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EARLY SCIENTISTS OF PHILADELPHIA.

BY EDGAR FAHS SMITH.

Mr. President, Ladies and Gentlemen:—To tell the story of the scientists of Philadelphia would require many hours. I propose therefore to restrict myself to a recital of the work of some of the men who were partial to my science, chemistry, because it is the oldest of the sciences. All other sciences are dependent upon it. In the language of another, it has done more for the comfort, the welfare and the happiness of man than all the others put together. There was a time when chemistry was looked upon as the black art. There was a period in its history when kings and emperors called it to their aid. When their money coffers were depleted they looked to the devotees of the science to replenish them. That was the period in which chemistry bore the name alchemy, when it was said to be the science or the art of making gold and silver; when through the instrumentality of what was termed the philosopher's stone, base, ignoble metals were transmuted into the precious metals, silver and gold. No one ever dreamed that alchemy was practiced outside of Europe. If five years ago any chemist in any part of the world had been asked whether alchemy was

practiced, or had been practiced, in America, the answer would have been no, and yet in these short five years we have come to learn that there were alchemists in what is now the United States of America. Governor Winthrop, of Connecticut, was an alchemist. Alchemy was practiced by him and his associates, and among the settlers of Virginia there were alchemists. They belonged to the closing period of alchemy. They brought its methods out here when the earliest provinces were settled. We did not have any alchemists in this province. Chemistry as we know it to-day came to Pennsylvania. It was a chemistry that had freed itself almost entirely of the shackles which surrounded the old chemist, and yet it was encumbered with a peculiar theory known to chemists as the phlogiston theory.

If, for example, iron was burned a red residue remained. Those who believed in the doctrine of phlogiston said that the iron had lost its phlogiston, which is the combustible part, and the red substance which remained was its calx. If brimstone, perchance, was burned, the smoke that resulted was the calx, but the sulphur had lost its phlogiston. That theory prevailed for sixty years among the chemists of Europe. That theory was brought to these shores, and if I confine myself to Philadelphia I must say that some of the earliest physicians of this city were phlogistonists. They were, of course, medical men, but in their pursuit of medicine they acquired some knowledge of chemistry, and believed that all substances that burned lost this peculiar, enigmatical, subtle body, phlogiston. Early chemistry, including the doctrine of phlogiston, was brought into Philadelphia through that group of men and emphasized by one of our greatest physicians, Benjamin Rush, who while pursuing medicine at Edinburgh, followed chemistry under one of the grandest teachers that Europe ever

had, Joseph Black, a pronounced phlogistonist in the early part of his life. I fancy from what I have been able to gather from letters and early documents that Benjamin Rush had much difficulty in his student life to determine whether he should be a practitioner of medicine, or whether he should be a chemist. In the archives of this Society and in the old newspapers of this City, in the Pennsylvania Gazette and the Penna. Journal, are records of chemical lectures delivered by Benjamin Rush down on Fifth Street. A few of the titles of his lectures are chemical apparatus, the objects of chemistry, simple and compound salts, the manufacture of saltpetre and gunpowder, the manufacture of glass and porcelain, inflammable bodies, fermentation, the chemistry of vegetables, the elements and the principles of agriculture.

In this programme there is excellent evidence of the fact that in 1775 Benjamin Rush hoped to acquaint this community with the nearness of chemistry to every individual. There is a title somewhere here among these, on chemistry in the home, and I fancy that as he became more familiar with the science he was quite satisfied that it could do more in the upbuilding of this colony, or of all the colonies, than perhaps any other science. It was a virgin country into which the forefathers had come, and it was for them to determine what things about them could be so worked upon by the methods of chemistry as to bring results which would be worth while, not only to the colonies or provinces, but also to the mother country.

This was in 1775. The Revolutionary War was upon us, and one cannot but admire Doctor Rush for devoting his time to these things when there was so much going on about him of an entirely different character, and when he was a partisan. As you know, he signed in the year following the Declaration of Independence. In 1769 Benjamin Rush, in order to make

the science of chemistry of some consequence to the students who heard him lecture, printed a syllabus of his lectures on chemistry for the use of students out in the old college. He was made professor in that year, and as Philadelphians we ought to rejoice in the fact that this professorship was the first of its kind in the United States of America. I like to rub that fact in as I go about the country, talking about contributions of various institutions to educational affairs. Yes, the first chair of chemistry, not of chemistry and medicine, not of chemistry and mineralogy, not of chemistry, physics and mathematics, but just chemistry, was founded here in the Old College of Philadelphia, and the first occupant of the chair was Benjamin Rush. As you look at this little book and read its statements you will find that Rush was a phlogistonist. He believed that when phosphorus burned the phosphorus lost something. We did not hear of antiphlogiston until after the discovery of that wonderful gas which is part of the atmosphere we are now inhaling, and which has come to mean so much not only to us as living beings, but to the great factories of the world, a gas that now is liberated from water in immense volumes, a gas that we are getting from the condensation of the atmosphere. One of the components of the atmosphere, after the air becomes liquid, goes off quickly and leaves oxygen gas which was discovered in 1774. Rush talked so earnestly in favor of the science that he influenced, as I will show after a little while, a number of younger men who were his pupils in medicine, to leave medicine and go to chemistry. Philadelphia then is undoubtedly the City in which chemistry, as we know it to-day, began in this western world.

The war, of course, was on and much was not being done by Benjamin Rush and others who knew some chemistry, but in 1795, after Rush had vacated the chair the vacancy was filled by the selection of a young

man twenty-four years of age, named James Woodhouse. He was the son of English parents living on South Front Street. In fact he was born in House No. 2 on South Front Street. He graduated from the College of the University and two years after from the Medical School of the University, and having listened to Doctor Rush and talked over matters with him, concluded that he would give himself to chemistry, but before he took that step there came into this City that remarkable man, Joseph Priestley, an English dissenting clergyman, who in 1774 on the first day of August discovered the element to which I have already referred, oxygen. Priestley was a phlogistonist. His discovery attracted a great deal of attention all over Europe. A French chemist named Lavoisier, when he became acquainted with oxygen during a visit of Priestley to his home in Paris, questioned whether there was such a thing as phlogiston and whether when iron was burned and left a red residue the latter was not the iron plus the oxygen that was in the atmosphere. So he did the thing which Priestley had not done, he weighed the iron which he afterward burned in the air and weighed the product of the combustion and found that that product was heavier than the original iron. Now by combustion there was not anything lost, as the doctrine of phlogiston required, but there was an increase in weight, so he immediately set his hand against the idea of phlogiston. He opposed it and the controversy was a bitter one extending all over Europe, through France, Germany, Italy and Spain, through the Scandinavian Countries, and, of course, we heard something of it here, or our forefathers did, and when Joseph Priestley landed in New York on the 8th of June 1794 he was not long about making known his views on this peculiar doctrine. He came over on the 15th of July of that year to Philadelphia. He stayed here three days. He said this was the worst

city he had ever lived in, it was the most expensive city, he did not like it, it was hot here, hotter than any place he had been in. I think the real reason is that the Doctor and Mrs. Priestley were so fatigued and worn by the long journey and by all they had experienced for some ten or more years in the way of persecution, that they wanted to get out into the quiet prevailing on the North Branch of the Susquehanna where a beloved son had already settled, hence they journeyed there, and in a very short while Priestley had the work going on, chemical work, making experiments to prove that there was such a thing as phlogiston, and yet his own element, oxygen, in all its behaviours was making men throughout the world believe that phlogiston did not exist. Joseph Priestley came down to Philadelphia. James Woodhouse, whose name I mentioned a moment ago, was uncertain whether he was a phlogistonist or not a phlogistonist, but he began to experiment in his laboratory on Fifth Street between Chestnut and Walnut, on the east side, looking over on Independence Square. There he worked and old Doctor Priestley visited him. He saw the experiments the young man was conducting, experiments demonstrating clearly that the ideas the Doctor had entertained were erroneous, that phlogiston did not exist, and this controversy extended to New York, and Samuel Mitchill, who in 1792 had taken the chair of chemistry in Columbia, entered, and his evidence too was that phlogiston did not exist, that when iron burned it was oxidized, that Priestley's element, oxygen, combined with the iron. Woodhouse demonstrated to the satisfaction of everybody but Joseph Priestley that in respiration it is the oxygen of the air that does the burning of the carbonaceous matter in the blood, that in what we call oxidation it is the oxygen of the air that does the work. It was a splendid contribution for a young man not over twenty-six years of age to have made, and yet we

in this country are absolutely ignorant of the fact that there had been fought here on our own soil this great question.

Woodhouse's name has gone to Europe as the one who, together with Lavoisier, the great French anti-phlogistonist, helped lay that strange and erroneous idea. We are becoming proud of the fact now in chemical circles, but why is it we did not know about it long, long ago? Why is it that it is only recently that the country at large began to hear of James Woodhouse?

Doctor Priestly made several trips to Philadelphia. His friends in this City were Bishop White, Provost Ewing of the University, and many of senators and congressmen. Mr. Washington invited him to drink tea with him. Priestley was pleased to receive this invitation, accepted it and mentions that Mr. Washington, as he retired, extended a second invitation, but there was a little coolness there because Washington stood for the Great Republican Government that we had here, while Priestley seemed to be always against government and church and the state in everything. I do not know why, but he was. In England he was persecuted. They burned down his house. They burned his laboratory in 1791. They were trying to get him and they would have killed him but his friends secreted him. He was elected a member of the French Assembly and the French Convention, and oh, how Burke did rant and tear when he heard that Joseph Priestley, a minister of the Gospel, was mixed up with the mob in Paris, and he was for expelling the Doctor as he was for expelling some other people. Is it not a strange thing that I have here to-night with me this letter written in 1792? I will tell you its contents. The English pressed Priestley so hard, that is to say, they destroyed his home in 1791, they thought that he was in league with the people who ran things during

the Reign of Terror in France; he was elected a member of the Assembly. He was elected a member of the Convention, but he replies in this letter, "I have just received notice of my being made a citizen of France, a member of the Assembly and Convention," and then goes on to say that he considered it a great honor but could not accept it. It is addressed to the members of the National Assembly of France. There is the answer of the old gentleman to the accusations that were brought against him. I think it clears his skirts. It makes plain that although he talked against the English Government, and although he had a great deal to say against the Anglican Church, yet he was an Englishman and even declined to become naturalized after living in this Country, because he said, "I want to die an Englishman." On one occasion he and Mrs. Priestley attended services in the Baptist Church on Second Street when a reverend gentleman named Rogers, a professor at the University, seeing Doctor Priestley and Mother Priestley coming down the aisle raised his hands and said, "Oh, Lord, and the Priestleys come to tear Thee from Thy Throne." That actually occurred in the City of Philadelphia, but time went on and Reverend Doctor Rogers, who next day was scored unmercifully by the American Philosophical Society for what he had done, saw the error of his ways and apologized.

Doctor Priestley had in view two objects in coming down here from Northumberland. One was that this City was full of infidelity and atheism and he wanted to attack the infidels, so he wrote a sermon, or half a dozen of them, on infidelity, brought them with him and he preached against it. Volney, the great French historian, an infidel, would follow the Doctor up the next day to overthrow his arguments in favor of God. Then Priestley wanted to see the chemists of the town, James Woodhouse, Adam Seyfert and three or four

other pupils of Benjamin Rush. He felt badly to think that James Woodhouse, who apparently was a favorite of his, by all his experiments was knocking the phlogiston theory to pieces. But he had complete confidence in Woodhouse and said the day would come when Woodhouse would return to the fold, but he never did. None of them did. They all went away from the Doctor's fold. They became antiphlogistonists. They recognized the rôle played by the wonderful element oxygen. I wonder if any of you have ever gone to Doctor Priestley's home at Northumberland, the old home standing there on a slight bluff, the lawn tapering down to the Susquehanna. You know this is just a talk. I told the President of the Society I would not bring an address here to-night, but would come down and talk. I want to talk intimately with you. I want if possible to have you get as well acquainted with Doctor Priestley as I think I am. As a boy I was told that Unitarians were people I ought not to go with. I was brought up in that kind of hostility, and when I learnt that Doctor Priestley was a Unitarian, a man that founded the Unitarian Church in this part of the world, I thought maybe I did not wish to have much to do with him. If you were to come out to my office to-morrow and see the books that I have, written by Dr. Priestley, his history of the Christian Church, his four volumes on the Bible, his Prayer Book, and then see three letters which I have, addressed to Christian friends in this Country, closing with these words, "Sincerely yours in Jesus Christ," and other endings similar to that, you would understand my love for him. If there ever was a good man in the world it was Joseph Priestley. He was a real Christian and his influence in this community was for the very best. I think America owes a debt to Joseph Priestley which she can never repay. I must not spend so much time on him. Every day my absolute faith in him grows.

He not only discovered oxygen, he discovered many other things of the utmost importance, but these wonderful discoveries of his failed to get into our textbooks of chemistry, largely because we were not of his faith. I mean the writers of chemical textbooks cut out everything discovered by Joseph Priestley save oxygen. That they could not very well eliminate. They said it was discovered by Joseph Priestley, but they failed to tell that he had nitrogen, on two separate occasions, in his hands. He was the man that gave us gaseous hydrochloric acid and many other things. Chemists will know the richest. That dear old man, walking up and down Market Street, across to the Philosophical Society, sitting there with those who constituted the membership at that time, spending hour after hour with Bishop White, the great Episcopal Bishop; with John Ewing, one of the leaders of Presbyterianism in this community, and with several of the Methodist preachers who were here at the time. He fraternized with them as he did with men like Mr. Adams, Mr. Jefferson and Mr. Monroe. Mr. Jefferson at one time wanted Joseph Priestley to help him found the University of Virginia. He said he would give him a professorship but he would not go.

Next let me present James Woodhouse because he is more of our own. He was born in this City and educated here, and won his spurs here by overthrowing the doctrine of phlogiston on American soil. Did he do anything else worth while? We have about ninety-two elements. Iron is an element, lead is an element, zinc is an element, nitrogen is an element, sulphur is an element, and so on, but there were not that many when James Woodhouse traveled the streets of this City. There were not more than about thirty-four. You know what potash is. You know what soda is. On one occasion young Woodhouse mixed wood ashes with lamp black, put the mixture into an iron crucible, then

exposed it to intense heat, and separated from that mixture the element potassium. That was in 1808. In 1807 Sir Humphrey Davy of the Royal Institute in London had separated potassium for the first time in the history of the world by the action of electricity on caustic potash. The following year James Woodhouse separated it by an entirely different method, a novel method, an original method, and the chemical world took no notice of it. That is a strange thing. Philadelphia, at that time the centre of culture, the place where the greatest amount of publication was done, for more books went out of Philadelphia than from any other city of the little Republic. There were activities here not only in the science that I am representing this evening, but in other sciences. Eminent men in law, theology and medicine were here, and to think that one of our profession could perform such an important experiment as that, the isolation of an element from its compound by an absolutely original method, and no notice taken of it, I cannot understand. Persons have said to me, was it not printed? Yes, it was printed. An account of the method was printed but in an out-of-the-way journal and it never saw daylight. We have evidence at present that Woodhouse's experiment was really what I have described it to be, genuine. Yet in the great dictionaries of chemistry no mention is made of the fact. His method seems to have been rediscovered a few years later. When a chemist discovers an element his colleagues give him a first place in the profession. We have had therefore in this City of ours a man entitled to sit in the first row among the chemists of the world from the beginning down to the present, and yet we did not know it. James Woodhouse further showed what happened when plants breathe under water. He knew more about the chemistry of plants than any other living man. Now and again we find his name mentioned in connection with the breath-

ing of plants. There are certain other theoretical things that might be mentioned concerning Woodhouse, but they would not interest you as non-chemists. Twenty-five years ago we patted ourselves on the shoulders and said, "We are teaching chemistry right now. We are making beginners go into the laboratory and become familiar with the elements and their compounds and see, handle and do all sorts of things." In 1798 James Woodhouse published a little laboratory guide. Anyone sitting here to-night could take that guide, go into a laboratory and carry out the experiments with a great deal of pleasure. So Woodhouse was a pioneer in the teaching of the science. Then time and time again he called the attention of the community to the importance of developing what he called industrial chemistry, and printed with a great deal of care and fullness an account of how to purify camphor on a large scale.

Adam Seybert was another Philadelphia chemist. He was just three years younger than James Woodhouse, and went across the water because Benjamin Rush told him of the opportunities he might have there, but instead of studying medicine he studied chemistry and mineralogy. He was the first American to go to Germany to study chemistry and mineralogy. On his return to this City he opened a laboratory on North Second Street, No. 169, and there entered on this special study of his—the minerals about this City and in the town and country around us. He had the finest collection in the United States after five years. He sold that collection to the Academy of Natural Sciences in 1814.

There are Yale men here. I am going to tell them they had a great chemist by the name of Benjamin Silliman years ago, a lovely man, and when the corporation elected him—their first professor of chemistry—what did he do? Feeling that he lacked training,

he came to Philadelphia, to James Woodhouse, and entered as a student of chemistry and brought with him in a couple of little boxes, large enough to carry half a dozen spools of cotton, all the minerals that Yale had. He did not know what they were, but Adam Seybert, an expert in mineralogy, named those minerals for Silliman and that was the beginning of the magnificent collection of minerals which Yale now possesses. But Adam Seybert was won away from mineralogy and chemistry and lured off to Congress, where he compiled that splendid volume called Statistical Annals.

John Redman Cox, another Philadelphian, was a pupil of Joseph Black in Edinburgh and of Benjamin Rush. He became a professor of chemistry, doing some splendid work on what we call the speed of reaction, probably the first work of its kind ever done in the world. He seems to have been a scholar, more of a scholar and literary man than he was scientist. If you read his chemistry you will find it cannot compare in any way with the work of James Woodhouse. His experimental work cannot compare with the work of Adam Seybert. There may be some in this audience who knew Henry Seybert, the son of Adam Seybert, one of the most remarkable chemists this Country ever had, although he belongs to a much later period. You saw him. I recall seeing him here at functions of one sort and another years ago. He actually did things in chemistry that the whole chemical world recognizes today, but he, too, like his father, wandered away from chemistry. Adam Seybert was the first analyzer of air or gas in this country. He made extensive studies of the atmosphere around Philadelphia, down in the Neck. He studied the air at sea. He studied the temperature of sea water. His papers were all published in the American Philosophical Society's Proceedings. They are classics. But the thing that always disturbs me is that we do not find these names which I have mentioned

spread in our literature as they spread the names of others, men who have not done nearly as much as those men did. I suppose it is the modesty of us Philadelphians that has prevented these names of masters from appearing on the page of the printed book. Now I come to a name I wish I had all night to talk to you about. It is that of Robert Hare, born in 1781 and died in 1847. He was a real giant in chemistry. Down on Walnut Street where Dock intersects Walnut there was a wedge-shaped house on the southwest corner, owned by a good woman bearing my name, Smith. She had a boarding house there. Members of Congress boarded there and men like Horace Binney boarded there. Robert Hare boarded there. I do not know why he left home, but he went down there, and in the basement of that house he had a laboratory. Benjamin Silliman boarded there in 1802, 1803 and 1804, and became a real chum of Robert Hare, two people as unlike as could be. There was that cold New Englander Benjamin Silliman, a regular Puritan, who wrote to his brother: "All the young men who sit around our dining table have at their places beer mugs and on the mantelpiece is a decanter filled with whiskey. They do not say grace at table." It was terrible, but down in that wedge-shaped building on the ground floor was the laboratory of Robert Hare, and what was he doing? He was not yet twenty years old. He was trying to burn the oxygen of the air in an atmosphere of hydrogen, and he did it, and the flame which resulted was so intense that it melted platinum, that it melted rocks that were refractory, that no heat known up to that time was able to disturb. That flame is called the oxyhydrogen flame. When he found that he could melt platinum, of course, he was delighted. He was going to give the chemical world an instrument such as they had never had before, this intense heat, and they would be able to accomplish things they

could not do prior to that discovery. Benjamin Silliman, seeing these experiments day after day, wanted to work with him and did work with him, and a friendship began that continued to the end of their days. It was a beautiful friendship and I wish you could read the letter that Benjamin Silliman wrote when he was seventy-five or seventy-six years of age to Robert Hare, who was just a year or so younger, after Hare sent him his volume on Spiritualism. Benjamin Silliman did not reply then, but when he did reply it was such a letter as is only written once in a generation, but in it one sees the affection which existed between those two men, both real masters. Maybe some day you will come across that letter and then you will wonder why more has not been said about Robert Hare. The oxyhydrogen flame was his first discovery. He announced it when he was twenty years old, and, of course, some people on the other side of the water were impressed by its importance and tried to rob him of his discovery. It took years to prevent them from getting it into their possession and attaching their names to it. That simple thing, that oxyhydrogen flame, lives today. One of his students later founded the first platinum works in America, the Bishop Platinum Works at Sugartown and Malvern, the greatest platinum works for years and years in the country, as a result of his contact with Hare and seeing that experiment made over and over again. We talk about the calcium light. The calcium light was nothing more than that oxyhydrogen flame playing on lime, and that was the illuminant of the early lighthouses along our coast, making it possible for vessels during the blackness of the night to find their way home. Robert Hare gave that to us. You hear a great deal about the electric furnace. You hear about artificial graphite. You hear about calcium carbide. Hare was the first person in the world to make artificial graphite from charcoal.

He was the first person who made calcium carbide, and when he threw it on water got acetylene. He was the first person that ever built an electric furnace. Not to give you my words but to give you the language of a professor in Cornell University: "Hare was in many respects the precursor of Moissan, the great French electro chemist, though a much more brilliant man than the latter. Hare was born too early. If we call Moissan the Christopher Columbus of the electric furnace we must call Hare the Leif Ericsson of the same." That is not from a Philadelphian. Here are some more lines written by a New Yorker. How he ever got these lines written I do not know. He was so carried away with the brilliancy of the work of Hare. "Another of Hare's most important contributions to the general welfare was his rock-blasting apparatus, devised in 1833, whereby the use of what is now termed a plunge battery, essentially Hare's form of battery, a wire is brought into candescence, and thus becomes the means of igniting gunpowder, or other explosives, and this at any distance, under water, or practically any condition. As one looks around New York to-day and wonders at its sky-scrapers, its magnificent bridges over deepened waterways, its underground tunnels, its tunnels beneath the rivers, its splendid water supply brought from the Catskills, under three rivers, and finally under the Narrows to Staten Island, an engineering operation second only to the construction of the Panama Canal, how little we realize our indebtedness to Robert Hare."

I wish I could have taken the hand of Robert Hare. I would have loved to have heard him lecture over in the building of the University where the Post Office now stands, because there, before an audience that crowded every inch of space, in public lectures he showed many of these wonderful discoveries. Yet until recent years there was no history of Robert

Hare's work. Doctor Ira Remsen of Johns Hopkins University, when presented with the Willard Gibbs Medal a few years ago by the University of Chicago, said: "Well, gentlemen, of course, you have paid me a great compliment but I will not sail under false colors. Some of you have emphasized my theoretical discoveries, but I must tell you the whole story. When I completed the particular paper to which you refer I sent it to Wolcott Gibbs, then the leader of American chemists. In the course of a few days I received back a letter, 'Dear Remsen: Turn to page 161 of Robert Hare's Compendium of Chemistry and read.'" Remsen said: "I did as I was bidden. I read and lo! my wonderful theoretical discussion was all there, made sixty years before by Robert Hare." That was a splendid tribute to Hare, and Wolcott Gibbs, who told Remsen he should go to Hare's Compendium, came down from New York, after he graduated at Columbia in 1842, and became a student under Robert Hare.

There are great industries at work at Niagara Falls now, the making of caustic from common salt and things of that kind, in which they use what is called the mercury cathode. Robert Hare was the first person to use a mercury cathode. There is a division of chemistry called electro analysis, in which a mercury cathode plays an important part. Robert Hare was the first person to do that. I often have wondered since I have become acquainted with these really marvelous things done by a Philadelphian, who was born here and died here, why it was that the world at large did not know more about him. I think it is something like this. Robert Hare was an intense American. In the War of 1812 the business of his father, which was that of a brewer, was swept away, and he wrote to his dear friend Silliman, "I publish nothing in English chemical journals." He had not before and did not propose to do it then or any time later, so what did he do? He got

out pamphlets and sent them to a few of his friends, and the world at large did not get to see them. He was content but what glory he lost. But he was not seeking glory. He did not have a keen appetite for popularity and fame. He was an humble scientist and lived and moved here in this City. His Compendium of Chemistry is one of the most original textbooks ever written. I have a couple of his letters here. They are dear letters. One of them was written in London. He happened to be there in 1840. This one is to his friend Doctor Brande, an eminent English chemist. One cannot read a page written by Robert Hare without filling up with admiration for him. He was a true master in chemical science. There were many other things which he did to which I would like to call your attention. We have a building at the University we call the Robert Hare Laboratory of Chemistry. I was so happy when Provost Harrison decided to give it that name. His name is not preserved but the chemists of the country are now beginnning to give him place. Over at the Chemists' Club in New York there is a niche in their great auditorium. It is empty but there is being prepared a bronze bust of Robert Hare that is to fill it. Hare is coming into the place where he belongs. He became a spiritualist in his last years. He wrote a wonderful book and invented an apparatus called a spiritscope, and before three thousand people in the City of New York showed them how this instrument worked. I once made one to see whether it would work, but mine did not work. I think that I did not have the power of Doctor Hare. I have some verses which he wrote on George Washington, and which he communicated to the President up there. He held communion with Benjamin Franklin, who told him that some of his work in pure physics was wrong, that he should make certain corrections, which he did, and the work stands to-day. It was a sad conclusion of a

brilliant life, and I felt that possibly it was on that account that his life story had never been told. It reads like a novel, and by the way, Hare wrote a novel. Maybe you read it, "Standish, the Puritan." As the boys say, it is a bully story. There are a couple of other stories which are undoubtedly Robert Hare's. There are some verses too but they do not bear his initials, but if you have acquainted yourself with Hare's style you can detect him even if his name is not attached to writings. He was a vigorous writer.

There is one other person and then I will stop. A strange character he was. His name was Thomas Cooper. He came here in 1793. He was a graduate of the University of Oxford. He studied law, studied medicine and studied chemistry. He got mixed up with that French trouble and actually went to Paris and sat in the Convention, and got into trouble with Robespierre, who was going to have him assassinated, so they conveyed him back to England. There Burke got after him, and he came to this Country. He did not stay very long. He returned to England and with his family, what was left of it, came to Philadelphia in 1794. He joined the Jefferson crowd. He sided with the Outs, and wrote some of the bitterest papers you can imagine against the Federalists. He had no use for Alexander Hamilton. He was devoted to Thomas Jefferson. He made a living writing newspaper articles for a while. Then Joseph Priestley called him to Northumberland. He went there. Here we have the great exponent of Unitarianism fraternizing with a pronounced atheist. They lived under the same roof, worked in the same library and in the same laboratory. Was Thomas Cooper a chemist? Yes. What did he do? There are methods used in chemistry now by which we determine the presence of certain elements from the color they impart to colorless flame. He made that discovery. Then he found some new

and important methods for the detection of arsenic, copper and mercury. He brought into this Country most useful means of bleaching calico, printing and dyeing, and lighting streets with gas. He further edited a number of books on chemistry. He was undoubtedly one of the most brilliant teachers of our science that we had. He did not stand five feet high. His head was the biggest part of him. He was a trouble-maker. Thomas Jefferson had become very intimate with him in his first term as President, and appointed him judge of the Fourth Judicial District of this State. For eight years he dispensed justice, but was so obnoxious to people of his own party that they prevailed on Governor Snyder to release him and he was demoted, kicked out into the world. At Dickinson College they needed a professor of chemistry, and after two days' wrestling those dear people concluded to try this pronounced atheist, who in his introductory lecture told the folks what he thought about creation, about the Pentateuch, about all kinds of things, and one good minister of the Gospel said they thought they were electing him to the chair of chemistry and he had better talk about chemistry. He said he would do that when he got his classes but he wanted them to understand where he stood. This remarkable man could not be counted on. He would break over the traces at any time. He broke over them at Dickinson. Then he came to this City. Here he wrote for newspapers and wrote a book on the chemistry of the kitchen and things of that kind, just making a bare living. The trustees at the University on the 3rd of December 1816 elected him professor of chemistry in the College Department of the University. I do not see how it was brought about. That is past history, but they put him into that chair. As I said, he was a brilliant teacher and experimenter. He was not in the chair very long until there was a vacancy in the chair of chemistry in the Medical Department and Robert Hare won it. The Medical

Faculty said, "We don't want a man in our Faculty who has not been trained in medicine. Robert Hare has not been trained in medicine. We don't want him." Thomas Cooper then wrote an article, about twenty-five printed pages octavo, informing those trustees that a man to teach chemistry does not need to know anything about medicine, that Hare was more than well qualified for the position. Then he was elected to the chair, I think as much through the letter Thomas Cooper wrote to the trustees as through the honorary degrees which came to him.

Cooper was a great diner. Once a week he and a lot of his cronies would have dinner at four o'clock in the afternoon and go home at eight. At least that is what it says in these old books. Something came across his horizon here and he left us, but before he left Thomas Jefferson was trying and indeed succeeded in having him elected to the chair of chemistry in his University of Virginia, but the University of Virginia was not yet founded. Then he talked about a central university, and as soon as it was founded and buildings erected Cooper was to go there, but when the good people of the State of Virginia heard that Thomas Cooper was likely to occupy one of their important chairs they rose up *en masse.* The result was that even Thomas Jefferson had to come down and say, "Cooper, I am sorry, but you see what people say. You can't have the place."

Then Henry Clay got busy and thought he would take Cooper to the University of Transylvania, Lexington, Kentucky. I have all the correspondence that took place between Henry Clay, other important gentlemen and Thomas Cooper. It wound up in the usual way. There were a lot of Presbyterians out there. They did not want Thomas Cooper in that part of the world, so he was not given the chair, but those unsuspecting people, Episcopalians at Columbia, South Carolina, asked him to come down and be professor of chemistry. He went and in the course of two years

he became the president of the College of South Carolina. It is said by a number of people whose word cannot be doubted that frequently Doctor Cooper would lead the chapel exercises in the morning and fifteen minutes after chapel would be talking to them about the non-existence of God and things of that kind. He went on in such a high-handed way that the attendance in the course fell down to twenty-one students in the whole college. The trustees then appealed to the Legislature, but the Legislature would not take any part in the fight, and finally Doctor Cooper, finding that they really did not want him around, in 1834 resigned and was appointed to codify the statutes and laws of that State, and did so for about five years, when he died and was buried in Trinity Church Burying Ground. For a while it was a question whether they would let him lie in any cemetery, but they did, and here is a letter of his written in 1806 while he was here in Philadelphia. It is written to William Tilghman, Esq., Chief Justice of Pennsylvania. If you read this you will get just a bit of a hint as to the type of man he was. I have talked to you about five or six of the early chemists. I have told you really more about their personalities than about their scientific attainments, except in the cases of Hare and James Woodhouse.

There is another James in my list, James Cutbush. He is remembered today because his book on military pyrotechnics in the recent war was consulted by more people in this country and abroad than any other textbook, and that was written away back in 1819, a hundred years ago. A Major General of the United States army who was connected with the Chemical Warfare Service told me on several occasions, referring to it in my presence, that that was the book that all the military men who were engaged in that particular specialty were looking to almost every day. It is a rare publication. It is, of course, out of print, but he was here in this town. He grew up not in the company of Robert

Hare nor in the company of Adam Seybert, but he knew them. He became professor of chemistry at West Point. He died in 1825. There is a monument erected to his memory by the corps of cadets of that year. There are other things that James Cutbush did that are deeply chemical and they are a little difficult to explain before an audience of non-specialists, but he is to be looked upon as one of the first chemists of our country.

I might go on and tell you about Gerard Troost, Vanuxem, Larned, Joseph Cloud, and a host of others, but I may not do that. I have simply introduced you to early members of the chemical fraternity who lived and worked in Philadelphia. Some of my New England friends, chemists, every now and then say to me, "Stop talking about Philadelphia and early chemists. You are too enthusiastic." It seems to me that if we were to go back and acquaint ourselves, those of us who love chemistry with the early chemists, those who love botany with the early botanists, those who love geology with the geologists, those who love mineralogy with the mineralogists, and those who are deeply interested in literature, and in the law, we would find master minds right here in this community of ours. Can you imagine a church overcrowded, as in the days of Joseph Priestley, when he preached and President Adams was there and all Congress was there? All desired to hear him although they did not share with him his peculiar views. He gave an uplift to the community. This City of ours was given to infidelity during that period. It was filled with Frenchmen and they brought in all their ideas about religion. There that little man, Dr. Priestley, stood facing the whole community and laid before them the real gospel. You cannot read what I call his religious documents without feeling that he was not narrow. He was broad. He was tolerant, but we read in most of the story books about him that he was the most cantankerous man that

England had, and she thought that this would be a bigger lot in which he could play if he came here. They thought he would be cantankerous here, but he did not give any trouble. True, Mr. Adams wrote a letter to him that unless he stopped criticising him on some lines, with regard to naturalization perhaps, he would invite him to go home, but he did not do it. But Mr. Adams saw to it that Thomas Cooper was in prison for six months and paid a fine of $400, which money never came back to Cooper, although it did to his descendants. He was dead and gone when the Government found it had made a mistake. To chemists the work of this man appeals strongly. It was of the highest order and then to a lover of men these individuals appeal most strongly. They were just as human as we are but they did great things, and they did them in a period of this country's history when it was difficult for them, yet they stand out. They were marked men. I would like to see a street called Priestley Avenue, Robert Hare Avenue, James Woodhouse Avenue, James Cutbush Avenue. Shall I say Thomas Cooper? If you want to see a very good picture of Thomas Cooper go to the College of Physicians. There it is, an oil painting. Sully I think painted it. For years and years I went up and down this town, in back alleys, looking for a picture of some kind of Thomas Cooper. A friend of mine joined me in the search but we failed, and one day somebody said they thought there was one over there, and it is there. They say there is another one at Columbia, S. C. I hope before long to go down and see it, but that picture ought to be somewhere else than over at that college, it ought to be here, because Cooper helped to make history, the early history of this State and in part the Nation's history. I tell you here, because this is a sort of family affair, that I have been trying to write Thomas Cooper's life. I started years ago. When I read his atheistical stuff I threw the whole bunch into a chest and said, "I am not

going to touch him. I won't have anything to do with him." Then I would search further and find something and it would make me feel he was a man. I do not believe he meant those things. I do not care to whom he said them. I do not think he laid any great stress on them. It is just a little vaporing, a little idle talk, and now I have such piles of material that I scarcely know how to move, because he was not only a chemist but was a medical man. He was a veterinarian. He was a lawyer. He got to be a judge. He translated Justinian. He wrote the first book on political economy written in the United States, for the use of his students, in the college of South Carolina. He appeals to you now or does to me, and I would like to see his picture here on these walls.

I want to thank you for letting me come before you and talk to you about a few of the men whom I love. I love their memories. Of course, as a chemist I can appreciate the great things that they did. Out in my office is the chemical balance of Joseph Priestley. He brought it over here in 1794.

A MEMBER: Will you tell us of the discovery of oxygen and how he made it?

DR. SMITH: Joseph Priestley was not a chemist by profession. He made up his mind, I think under the influence of an aunt who brought him up, and he thought he would be a dissenting clergyman. He did start in to preach but had a defect in his speech. He worked hard to overcome it. He would go out into the country and talk to the trees and everything else to overcome this impediment. So he began to teach. He was in one or two different schools or half a dozen different schools. He started out to repeat experiments made by a Mr. Turner. He let the concentrated rays of the sun play on what is called red oxide of mercury. He noticed it changed color. That disturbed him. Then he observed, too, that if he happened to bring a bit of wood that was burning over the mouth of the

tube in which he had the substance that was being heated, that that burning body would increase in flame. He reasoned the thing which causes the increase in the flame is probably in the oxide of mercury. After a long period of experiments he captured that gas. He had it in a jar. The jar had first been filled with water. Then he displaced the water with gas. Into that jar he put a little mouse. The mouse in a moment or so began to jump up, turn somersaults and do all kinds of things, then lay down and seemed to die, but, taking this bottle away from it, or taking it out of the bottle in some way, and letting it lie in a warm place, it came to life again. That then set him to work to seriously test this gas, and he spoke of it as being more wholesome than the ordinary air. It was a new kind of gas. He put a candle dip that was burning into a vessel with the gas and the flame was increased, and he tells the story of how time and time again he would breathe it and felt exhilarated and lifted up. Now you know when a man is suffering from pneumonia and breathing hard and the heart pumping away, how doctors force oxygen gas in and try to carry them over the critical stage. God knew when He made the world we could not live on that gas, we would all be turning somersaults if we had nothing but that, so He put in the other gas, nitrogen, and the mixture is the air. That is roughly the story of the isolation of oxygen. The doctor made that experiment many times in this city.

Those were great men. People laughed at science but you cannot do it. In these days chemistry is running the world. It is dominating everything. It fought the last war and all warriors of the future will come to the chemists and say, "Give us means to get rid of the enemy." Those old fathers were patriots. Robert Hare was a patriot. James Woodhouse was a patriot. Adam Seybert was a patriot. They were the men that made the nitre that was used in the preparation of gunpowder in the war of 1812. Science is a

peculiar mistress and chemistry has, of course, taken hold of many men who loved experimentation and has shown to them things that are worth while. I must not get off on that line. I come back again and thank you once more for the attention you have given me this evening while I have tried to introduce a few of my old brothers to you, but do not forget that they were Philadelphians and all other cities must take their hats off to Philadelphia.

A MEMBER: Did you ever hear or know of Priestley's burning glass?

DR. SMITH: Yes, it is up at Carlisle in Dickinson College.

A MEMBER: I thought Thomas Cooper took it down.

DR. SMITH: Thomas Cooper took it up. I do not know whether he bought it from Joseph Priestley. Thomas Cooper was out visiting Dr. Priestley when he died on February 6th, 1804. He carried many of his instruments up to Carlisle. I have been after President Morgan and tried to get them. I believed the only place for the Priestley apparatus was the University of Pennsylvania, but he will not believe, not yet. I think he said if I would come up and talk in the Chapel he would give me a little something or other. He has given me a letter. Perhaps if I go to visit him, as I did the Misses Priestley, I may win out. Doctor Priestley had a beautiful seal ring which fitted this little finger of mine. I put it on and walked up and down the parlor, but of course, there came a time when those dear ladies were expecting all the relics that they laid before me to be handed back. Of course, I waited and hoped Miss Jean would say, "You may keep that ring," but she did not say anything, and Miss Anna did not say anything, so I said, "I am awfully sorry but this fits so tightly I don't believe I can get it off," but they let me work there, put my finger in my mouth and do all the things we do to get a tight-fitting ring off, and at last, of course, it came off.