of the New England colleges of that day, the following incident related by Professor J. M. Kingsley is illuminating:

"In the autumn of 1874, together with the rest of the junior class in Williams College, I began the study of chemistry under Professor Ira Remsen. After a few days I asked him for the privilege of carrying my studies farther in his private laboratory, as there was no laboratory work connected with the regular course. He replied to the effect that he would have to lay my request before the faculty, as there was no provision for such work in the curriculum. A few days later he asked me to stop after the class was dismissed, and then he informed me, in the most disgusted tones, that 'The Faculty, *in their wisdom,* have decided that you would break too much glassware and waste too many chemicals to allow you to work in my laboratory.'"

Kingsley became a zoologist of note instead of a chemist.

Satisfactory textbooks are an important aid in teaching. No book that was available for American students adequately treated the fundamental concepts and theories on which the newer chemistry was based. The appreciation of the significance of Avogadro's hypothesis, molecular weights, specific heats, etc., and the developments based on the structure theory of organic chemistry, had recently placed chemistry on a firm theoretical foundation. Remsen undertook, while at Williams College, to weave the important principles of chemistry into a logical whole. The result was his "Theoretical Chemistry," in which such subjects as the determination of atomic weights from the weights of gases and vapors were explained in a masterful but simple way. He even included a statement of the demonstration of the monatomic character of the molecules of mercury vapor, based on the ratio between the specific heat at constant volume and that at constant pressure.

Remsen repeatedly expressed his admiration for the great achievement of Canizzaro in so interpreting the facts of chemistry in the light of Avogadro's hypothesis that chemists saw clearly for the first time the significance of the relationship. His own great achievement consisted in reducing this and other

fundamental principles underlying so-called theoretical chemistry to such a simple form that the student could understand the beauty of the logic of it all. The book received immediate recognition and was soon translated into German and Italian. His methods of presentation have been largely followed or slightly modified in the great number of elementary books that have been written since his masterpiece appeared.

During this period he also translated Wöhler's "Organic Chemistry."

Remsen's attempt to systematize and coördinate the fundamental principles of chemistry in his work on his textbooks had a marked effect on his subsequent research. While at Williams College he published an account of a research on the oxidation of carbon monoxide, which had as its aim the discovery of how the molecules involved reacted. He compared the unsaturation of the carbon in the oxide with that of the carbon atoms in ethylene. It was known that chromic acid oxidizes carbon monoxide. He reasoned that if the oxidation comes about as the result of atomic oxygen formed from the acid, or from oxygen molecules when oxygen gas is used, ozone should be capable of oxidizing carbon monoxide at the temperature at which the former is decomposed. He found, however, that no oxidation takes place. It had been stated that oxygen in the presence of phosphorus converts carbon monoxide to the dioxide, and the explanation put forward that ozone formed during the oxidation of the phosphorus caused the formation of carbon dioxide. Remsen determined to test this view and later carried out the work at Johns Hopkins University. His results were in accord with his previous experiments; no carbon dioxide was formed. The publication of his paper launched a controversy. The work was repeated with scrupulous accuracy. The outcome was the discovery that phosphorus, as ordinarily prepared, contains very minute amounts of carbon (up to 0.04%), and that the carbon dioxide observed by other observers came from this source and not from carbon monoxide. In the course of the investigation a new form of phosphorus was discovered and a method was developed for the analysis of phosphorus containing small amounts

of carbon. The heat of combustion of a mixture of carbon monoxide and oxygen shows that such a mixture is thermodynamically unstable and the mixture with ozone must be still more so. Chemists are almost as far from a theoretical explanation of these facts as they were when Remsen tried these experiments.

This research illustrates clearly with what skill he attacked a difficult problem involving the search for traces of a substance, the presence of which might be attributable to methods of manipulation or to unsuspected impurities. It showed his keenness in searching out and avoiding causes of error.

Remsen supplemented his study of the behavior of carbon monoxide and ozone with an investigation of the action of the latter on phosphorous trichloride. Both carbon and phosphorus appeared to be unsaturated. The carbon compound was not oxidized, but phosphorus trichloride was converted into the oxychloride. Remsen interpreted the reaction as one of true oxidation in which the valence of phosphorus increased from three to five. At that time the doctrine of constant valency was held by many and it was necessary to marshal the evidence in favor of his point of view. Phosphorus pentachloride had been explained as a so-called molecular compound of the trichloride and chlorine. Wurtz had recently shown that the vapor density of phosphorus pentachloride in an atmosphere of phosphorus trichloride approaches very close to the density corresponding to the formula PCl_5 and on the basis of this Remsen concluded that the structure of phosphorus oxychloride was $O{=}P{-}Cl(Cl)Cl$. Kopp had shown much earlier that the doubly bound oxygen atoms of aldehydes and ketones has a much greater atomic volume than the singly bound oxygen atoms of ethers and alcohols. The increase in the atomic volumes should, of course, be ascribed to the double union and, in that sense, to both the oxygen and the carbon, as Sugden has done in his recent discussions. Thorpe had recently determined the molecular volume of phosphorus oxychloride and found that this indicated a singly bound oxygen

atom in the compound. He proposed the formula, $P{-}O{-}Cl(Cl)_2$.

Remsen, attaching more weight to Avogadro's principle than to the evidence based on atomic volumes, decided in favor of quinquevalent phosphorus. Rather recently, Sugden has determined the parachor of phosphorus oxychloride and has confirmed Thorpe's evidence for a singly bound oxygen atom. He explains the relation, however, by assuming a semipolar union between the oxygen and phosphorus. This gives the formula,

, and furnishes a satisfactory reconciliation between the quinquevalent phosphorus assumed by Remsen and the singly bound oxygen assumed by Thorpe.

The publication of the translation of Wöhler's "Organic Chemistry" and of the "Theoretical Chemistry" and, still more, Remsen's persistence in research under discouraging conditions, attracted the attention of President Gilman, who was seeking men for his faculty at the Johns Hopkins University. He had already secured Gildersleeve for Greek, Rowland for physics and Sylvester for mathematics. Remsen was invited to Baltimore to meet the Board of Trustees and was entertained at a dinner at which he was seated beside one member of the board after another. In this way Professor Remsen became one of that galaxy who worked with President Gilman to organize the first genuine university in America, where more than half the students were graduates of other colleges and where the purpose was not so much to teach what is already known as to develop men into productive scholars and add to the world's knowledge. President Gilman had the somewhat rare quality of fully trusting the men he selected and allowing them to develop the work of their departments without interference. His injunction to Remsen was, "Do your best work in your own way."

Professor Remsen followed rather closely the models with which he had become so familiar in Germany. He gave lectures on inorganic chemistry during the first semester and on organic

chemistry, the second. He illustrated these well with experiments and had a crystal-clear, masterful method of presenting his subject. Once a week there was a meeting of graduate students for reports on current literature.

Professor Morse has said of these "Journal Meetings": ". . . nowhere else [in America], so far as I know, had the advanced students been taken in and given an opportunity to familiarize themselves with the current progress of the science and of perfecting themselves in the art of giving concise and lucid expression to the information acquired in the course of their reading."

Of his lectures, Professor Morse says, "I will only say, as many others have said before me in effect, that I have never seen his equal as a master of simple and lucid exposition . . . as a teacher of many other teachers, his influence, direct and remote, has been and will continue to be of incalculable value to American students of chemistry."

In general, his method was that of the masters with whom he had come in contact in Germany, but he brought to bear on the problem a keen appreciation of the mental processes and needs of the student. His lectures were characterized by clearness of expression, the use of simple but effective logic, and the complete absence of dullness; they possessed an element of charm. Remsen avoided inconsequential details, but he inspired an appreciation of facts and the desire on the part of the student to search these out for himself. He brought out the high lights of a subject, emphasized principles, and made every lecture a model to be followed by the young, prospective teachers before him.

It was the custom for graduate students to follow closely his lectures given to beginners in chemistry and to attend the courses for graduate students as long as they were at work. Much could be learned by following the lectures on organic chemistry for the second or third time.

Remsen's lectures on the history of chemistry were a pure delight. He had come into close touch with many of the great men who had made modern chemistry, and he drew their pictures and appraised their influence in a fascinating way. Chem-

istry became a story of individual achievement in which there was still opportunity for one inspired with a desire to add to knowledge. In these lectures Remsen proved himself to be a philosopher as well as a scientist, and he often exhibited a sense of humor that was keen and delightful.

In the year in which one writer of this sketch received his Doctor's degree Professor Remsen called together the young men about to go out into the world. He talked for an hour on what was ahead of us; cautioned us against giving up the desire to push ahead by continued study and work. He warned us against allowing our present accomplishments to be the high spots in our lives. He urged us not to wait for a brilliant idea before beginning independent research, and emphasized the fact that Lavoisier's first contribution to chemistry was the analysis of a sample of gypsum. He told us that the fields in which the great masters had worked were still fruitful; the ground had only been scratched and the gleaner could be sure of an ample reward. He told us something of the methods he used in lecturing. A lecturer should be an historian rather than a prophet. It is less embarrassing to explain an unexpected result of an experiment after the observation has been made than it is to extricate oneself after telling what will happen and finding that it does not. (He evidently did not forget an experience he had when he was lecturing to an elementary class when the writer was a student. He told us that we should see that oxygen was a colorless gas. To his dismay and the amusement of the class the mercury oxide yielded, when heated, a distinctly yellow gas. A mistake of the lecture assistant was to blame.)

Professor Remsen cautioned us against giving dull lectures. The mind is capable of close application to a given subject for a limited time only. After a period requiring close attention the lecturer should see to it that a break occurs, that the mind is given a momentary rest. In every lecture the audience should have an opportunity to smile at least once. No extraneous commonplaces should be dragged in, but the resourceful lecturer will find some way to lighten the strain. This advice of

Remsen's was designed to be helpful; in it a thoughtful teacher spoke.

It is clear that the inspiration and training of future chemists held the highest place in Remsen's mind. He lived to see his efforts rewarded. Many of the leaders in research in chemistry today in America are the products of his care. The ability to express the principles of chemistry clearly and forcibly, acquired, consciously and unconsciously, by his disciples, has made many of them successful teachers.

The most important and vital part of his instruction was the daily visit to the desk of each research student. Often, at critical points, he would stop and work for minutes or for an hour or more with the student, and the product, in the end, was the joint work of professor and student as it had been in Liebig's laboratory.

Professor E. E. Reid writes: "It is impossible to characterize or describe Remsen. He had a keen sense of humor and a ready wit, a personality in the fullest sense of the term. He drew people to him but always kept them in their place."

Those trained under him look back to him as a father, who always required high quality in their work, who was wise in his advice and helpful in their difficulties.

Remsen extended his influence as a teacher by means of his textbooks. His "Organic Chemistry" was a masterpiece of lucidity and logic. It convinced the whole world that one could learn the fundamental principles of the science without being compelled to master the array of disjointed facts that were crowded together in the textbooks of the day when he produced his. The book received widespread recognition and was used over the world in translations in several languages. He wrote three textbooks on inorganic chemistry. The "Briefer Course" and "Introduction" remained for many years the standard texts on chemistry in America. He wrote, in all, eight textbooks and laboratory manuals.

Immediately after assuming his duties at Johns Hopkins University Professor Remsen began a series of interesting and important investigations, carried out with the aid of graduate stu-

dents and others. These were never undertaken merely for the purpose of adding to the list of organic compounds, which has grown all too rapidly in the hands of thousands of zealous chemists, young and old. There was always some fundamental principle at the basis of the work and his ideas were worked out with very great care and accuracy.

During the early years the starting point for many of the studies was the observations made at Tübingen that a methyl group ortho to a sulfonic acid group is not oxidized by the usual oxidizing mixture of potassium dichromate and sulfuric acid and that the sulfamide group, SO_2NH_2, "protects" ortho alkyl groups in the same manner and is not hydrolysed during the oxidation. This principle is known as "Remsen's Law" and was extended to show that ethyl and propyl as well as methyl groups are "protected" from oxidation and that halogen atoms and nitro groups have the same effect as the sulfonic acid or sulfamide groups.

It was found, quite early, that ortho groups may be oxidized by potassium permanganate and Remsen and Fahlberg discovered that the oxidation of orthotoluene sulfamide, $C_6H_4\begin{cases}CH_3\\SO_2NH_2\end{cases}$, gives an anhydride, $C_6H_4\begin{cases}CO\\SO_2\end{cases}NH$, which was called benzoic sulfinide. This was the first of a whole series of similar compounds. Because of its extraordinary sweetness, several hundred times that of cane sugar, benzoic sulfinide is manufactured in large quantities and sold under the trade name of "saccharin."

In the earlier papers, it was assumed that the salts of the sulfinides were derived from the sulfamides of benzoic acid, $C_6H_4\begin{cases}COOH\\SO_2NH_2\end{cases}$, but it was shown in another laboratory that they are formed by the replacement of the hydrogen of the NH group or of the hydroxyl of a tautomeric form and that the true salts of the sulfamide of benzoic acid are not sweet.

The original method of preparing orthotoluene sulfamide, used for making benzoic sulfinide, is tedious and gives very poor yields. In the hope of preparing the sulfamide more easily, Remsen attempted to replace the amino group of the para-aminosulfamide of toluene with hydrogen by the well-known diazonium reaction. To his surprise, the amino group was replaced by the ethoxy group, $O\text{-}C_2H_5$, instead of being replaced by hydrogen.

Professor Reid reports an incident in the laboratory which also led to the study of this replacement reaction. The laboratory book said "add alcohol and smell the aldehyde." A student came to him and said he did not smell aldehyde. Remsen took the tube and could not smell aldehyde, either. He made this into a good story, telling how stubborn the student was who wouldn't smell aldehyde when told to do so.

These observations started a new series of interesting studies to determine conditions which cause the replacement by the ethoxy or methoxy group or by hydrogen. The first paper announcing the discovery was published in 1886. It was found that pressure has a marked effect on the reaction. The yield of the ethoxy derivative was 37% when the pressure was 120 mm. and 60% at 800 mm. The nature of the substituent and its position were found to be determing factors. The methyl radical in either the ortho, meta or para position brought about almost exclusively the replacement of the diazonium group by ethoxyl, whereas the nitro or carbonyl group in the three positions favored the replacement by hydrogen. Substitution in the para position favored the hydrogen reaction and in the ortho and meta positions the alkoxyl reaction. The proportions of the two compounds formed was thus shown to be determined by the character of the group and its position. The observations made are a valuable addition to our knowledge of the effect of substituents on linkages between atoms in organic compounds. They may prove helpful in the further development of the electronic theory of the nature of the bonds between atoms. They illustrate very clearly how far the experimental knowledge of organic chemistry has outrun the theoretical explanations at our command.

The commercial manufacture of "saccharin" soon made orthosulfobenzoic acid, $C_6H_4 \begin{cases} COOH \\ SO_2OH \end{cases}$, more easily available. In the course of the study of this compound the chloride was prepared. The oil obtained yielded on crystallization a solid possessing definite properties. Some years later in studying the action of aniline on the chloride the crude oil was used. Since two isomeric compounds were formed it appeared probable that the chloride was a mixture of isomers. It was suspected at that time that there were two chlorides derived from phthalic acid. The possibility of the existence of similar isomers in this case made the subject an important one to investigate. After several painstaking researches two crystalline substances were isolated from the oily chloride. One of these, the higher melting form first obtained, always gave a definite derivative when treated with reagents, the low melting chloride gave the two types of substances produced from the original mixture. The results indicated that the low melting chloride was unstable and rearranged in part to the other form when it reacted with other substances. In the midst of this work it was discovered by List and Stein that Remsen's low melting chloride was the eutechtic mixture of the high melting variety he had isolated and the true isomer. This observation cleared up the situation and an intensive study of the two chlorides was undertaken. The high melting form of the chloride was shown to have the symmetrical structure, $C_6H_4 \begin{cases} COCl \\ SO_2Cl \end{cases}$, the low melting, the unsymmetrical structure, $C_6H_4 \begin{cases} CCl_2 \\ SO_2 \end{cases} > O$. The unsymmetrical chloride was found to be the more reactive and to yield derivatives, the structure of which were shown to be in accord with the formula assigned to the chloride. For example, ammonia converted the unsymmetrical chloride into *o*-cyanobenzene-sulfonic acid, and the symmetrical chloride into saccharin.

The isomerism exhibited in these two compounds and the difference in the behavior of the halogen atoms as the result of their position and relationship in the two molecules were facts that invited detailed study. The work was broadened by the investigation of derivatives of the two type molecules, such as nitro and bromine substitution products. The study of the behavior of the isomeric chlorides with aniline, urea, thiourea and other substances yielded important results.

The problems that arose covered a wide field and touched many of the more important and fundamental concepts of organic chemistry of that day. Remsen's contributions to the science resulting from his thorough investigations in this field should be classed with the work of the leading chemists of his time.

In 1884 Remsen published his first paper on the sulfonephthaleins. The similarity in structure between phthalic anhydride and the anhyride of *o*-sulfobenzoic acid led him to study the condensation of the latter with phenols. Difficulties were encountered in the purification of the products of the reaction but the work yielded finally a series of compounds analogous in structure to the well-known phthaleins. Compounds of this class have found use as indicators.

Remsen's chief contribution to inorganic chemistry was his systematization of the facts relating to double halides. When he was preparing his textbook of inorganic chemistry he made a detailed study of compounds of this class with the expectation of finding some general principle underlying their molecular composition. As a result of his study of the literature he formulated his conclusions in the following law: *When the halide of any element combines with the halide of an alkali metal to form a double salt, the number of moles of the alkali salt which are added to one mole of the other halide is never greater and is generally less than the number of halogen atoms in the latter.* Seeking a reason for this fact he was led to propose a possible structure for double halides. He noted the analogy between the composition of oxygen acids and double halides and offered the view that in the latter two halogen atoms in combination function as a single oxygen atom. For example, the

compounds having the formulas K_2PbO_2 and K_2PbI_4 could be considered as constituted as follows:

$$Pb\begin{matrix}O\text{–}K\\O\text{–}K\end{matrix} \quad \text{and} \quad Pb\begin{matrix}I=I\text{–}K\\I=I\text{–}K\end{matrix}$$

Remsen pointed out many such relationships. He did not claim originality in his point of view and states clearly that many ideas in his paper had been previously suggested by others. He emphasized, however, the advisability of the correlation of the facts and suggestions scattered through the literature of double halides. His paper and the subsequent work that it inspired in his and other laboratories centered the attention of chemists on this part of inorganic chemistry.

Remsen was intensely interested in the subject. He used to draw from it a lesson for his students. In considering the subject he would write the formula for a double salt as usually given, for example, $PtCl_4.2KCl$ and pointing to the period in the formula would remark with a twinkle in his eye: "That period has for many years been a full stop to thought. Don't let such devices keep you from trying to find out what lies behind them."

Remsen found in the literature descriptions of a number of compounds the composition of which did not accord with his law. He immediately undertook their investigation and extended the work to the preparation of double halides that had not been described. As a result, a number of those reported as capable of formation were found not to be definite compounds but mixtures. Out of over 400 salts, only three or four did not fit his generalization. To explain the possibility of their formation the concept of an atomic complex of the type $-Cl\begin{matrix}/Cl-\\|\\\backslash Cl-\end{matrix}$ was introduced.

The structure of the double halides proposed by Remsen has not been generally accepted. Shortly after its proposal Werner, in 1893, proposed his theory of coordination and much later G. N. Lewis, Sidgwick and others have given electronic

interpretations of the relations involved. Remsen's accurate experimental work in this field is, however, of permanent value.

In one of Remsen's earlier papers (1884) are reported the results of the study of the effect of structure on the reactivity of the bromine atom in the members of a series of alkyl bromides. He first studied the replacement of the halogen when the compounds were reduced by means of zinc and an acid. The normal bromides were found to decrease in stability with increasing molecular weight. Isopropyl bromide was much less stable than the normal bromide. When the reduction took place in alkaline solution the order was reversed and isopropyl bromide was much more stable than the normal bromide. With ammonia and with alcoholic sodium hydroxide normal propyl bromide was the more reactive of the two. With silver salts, however, isopropyl bromide reacted faster than did normal propyl bromide. The pressing problems that were arising in his other work led Remsen to forsake this field of research. It was only toward the close of his activity in the laboratory that he returned to the study of a problem that had always held his interest. In a paper published in 1899 he points out that he had frequently observed that the rates at which compounds of a certain type enter into reaction with the same reagent are dependent on the nature and position of the substituents present. He had observed this particularly in the case of acid amides. Accordingly a research was planned to study the relationship more fully and accurately. He notes that the results obtained were "most interesting." The work was carried out from the modern point of view. The effects of change in temperature and of the concentration of acid or base used were studied. Velocity constants were determined for the hydrolysis of a number of amides containing a variety of substituents in the ortho, meta and para positions. This pioneer work is becoming more significant in the light of similar studies carried out today.

In the beginning of Remsen's work he published several papers of interest on a variety of subjects, but as the problems developed he was forced to center his attention on the more important ones. Two of his early communications describe his study of

the influence of a strong magnetic field on chemical action. He discovered that iron under these conditions is more feebly acted upon by hydrochloric acid at the poles and that copper deposits on the iron in rings perpendicular to the field of force of the magnet. The results appeared to be of sufficient interest to Mendelejeff to warrant calling attention to them in his textbook of chemistry. Remsen showed in another paper that finely divided iron absorbs nitrogen.

When Remsen went to Johns Hopkins University in 1876, there was no satisfactory medium in America for the publication of an account of his researches. A few of his articles were published in *The American Journal of Science,* but Professor Dana, the editor of that journal, soon decided that researches in organic chemistry did not furnish material of sufficient interest to his readers and advised publication abroad. Professor Remsen was not satisfied with this and, with the aid of other chemists, he established *The American Chemical Journal.* With far-sighted vision, he made this a medium of publication for American chemists and not an organ of the Johns Hopkins University. For thirty-five years this journal was a very important agency for the promotion of genuine chemical work. It was the first American journal in this field which secured widespread recognition abroad and it would be difficult to overestimate its value in stimulating chemical work and in placing Americans in their rightful place among the chemists of the world. At the close of the fiftieth volume President Remsen decided that publication in America would be better served by incorporation of *The American Chemical Journal* with *The Journal of the American Chemical Society.* This was done and the latter journal carried on its title page a record of the consolidation of the two journals, until the time of his death.

In the last number of *The American Chemical Journal* Remsen said: "The American Chemical Society has grown to great importance and is amply prepared to provide for the publication of all articles on chemical subjects likely to be prepared in this country. . . . Taking everything into consideration it now seems best to the editor to place the control of his journal in

the hands of the society. It is needless for him to say that after 35 years of editorial work he does not now withdraw from it without a feeling of deep regret. His earnest hope is that the step may prove wise."

When the University of Chicago was organized Professor Remsen helped in the preparation of the plans for the Kent Chemical Laboratory and President Harper made him a very flattering offer to induce him to accept the position of Head of the Department of Chemistry. The students and all his friends in Baltimore were very happy when he finally decided to remain at Johns Hopkins.

Remsen served as acting President of Johns Hopkins University while President Gilman was in Europe in 1889-90. When President Gilman retired in 1901 he was chosen as Gilman's successor. The resources of the university had been depleted by the depreciation of some of its securities and the period of his administration was a difficult one. In spite of this, the university continued a steady and satisfactory development. The school of engineering was founded and the cramped quarters in the heart of the city were exchanged for the magnificent campus which the university now occupies on the outskirts of Baltimore.

Remsen's motto as President was, "Every man does his best work when he is allowed to do it in his own way."

Professor W. H. Howell says of him, "The many criticisms that in recent years have been directed toward this (the president's) office in our American institutions are certainly not applicable to him. He never abused the power placed in his hands, there has been no autocratic interference with the autonomy of the individual departments, and above all there has been no suspicion of indirection in his dealings with his staff. . . . We have been very contented, happy and prosperous under his administration."

In 1881 Boston had trouble with her water supply and Remsen was called on for his advice. During the same year he undertook an investigation of the organic matter in the air and

a study of the impurities in the air of rooms heated by hot air furnaces and by stoves, for the National Board of health.

In 1909 he was appointed by President Roosevelt as Chairman of a Board commissioned to study problems connected with the administration of the pure food law. The other members of the Board were R. H. Chittenden, J. H. Long, G. A. Herter and A. E. Taylor. After the death of Dr. Herter he was succeeded by Theobald Smith. The publicity and the political and commercial influences connected with the work of this Board were very distasteful to President Remsen.

After the great fire in Baltimore, in 1904, President Remsen was the most important member of a Commission which prepared the plans and had charge of the construction of a system of sewers and of sewerage disposal for the rebuilt city. It is doubtful if the large sums of money required were more honestly expended in any other large American city.

President Remsen retired in 1913. After that he spent his time in travel, in revising his books, in work for the government as chairman of the Referee Board, and in consulting work for one of our largest industrial corporations. He died at Carmel, California, in 1927, at the age of eighty-one.

Remsen was the recipient of many honors. He was chosen a member of the National Academy of Sciences in 1882. He was President of the Academy, 1907-13. He was President of the American Chemical Society in 1902; of the American Association for the Advancement of Science in 1903; of the Society for Chemical Industry in 1910. He was an honorary member of the Société Chimique de France; of the Pharmaceutical Society of Great Britain; of the American Chemical Society; and honorary fellow of the Chemical Society (London). He was medalist of the Society of Chemical Industry in 1904, and received the Willard Gibbs medal in 1914 and the Priestly medal in 1923. He was awarded many honorary degrees: LL.D., Columbia University, 1893; Princeton University, 1896; Yale University, 1901; University of Toronto, 1902; Harvard University, 1909; Pennsylvania College, 1910; University of Pittsburgh, 1915; D. C. L. University of the South, 1907.

Remsen was married in 1875 to Elizabeth H. Mallory, a daughter of a New York merchant who with his family spent his summers in Williamstown. He left two sons, Ira M. Remsen, an artist, who died in 1928, and Charles M. Remsen, a surgeon, who lives at 515 Park Avenue, New York City.

In his boyhood Remsen was reared in a very strict, religious atmosphere and he retained a simple religious faith throughout his life. In his address "On the Life History of a Doctrine," delivered as president of the American Chemical Society, after pointing out that "faith is called for at every turn in scientific matters as well as spiritual," he said, "It would be as illogical to give them (atoms) up as it is, in my opinion, to deny the existence of a power in the universe infinitely greater than any of the manifestations familiar to us; infinitely greater than man; a power that 'passeth all understanding.' "

Ira Remsen's ashes rest in a beautiful new laboratory dedicated to his memory and named Remsen Hall. The men who were reared as chemists in his painstaking hands have established a fund in his honor to be used in furthering research in chemistry at the University.

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J. C. W. FRAZER

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G. H. Cartledge. Studies on the periodic system. II.—The ionic potential and related properties.

L. H. Reyerson and L. E. Swearingen. The catalytic activity of metallized silica gels. V.—The oxidation of ethylene.

Eugene C. Bingham and Theodore R. Thompson. The fluidity of mercury.

Frederick H. Getman. The color of iodine solutions.

Martin Kilpatrick, Jr. Catalysis in the hydration of acetic anhydride.

William A. Noyes. The interaction between nitrogen trichloride and nitric oxide. Reactions of compounds with odd electrons.

Charles Snowden Piggot. Radium and geology.

C. N. Meyers and S. F. Acree. III.—The reversible addition of ethyl alcohol to para-bromobenzonitrile catalyzed by sodium, potassium and lithiumethylates.

E. P. Wightman. The fogging by acids and oxidizing agents and the intensification of the photographic latent image.

Laurence L. Quill and Pierce W. Selwood with B. S. Hopkins. Observations on the rare earths. XXX.—Studies in the absorption spectra.

Roger K. Taylor. Three laboratory devices: a vacuum stirrer, a pressure alternator and a gage for measuring low pressures of permanent gases in condensable vapors.

Frederick K. Bell. The infra-red absorption spectra of organic carbonates.

J. N. Pearce, M. D. Taylor and R. M. Bartlett. The vapor pressures of aqueous solutions of potassiums iodide and sodium bromide at 25°.

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G. H. Latham. The thickness of absorbed vapor films. II.

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James F. Norris and Spencer Ward Prentiss. The reactivity of atoms and groups in organic compounds. VII. The influence of certain solvents on reaction velocity—adjuvance.

F. O. Rice and Joseph J. Sullivan. Catalytic studies on acetoacetic ester.

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A. W. Dearing and E. Emmet Reid. Alkyl orthosilicates.

Francis H. Case and E. Emmet Reid. Some 1, 2-dialkyl cyclopentane derivatives.

Lee R. Herndon and E. Emmet Reid. The decomposition of organic compounds at high temperatures and pressures.

Austin M. Patterson. The nomenclature of parent ring systems.

Joseph S. Chamberlain and Malcom F. Dull. The preparation of compounds of malachite green and of phenolphthalein by means of the Grignard reaction.

E. P. Kohler and N. K. Richtmyer. Pseudo-bases and their salts in the isoxazole series. Second paper.

IMPRESSIONS OF IRA REMSEN [2]

By E. T. Allen, Ph.D., 1892

Of my first meeting with Doctor Remsen I have now no recollection, but I know it occurred early in October just forty years ago this year (1927). It was probably on the same day that I first saw President Gilman. He personally received my credentials for matriculation, as the custom of the University then was, and I recall his tall, fine figure, animated expression, and vivacious manner distinctly.

Johns Hopkins formed a marked contrast to the quiet New England college where I had just graduated, indeed in many ways it was unique among educational institutions. Materially speaking, the University of that day was a heterogeneous aggregation of three fair-sized laboratories, an administration building which did miscellaneous duty, and a number of old brick dwellings which housed the less popular departments—all located in a busy, noisy, dusty part of old Baltimore. There was little open space or green-sward about any of the buildings and no trees. Street cars passed each side of the group. The sound of the city's traffic penetrated the walls. Heavy trucks, lumbering over the uneven cobblestones, rattled the windows and set the balances a-tremble, while a fire-engine stationed close by rushed forth at intervals to loud alarms, considerably distracting the attention of the students. "Is this the Johns Hopkins University the papers are braggin' so much about?" asked a foreigner with a strong Irish accent whom I once met on Little Ross Street. "Why, Trinity College, Dublin, would turn this into an academy."

Even on paper it was not much of a *university* as the word was generally understood. There were no departments of law, medicine, or theology. Some of the sciences were hardly recognized at all. Many languages, and I know not what other subjects taught in other schools, were omitted from the curriculum and in some instances a single instructor had to stretch his activities to cover more than one field.

[2] From Johns Hopkins Alumni Magazine, March, 1928.

An examination of the records of the Johns Hopkins of that time would show that there were then close to five hundred students about equally divided between graduates and undergraduates—the influence of the graduates decidedly dominating. I have been connected with half a dozen collegiate institutions as student or teacher but nowhere have I ever seen a student body so thoroughly absorbed in intellectual work. This exceptional group of young men—at any rate the graduates—were drawn to Johns Hopkins by the fame of its faculty and perhaps even more by the belief that it offered unusual opportunities for original scholarship. It had been widely heralded in the press as a new type of school in America, a research institution like the great European universities.

The Johns Hopkins of that period was not well housed, still the buildings were better adapted to work than one might suppose and the equipment was excellent. The real strength of the University, however, lay in its faculty. It was President Gilman's statesman-like plan, now known to all educators, to subordinate everything else to the selection of an able faculty, and he searched Europe and America with care, under the best advice, offering high salaries and other attractive inducements to get the best men available to head his departments. Of this group Remsen was an outstanding figure.

My earliest recollections of Remsen are indissolubly connected with his lecture-room. I retain a very distinct impression of the contrast between my previous vague and faulty conceptions of chemistry and the new world that now unfolded under his skillful touch. There was a rapid expansion of my mental horizon, a strong sense of reality gained in the materials of the subject, and a clear view of their significant relations. The whole field took on a different aspect in the light of his clear exposition.

Professor Remsen at that time was forty-one years of age, a man not above medium height, of rather stocky, slightly rotund figure. His head was round and bald, his face full and somewhat florid, his eyes decidedly blue. He wore a short, well-trimmed beard and used glasses, I think, only occasionally.

He was always well groomed, dressed neatly and in the best of taste, and his hands were immaculately kept. Not a very striking exterior—which probably explains why I do not remember my first sight of him. You might have taken him for a prosperous medical man. He had an excellent voice, clear and strong, of baritone quality, his enunciation was good without being over-precise, and he always made himself easily heard in any part of a hall or lecture-room. In manner he was live and forceful without self-consciousness and without the eccentricities which distinguish many academic persons. He did have one mannerism which was characteristic. He would sometimes pause in his speaking, cast down his eyes for a moment as if in reflection, and draw down the corners of his mouth into a peculiarly smug expression which was rather amusing.

He had already gained a high reputation as a lecturer. As such he is remembered today by hundreds of his old students, and in that rôle he will probably be longest remembered. His style may be characterized in two words—simplicity and clearness. Nobody ever understood the beginner better than Remsen and he seemed to have the beginner almost constantly in mind. Realizing how prone mankind is to mask ideas with words, he thought out his ideas with great care and expressed them in terms ruthlessly stripped of all pedantry, avoiding at the same time any suggestion of crudity. "Much of our university teaching is over the heads of the students, *unquestionably,*" he used to say. "How would you teach the law of simple proportions when the number of exceptions is greater than the typical cases?" asked a student and teacher. "I wouldn't say anything about that," was the sensible reply. He used few notes and probably rarely or never wrote down a lecture as Williams, professor of Geology and one of his few rivals as a lecturer, used to do. His diction was therefore less literary, more direct. In illustrating his lectures Remsen intentionally avoided elaborate experiments such as frequently fail to work or experiments whose meaning is not readily grasped. Like all good teachers of science, he relied strongly on sight memory, showing in the lecture-room large numbers of specimens of raw materials and manufactured and laboratory products.

Perhaps all this sounds rather trite. Do not all good teachers, one may say, strive for clearness and simplicity? Remsen's distinction lay in the degree he succeeded in following out these principles and in the indescribable way he had of giving reality to his subject-matter and of arresting and holding the attention of his listeners.

His lectures abounded in allusions to hygiene, sanitation, and industrial matters of public interest. Outside his own subject it was the biological and medical sciences with which he was most familiar, but it may be unhesitatingly affirmed that there was never any insinuation that other fields were of lesser importance. His vision was bounded by a broad horizon rather than the narrow vista which too often restricts the outlook of the scientist.

Remsen succeeded remarkably with beginners but I think his success with more advanced students was not quite so great. I remember a certain feeling of disappointment which I felt in listening to a course of his lectures in organic chemistry for the older students which was offered only once in two or three years. There was new material, of course, but few if any new principles were presented, few new vistas opened, few important relations, scientific, industrial, or economic expounded. It all seemed like the earlier course somewhat "revised and enlarged."

I believe that in the late eighties "journal meetings" were an innovation in America. They are probably common now and I hardly need stop to say how much the student gained from them in the knowledge of chemical literature which was so much emphasized at Johns Hopkins. This, of course, was a German institution imported. In fact the Chemical Department was quite largely an adoption of German ideas and German methods. All our instructors with the exception of one laboratory assistant were German trained, as the best chemists of their generation almost always were. Remsen used to say he grasped the thought of a chemical treatise more readily in German than he did in English as most of his studies had been pursued in the former. Scientific research was not yet thoroughly at home in America and I think I vaguely realized the dependence on German authority, yet I am bound to admit there was never any sense of

unfairness toward the best that was being done in other countries. In these meetings generally Remsen was the responsible man, presiding and carefully following everything. His own reports, like his lectures, were always well prepared and presented. This was not true of all the other instructors and I remember one occasion when a very obvious lack of preparation led to a humiliating rebuke from Remsen.

In the final examinations leading to a degree at the University both written and oral tests were required. In the oral tests the examiners allowed themselves almost any latitude. It was said that one of the candidates in my time was asked some question by Remsen which he could not answer. When the examination was over he approached the professor and said he would like to know the answer to that question. Remsen frankly replied that *he* did not know. The astonished student then said, "Would you mind telling me, Professor, why you asked that question?" "Oh," said he, "I have here a good many bright young men who read widely, and I thought you might have found the answer."

Every day as a rule, following I believe a German custom, Remsen used to see each one of his research pupils to find out how investigations were progressing, and occasionally he made the rounds of the laboratory to show his interest in the work of the less advanced students. His questions were usually aimed at the larger aspects of the problem in hand and the general avenues of approach rather than at special means. Laboratory methods in themselves apparently had little interest for him. The ease with which a student may lose himself in a maze of laboratory directions was capitally brought out by Remsen in a talk I once heard him give on "teaching." "I go into the laboratory," he said, "and find a student busy about his work. I inquire into his activities, whereupon he goes to his manual, runs his finger down the open page and says, 'I am doing *that* experiment.' When I ask further what it's all about, he replies, 'I was leaving the reading till tonight.'" All this acted out to the life in most entertaining fashion.

Remsen never did any experimental work in my day. I have heard him regret that in consequence of it he felt in some degree

out of touch with the experimental work of his pupils. He "could not find the time," which meant, of course, that he was more interested in his lectures and in his writing. He had his own organic field which he cultivated through his students, and he will be remembered as the discoverer of saccharin. His work on the double halides aroused much interest and led to further work elsewhere. Regarding the latter he remarked that a student came to him one day in some excitement, saying that a *man* had come out with the idea that chlorine may have a valence of three or more. "Well," said Remsen, "what do you think of it?" "Why," said he, "I think it's absurd." "Then," said Remsen, in great glee, "I told him I was the man."

I have heard Remsen tell of the discovery of saccharin but quite without animus toward Fahlberg. The latter had the shrewdness to seize upon and to capitalize the sweetness of saccharin, which possibly Remsen might not have done, and he was, like many another scientist, not generous with the credit. I have heard from Morse what I presume is well known, that a German professor with whom Fahlberg had been associated cabled to Remsen, "I warn you of Fahlberg."

Others know the researches of Remsen better than I and will know better how to appraise them. Here obviously we are concerned with *impressions,* not with judgments, but without any wish to disparage him, it is doubtless true that any of us could point out a number of American contemporaries and many more European ones who would be generally regarded as greater investigators.

Johns Hopkins at that time was thought to be and probably was more thoroughly steeped in the ideals of research than any other institution in America. The ideals were constantly before us and Remsen had in this connection one piece of advice which deserves to be perpetuated. "Begin the investigation of some subject that interests you. Don't wait until you can think of something really great enough for you to do." Despite all this I have thought that Remsen, if he had engaged in research "with his own fair hands," in the words of Hill (of Harvard), would have gained immeasurably as a guide in actual scientific investigation.

He was always quick to head off a student who indulged in reckless speculation. He spoke to me once of the "trouble" he had with a former pupil of whom I knew, trouble in holding him down to actual facts. That, I should say, was Remsen's habitual attitude. But, irreproachable as this attitude may be, I think his students got little encouragement even in legitimate speculation. A man not naturally much inclined to speculation himself, I think he rather discouraged theorizing as an exercise dangerous perhaps to all but the greatest minds.

Hill once expressed to me regret that Remsen should expend so much of his energy in writing text-books. I used several of his books in a short period of teaching years ago but got no great impression from any of them except the *Organic Chemistry*. That, I believe, was a unique achievement judging by the interest it arouses in the student and its wide adoption in the schools. His books are marked by clearness and conciseness. "The style is simple, sometimes purely so," said a critic (I think Thorpe) of one of them. This of course was merely a smart shot but there was just enough truth in it to make a hit. I have examined none of the text-books for years and do not know how widely they are used today, but it is my impression that through them Remsen accomplished his purpose in reaching the wider audience which he sought as an educator. But, with the possible exception of the *Organic Chemistry,* none of them is distinguished by a new view-point, a new classification, or an original interpretation of a large body of facts brought to light by the author, such as mark the great text-book.

Remsen was very proud to be the founder of the *American Chemical Journal.* It was for many years foremost in its field and it is a pity it could not have been perpetuated. An article was once sent to the *Journal* for publication by one of the Harvard faculty in which the word "benzol" was repeatedly used. Remsen was much disturbed by it. He insisted on "benzene." This may seem rather pedantic in the face of an old and common usage, but I think he was wholly concerned here with consistency because it was in the interest of clarity.

In the late eighties the *Journal of the American Chemical Society* was a very weak organ. There was little of it and what

there was, was of poor quality. Remsen in reviewing one of its issues in the Journal Meeting, pointed out at length its obvious defects. "And *that,*" said he with some vehemence, slapping down the journal on the table, "*that* purports to be the official organ of *American* chemistry."

Remsen's attitude toward American chemical industry in that day was unfortunate. The intimate association which existed between the German universities and German industry and the mutual advantages that grew out of the association was a theme not infrequently touched upon in his lectures. Yet there was little attempt made by him to direct any of his students into industry; all his encouragement appeared to steer them into teaching. I suspect he may have had some unfortunate experiences with industrialists. He used to speak ironically of those who were boastful about operations "on the large scale" and I have heard him speak of being refused an entry into some of the Baltimore works. I dare say there may have been as much prejudice on the other side toward the schools, but if he had been a more tactful man prejudices might have been swept away and new opportunities for students might have been opened as well as new avenues of influence for a man so really practical as himself.

Remsen was sane and practical, eminently reasonable, never off on a tangent, direct and forceful, and should have made a great executive had he been possessed of sufficient tact. Humor he had in good measure and he knew how to make it tell in his teaching. I wonder if everybody has heard him relate how Wöhler (a teacher of Remsen) once making the rounds of the laboratory came upon a student leaning on his elbow and gazing intently at a solution on his table, apparently lost in thought. "What are you doing?" said Wöhler. "I'm crystallizing," said the pupil impressively. "Well, don't move," was the reply.

One of Remsen's best qualities was the power of balanced judgment which he possessed in unusual measure. He had the faculty of discussing a subject dispassionately, stating the facts pro and con and leaving to the listener often the right of decision. Oleomargarine, then of considerable public interest, was one subject which I remember as well summed up. Touching

on the effect of alcoholic beverages he decried the misleading methods of some "temperance" lecturers of the day. "Are we to suppose," he exclaimed, referring to an experiment in which alcohol was poured on white of egg, "Are we to suppose that everytime we take a drink of beer we coagulate our albumen?" "But," he continued, referring I think to the 'liquor of the good old times,' "we must remember that the real poison in liquor is alcohol."

Illustrating the same characteristic Remsen related with great satisfaction how an eminent mathematician (I think it was Sylvester) had once attended a course of his lectures in organic chemistry. The mathematician was interested in the number of isomers which an organic compound may have. Remsen had evidently proceeded in his usual cautious manner, stating the evidence and showing what the theory predicted without actually committing himself to it. The evidence had been piling up when one day after the lecture Sylvester came to him and said with ardent conviction, "Aren't you *satisfied* this theory is true? I am."

Everyone who knew Remsen was aware that he was somewhat irritable. He worked hard, taking the bulk of the teaching of chemistry on his own shoulders, and though he was rarely incapacitated I presume he was inclined to overdo.

On one of his visits he came to the "quantitative laboratory" where I happened to be working. A strong odor of ammonia pervaded the air. "What's all this? Who's responsible?" said Remsen in his quick way. Some student mentioned the name of Dr. B. who was at work in the basement. He was a man much older than the average, a real professor in a "Western" college and not much in awe of authority. Professor Remsen, sighting Dr. B. at that moment, exclaimed with great vehemence, "This is unbearable, Dr. B., unbearable!" "Well, what do you think of me?" said Dr. B. "I have to *stay* in it." "I don't care anything about that, I don't care anything about that," was the reply.

One day I happened to be talking with Remsen in his office, by appointment in all probability, when there came a knock at the door. Remsen paid no attention to it, but the knocker,

probably thinking he had been invited to enter, opened the door, and stepped in. He came up to Remsen hat in hand, a most awkward figure, a veritable Guy of Gisborne, as green of appearance as can well be imagined. Remsen's sense of dignity was instantly affronted by this unwarranted intrusion on his privacy. "My name's (we will say) Dubb," was the embarrassed remark. "Well, what of it?" snapped Remsen. "I wanted—" "Well, close the door, please, till I am at leisure." The poor fellow closed it, remaining *inside*. "Outside, please, outside," said Remsen.

My own relations with Professor Remsen were uniformly pleasant and that I believe was the general experience of his students. They were by no means as close as my associations with the genial Morse, a matter partly accounted for by the direction of my studies.

The handwriting may be an indifferent index to a person's character but it is a rather interesting fact that Remsen wrote an admirable hand. I still recall it after the lapse of years. The letters were even, the lines well spaced, the whole refined and conspicuously clear—such a hand as anyone would like to possess.

The extent of Remsen's influence and fame, especially in the educational world, is undoubtedly great. He had not, however, the picturesque exterior, the magnetic personality, the dazzling gifts which perhaps sometimes beguile us into overestimating a man. To some future biographer who has dispassionately studied his subject and mastered his materials must be left the task of measuring the breadth and the depth of Remsen's inspiration in the lives of men and its motive power in the development of chemistry. That he was a remarkable teacher would be the unanimous verdict of all his pupils.

I still visualize Remsen best in his lecture-room. I hardly need close my eyes now to call up my earliest impression of him and the strongest. There, behind his table in the old laboratory on Little Ross Street, he stands as he was in his early forties, a forceful if not magnetic figure, commanding the respect if not fully winning the affection of his pupils, doing the work which he loved best and fulfilling the mission for which Nature clearly intended him.

ECHOES FROM THE REMSEN MEMORIAL MEETING [3]

MR. WHITRIDGE'S ADDRESS

When the President of the Johns Hopkins University asked me to tell you of a contact I had with Dr. Remsen, I gladly consented, for I realized at once that it would be a theme of great joy to me to tell you, his friends, of my association with him, possibly in a way few knew him. I have since recognized that it would need an abler pen than mine, and a more learned and eloquent tongue to do justice to his memory.

Excepting two others, I know of no one person who has influenced me more than Dr. Remsen. He aroused in me the principle, that whatever a man's limitations may be, some of the talents God has given him should, in part at least, be used for the good of others, and especially for his native city, and not entirely for his own personal interests. To you his former colleagues, now so few in number, to you his former students, whom he taught and inspired, and to you his friends, gathered here to-day to honor the memory of a man you loved and respected, I shall speak of a characteristic, probably little known to the scientific world in which he lived, and tell you of a point of view I got of his make up and character during a period lasting nearly eleven years.

Many of you may recall, that after the great fire of 1904, Baltimore awoke from a semi-comatose state of mind in respect to public improvements. Up to this time we had been a big village. Now the citizens of Baltimore demanded that the Burnt District should be rebuilt in a modern and up-to-date way, and above all, that an adequate and proper system of sewerage should be constructed. Strange to say, until after the great fire, Baltimore had depended entirely on a system of cess-pools and a number of privately owned sewers draining into Jones Falls, or the Upper Basin. There was only one other large city with such an antiquated and unsanitary method for the disposal of sewerage, viz., Cairo, Egypt. For this improvement large sums of money had to be spent, and the Public and Press

[3] From Johns Hopkins Alumni Magazine, November, 1928.

demanded that the work be done honestly, efficiently, and without graft, and that the members of the Commission should be men of integrity and uprightness.

It was my privilege to serve on that Commission from the beginning of the work, in June, 1905, until we voluntarily resigned as a body, in January, 1916. The outstanding member of the Commission through these eleven years was Dr. Remsen, the then President of Johns Hopkins University. My other fellow-members were honorable and capable men.

We built a disposal plant on Back River practically automatic in its working; we sewered hundreds of miles of streets, connected to our system thousands of houses and factories, and asked for and spent over twenty-three million dollars. I think our work was well done, for I am told, that even to-day, the Baltimore system is as modern and up-to-date as any, and would cost to duplicate sixty-five millions.

When I was asked by the Mayor to go on this Commission I hesitated, and requested time to consider. Naturally, I consulted my father. At first he advised me to decline, with the remark, that he would regret to see any son of his mixed up in a political job. I remember telling him I thought politics could be kept out, and stated that Dr. Remsen would be a member. Quick as a flash, he said: "If Remsen will be on that Commission, accept by all means, for he will keep things straight."

Business men often say that scientific and learned men are lacking in hard, common sense. With Dr. Remsen this was not the case. He grasped a business matter quickly, and demanded and expected order and system to prevail. I recall, at the very outset, I asked him how we should start our work. Should we visit other cities and see how they were handling such problems? —"No," he said, "neither you nor I know anything about handling the situation ahead of us. As a chemist, I know something about the composition of sewage, but I know nothing as to the proper method of its disposal. The right way to handle this problem is to get the best experts in the country to tell us what to do." Through his contact with the leading technical educators, and especially through the help and assistance of his

friend, President Pritchett, of the Massachusetts Institute of Technology, now head of the Carnegie Foundation, we had for our advisers the three leading sanitary engineers of the United States, Messrs. Herring of New York, Stearns of Boston, and Gray of Providence, and later on, when in a very animated fight with a City official—a man of little experience and education—William Barclay Parsons, who helped to plan the Panama Canal, acted as a consulting engineer to us. In all the preliminaries to get these consulting engineers, Dr. Remsen took a leading part. With pride I can say, that due to Dr. Remsen's assistance, the total amount of their fees was less than $25,000, a sum well spent when millions were to be expended, and over a period of eleven years.

For eleven years I was chairman of the Committee on Accounts, and all bills and estimates had to be passed on by two members. I realized from the beginning the necessity of having our books properly opened and audited by a reputable audit company, and requested authority to employ such a concern. Our then Mayor hesitated and suggested an accountant employed in the City Hall. For obvious reasons this would not do, although the man was capable. I personally went to Dr. Remsen and told him how necessary it was to have a firm in whom the public would have confidence. Through his help and tactfulness with the Mayor, I had my way, and we employed a firm of reputable accountants; our books were opened properly, and at the end of each year audited. We were the first City department in Baltimore to inaugurate yearly audits. The cost was very little, but the satisfaction to all our members was very great, in knowing that our accounts were correct and in order.

Again, I recall a fierce and protracted dispute with the City Council regarding our plans. We had anticipated Baltimore's needs up to one million people in the large out-fall tunnel or sewer to Back River. Egged on by some of the political contractors, who had received none of our contracts, for weeks communications passed backward and forward between our office and the City Council, with queries from them and answers from us. One Thursday afternoon came the communication, that on Monday, by 5.00 p.m. the Council must have our reply.

To meet these demands from the Honorable City Council, on a number of occasions we spent a large part of Sunday in our office, and Dr. Remsen, busy man as he was, always was on hand. We finally won out, and satisfied the City Fathers that we knew our business and for the next eight years peace and quiet prevailed, and we were left alone.

In one respect we were a very remarkable body, for during the eleven years only three times, when we came to a final vote, was there a member or members dissenting. When it was apparent after a discussion, that there would be a divided vote, the usual method was to form a Special Committee, and place the dissenting member or members on it. The matter was carefully gone over in these Committees, and a report drawn up. This report was unanimously accepted by the Commission, and Dr. Remsen was generally chairman of these Committees. So we worked in harmony, and with respect for each other, and there was no ruction nor friction.

As to the man himself, I never saw him perturbed or upset by pressure of work. He was always genial and kindly, and while we knew that by education and ability he was the leading member of the Commission, he never tried to force through his views, always listening with deference and interest to those of others. There was never any petulance or arrogance about him, even if he held the degree of LL.D. from our leading universities. His manner toward his fellows was always kindly and approachable, and do you wonder we respected him and felt we always had a sheet anchor to windward?

In my eleven years' association with him only once did I see him depressed. It was after an operation at the Hopkins Hospital, shortly after he resigned as President of the University. He came to a stated meeting of our Commission. I asked him how he felt, and his reply was, that he felt better, but intended to resign from the Commission, as his days of usefulness were over, and remarked: "I am a has been." I remember telling him what he had meant to us, and how he had started us on the right track in our work, and how he had gotten the best men in the country for our consulting engineers. I felt, if he then gave

up his membership on our Board, the future might not be so pleasant, nor our work go on so satisfactorily, as the press respected him and the politicians looked up to him. I saw his face light up after my talk, and he said: "If you really believe I am of some use, I will stay," as he did until we went out of office in 1916.

Again, I remember going to Annapolis with him and some of the members of our Commission. There was an iniquitous bill before the Legislature. "The Professor," as the politicians called him, and Edgar Allan Poe, then City Solicitor, met in conference with some of the sponsors of the bill, and after some time had passed, Dr. Remsen came back to the rest of us, and gleefully remarked, that he and Mr. Poe had made a compromise. That compromise took all the sting out of the bill, for he and Edgar Poe together had "put one over" the politicians, and saved the City thousands of dollars, for the bill, as originally drawn, would have forced us to buy most of the private sewers. The compromise read: "if they were properly built and could be used in our system," and very few were used.

So I might go on from incident to incident, with President Remsen taking a leading part in everything we did, serving more than any other member as the head of committees, and always ready to help.

When we went out of office in 1916 I saw him at intervals, for his work took him to New York and Chicago, and afterwards he lived most of the year in California. Whenever he came to town I tried to see him, and he was always interested to hear about his colleagues, and what our former engineering staff was doing. The last time I saw him was in the fall of 1926. He had returned to Baltimore for the University's Half-Century Exercises and Dinner. His mind was clear, and I was surprised how well he remembered names and incidents.

When I said good-bye to him, in the quizzical way he often had, he shook my hand, and remarked: "I wonder how our Versailles fountains of sewerage are working at Back River, and is that balmy breeze still coming from the sludge digesting tanks? I should like to go there again with you."

I have missed him, and shall miss him, and am glad to tell you, his friends, in this simple way, what I thought of him, and how much I respected, admired, and loved him.

Many years ago Robert Burns wrote some verses about a dear friend; with some slight changes, may I use them in concluding:

An honest man is now at rest,
As e'er God with His image blest.
The friend of Man, the friend of Truth,
The friend of Age, the guide of Youth.
Few hearts like his with virtue warmed,
Few heads with knowledge so informed.
If there is another World he lives in bliss,
If there is none, he made the best of this.

Dr. Griffin's Letter

It is a profound regret and disappointment to me that I am unable to be present at the meeting in memory of Dr. Ira Remsen. I have been a patient at the Johns Hopkins Hospital for some weeks past, and have recently come to New York to stay for the present with my son.

My acquaintance with Ira Remsen began in July, 1872. After a residence of upwards of seven years in Germany as a student, he had returned to the United States to enter upon what was to be such a distinguished career. One can imagine the change from so many years of student life in Germany to a professorship in a New England country college,—Williams. This date makes Dr. Remsen, with only one or two exceptions, the oldest of my friends.

Nothing could have been more felicitous than the relations which he established in his new home and in his new duties. He at once showed himself a natural teacher, sympathetic and inspiring.

The chair which Dr. Remsen filled at Williams was a more comprehensive one than would now be considered suitable. He was professor of Physics and of Chemistry, and his predecessor, who was called to the chair of Physics at Yale, had emphasized the subject which was the less congenial of the two to Dr.

Remsen. He was expected to give physics rather than chemistry the more important place; but, if this did not agree with his own wishes, he disregarded them, and there was no one in the staff of professors who was more acceptable as a teacher, as an associate, and as a friend. The only drawback of which he ever complained was lack of time for original research.

When, after four years of most acceptable service, Dr. Remsen was called to the Johns Hopkins University, all of his colleagues recognized the fitness of this promotion.

It is quite unnecessary for me to speak of Dr. Remsen's long and distinguished career at the Johns Hopkins University,—as head of the Department of Chemistry, as the teacher for many years of an undergraduate class, as director of the advanced work of graduate students, as author and editor, and finally as President of the University. The many public duties which he assumed, the wide recognition which he received, both in this country and abroad, his extensive acquaintance among scientific men throughout the world,—all this, which is known to others as well as to me, I will leave unmentioned. If I were to attempt to express my sense of personal obligation to this dear and honored friend, my word would pass the limits which the proprieties of this occasion impose.