

Pioneers in Telephone Engineering

Experiences With the First Telephones

By Thomas A. Watson

[Before an assembly of the Telephone Pioneers of America, Mr. T. A. Watson gave a most interesting account of his connection with the early development of the telephone. The following transcript of the stenographic report of his address has been revised for publication in the SCIENTIFIC AMERICAN SUPPLEMENT by the author.—EDITOR.]

My recollections of Dr. Bell's early telephone experiences are only those of a boy, for I was about twenty years old when I first met Dr. Bell. But they are still very vivid, as boyhood's recollections usually are. Those lectures delivered by Dr. Bell in the spring and early summer of 1877 really had a most important effect upon the present development of the telephone. At that time there was a tremendous need for cash. We had just been bitterly disappointed, we four who composed the telephone business at that time—Mr. Hubbard, Mr. Sanders, Dr. Bell, and a boy by the name of Watson. We had just received a terrible blow: The Western Union Telegraph Company had refused our offer to sell all the Bell patents for \$100,000, and we were very much depressed over it. Just about that time Dr. Bell needed money, more, I think, than he ever needed it before in his life. He wanted to get married. The need for money was so great that some of the ladies prominently connected with the original four, insisted that telephones be made and sold, by the thousands—as many as could be put out and as quickly as possible. This would have meant the flooding of the country at that time with very imperfect telephones and also would have blocked the plan of leasing them that has resulted in the present unity and universality of the telephone service.

I doubt if that idea had been carried out, of selling these early telephones, whether it would have been possible for the exchange business to have been so thoroughly controlled by the original company as it has been. The lecture course that Dr. Bell gave during the spring and summer did away with the necessity of selling those telephones. We both lived in Salem, a coincidence merely, and in Salem there was a scientific association known as the Essex Institute, an old institution that was interested in botany, bugs, archeology, antiquities, etc. It took an intense interest in Dr. Bell's experiments and invited him in February, 1877, to talk to the members of the society about the telephone and to give them an exhibition of its powers.

This was arranged. We engaged a telegraph wire of the Atlantic and Pacific Telegraph Company to connect our laboratory in Boston at No. 5 Exeter Place with Lyceum Hall. At the Lyceum end there were two or three of those old-fashioned box telephones about fourteen or fifteen inches long and eight inches square with an enormous horseshoe magnet inside of it. At my end I had a cornet player, an organ arranged so that each reed made and broke the circuit each time a key was depressed, as loud a speaking telephone as we had at that time, and, lastly, my own voice to illustrate his lecture course. Dr. Bell discussed his theories and described his experiments, calling on me occasionally, who had to be constantly listening, to illustrate from my end of the wire what he said.

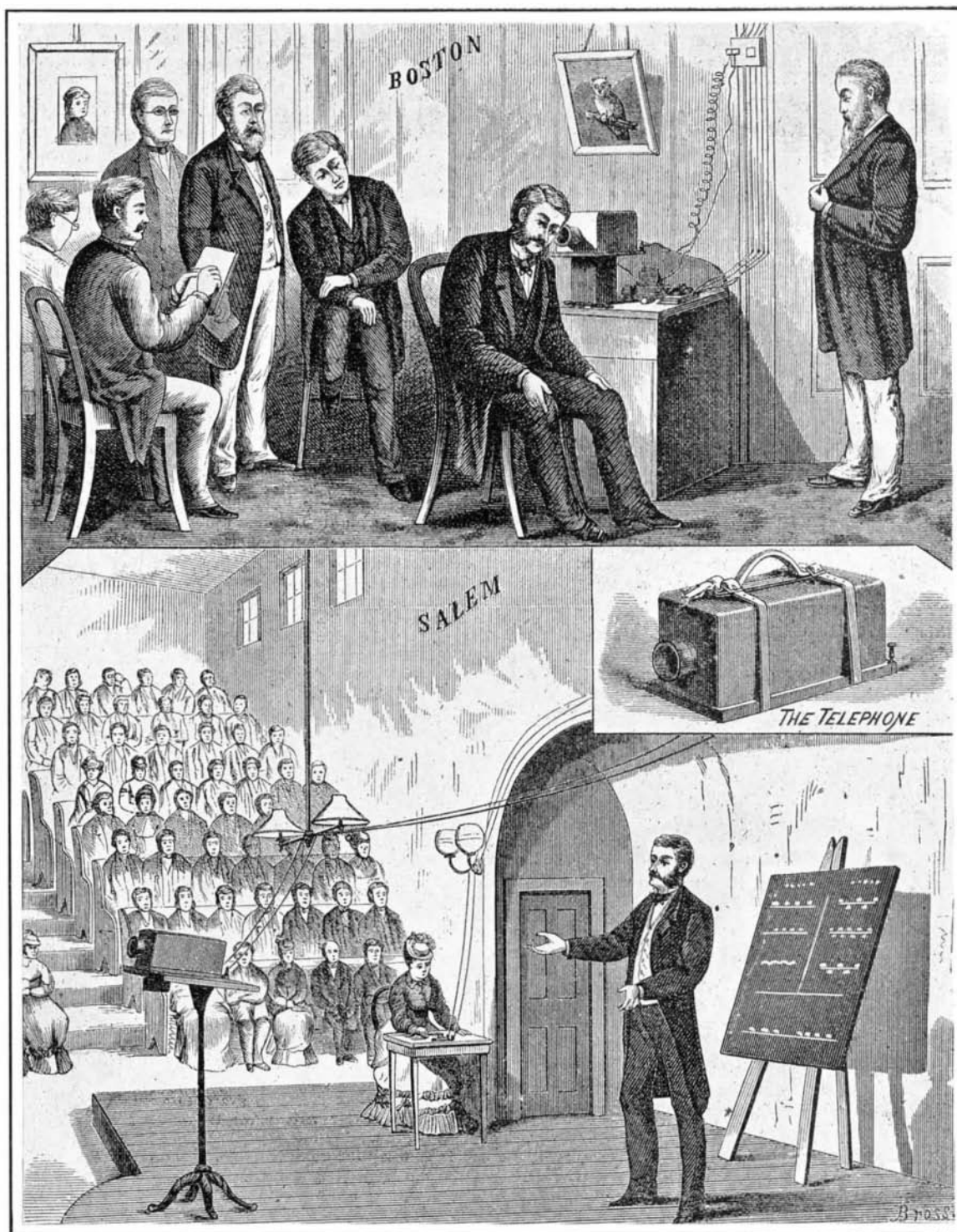
My first illustration was usually with the organ. I would play one or two tunes on that. As that produced a powerful intermittent current it came out very loudly at the receiving telephones at the hall end, even though it was sixteen miles away; then we had some cornet playing, and, although I say it—who should not—the great feature of the evening was the sentences I ejaculated through the instrument. My illustrations were usually about the same thing. They were such sentences as, "How do you do?" uttered in the stentorian voice I had developed at that time. They told me the sound came out at the receiving end, no matter how carefully I articulated it at my end, as something like "hoo, hoo, hoo;" but the rhythm was sufficient to make the audience think they heard the words perfectly; I would shout them other sentences such as "Good evening; it is a pleasant evening." "What do you think of the telephone?" etc. And then came my songs. I couldn't sing, but I had to, for they couldn't get another voice that could make the old box ring as mine did at that time. My repertoire consisted of "Yankee Doodle," "Pull for the Shore" (it was in the Moody and Sankey times), "Hold the Fort," "Auld Lang Syne," and for sentiment, "Do Not Trust Him, Gentle Lady." I remember once, at one of Dr. Bell's lectures, I branched out and added to my repertoire, "Nearer My God To Thee," but I did it but once,

for Mrs. Hubbard gave me an awful scolding the next day and I cut that out of my repertoire. After the lectures, the distinguished citizens of the town were invited to speak to Mr. Watson at the other end of the line, and there were reporters to record every word that was said. I remember very vividly how diffident distinguished citizens suddenly became when they were asked to talk through the telephone. One of our leading legal lights of Boston, who certainly should have been able to talk, when asked to speak through the telephone, gasped and all he could think of to say was, "Rig-a-jig, jig, and away we go."

That first lecture was free to the Essex Institute, but it was so successful and attracted so much attention in the newspapers all over the country, that it was repeated in Salem to an audience of five hundred that packed the little Lyceum Hall. Its success created a demand from other places. Dr. Bell saw that there was a chance to get an income, for a short time at any rate, out of the lectures, and arrangement were at once made for quite a large number of them. The first one after the second Salem lecture was at Providence, April 8th, to two thousand people who came there to hear the telephone talk. Doesn't it seem strange that such a common thing as the telephone is to-day could have attracted two thousand people to hear it? The arrangements were very much the same as in Salem, only we had in addition a brass band of five pieces. When it played in that little laboratory of ours, I don't

think I ever heard anything quite so loud in my life. It came out at the lecture hall very well, but they all said not nearly as well as Watson's singing. After that, a course of lectures was arranged in Boston. On the request sent to Dr. Bell for that course of lectures, were the names of Oliver Wendell Holmes, Henry W. Longfellow and many other well-known men. The first of these three lectures were illustrated from the laboratory, only about half a mile away from the hall; the second from Somerville; I can't remember where I was stationed for the third lecture, but it was somewhere within ten miles. The talk and the illustrations were very much the same as they were in the Salem and Providence lectures. After the Boston lectures came three lectures in New York. Prof. Bell was anxious to transmit his illustrations from Boston for at least one of the lectures in New York. To see if it was possible, a preliminary test was arranged over an Atlantic and Pacific wire connected from our laboratory in Boston to the Atlantic and Pacific building in New York. Dr. Bell came on here, and I had charge of the test at the laboratory end.

That recollection is extremely vivid in my mind because it took place in very hot weather. Our laboratory was in the upper floor of a boarding house, not an expensive boarding house either, I can assure you. The house was full of boarders, and as we had disturbed them quite seriously by shouting and talking and all sorts of noisy experiments, we were for that



This Wood-cut, Reproduced from the SCIENTIFIC AMERICAN of March 31st, 1877, Shows Prof. Graham Bell Lecturing to an Audience at Salem, Mass. The Inventor is Illustrating His Demonstration by Means of a Telephone Placed Before His Audience and Communicating With His Laboratory at Boston, Fourteen Miles Away.

and other good and sufficient reasons not on good terms with the landlady. So I realized that as I had to do the shouting of my life that night, I must muffle the noise. I took the blankets off of my bed and Dr. Bell's, and arranged a sort of a tent over my big telephone with five thicknesses of blanket. When I got the signal from Dr. Bell in New York, that he was ready to hear from me, I crawled in under my blanket tent and for two mortal hours I shouted to him. I needed no Turkish bath that night.

The next morning I asked the landlady rather timidly if I had disturbed the boarders during the night. They hadn't heard a sound. So the experiment was a success, like many others. In connection with one of the New York lectures I got into a very bad scrape. Of course, the singing that would do for Boston wouldn't do for a New York audience. So they engaged a professional singer, a negro, a big man with as superb a baritone voice as I ever heard. The first lecture was illustrated from New Brunswick, on the Pennsylvania Railroad. I went down there in the afternoon and found the negro ready to do his part of the work. I had the rest of my instruments, cornet, organ, etc., and my voice, that was always with me. I rehearsed him a little and told him, when he sang, to put his lips into that mouthpiece as tight as he could and to sing for all he was worth. He didn't like the sound of his own voice when it was so muffled, and I was a little bit anxious about it. But he promised me that he would do just what I wanted him to do that evening. I went to supper and at half past seven I went back there. The young lady operator had invited six or eight of her girl friends to witness that affair at her end of the line. It was clearly my duty to make that negro sing, and so I insisted on his crawling into that mouthpiece when Dr. Bell called for the singing. I held the telephone up to his mouth and chased him half way across the room to keep his

mouth close to it, but he backed away and wouldn't sing nearer than an inch. I knew perfectly well what was going to happen, and when I listened after he got through his song, sure enough Dr. Bell said, "The audience couldn't hear a sound, Mr. Watson; you sing." Twenty years old and the most bashful boy you ever knew, but there was no help for it, I had to sing. Those girls looked solemn; I never blamed them, but I sang my whole repertoire and I could hear them applauding in New York. My baritone singer looked at me with disgust and said:

"Is that what you wanted?"

I said "Yes."

"Well," he said, "Boss, I couldn't do that."

Then he left.

One of our troubles in those lectures was that the telegraph wires in those days were not nearly so good as they are to-day. I doubt if we ever used a larger wire than No. 8, galvanized, and I doubt if they knew how to solder their joints. The wires themselves were rusted badly. After the first lecture or two, the telegraph operators all along the line found out that their relays would hum, when I was sending the intermittent current from the organ; every station on the line would cut in its relay. As our telephones were not adapted to work against any such retardation as that, we had trouble. One night Dr. Bell lectured in Lawrence, Mass., and I tried to give them the usual programme, but not one sound could I get through because half a dozen stations cut in along the line.

Those telephone lectures created a tremendous interest. I am always surprised when I think how intense and widespread that interest was. There were many applications for lectures, so many that Dr. Bell had to employ a special agent to look after the business. The man that he chose was a young newspaper reporter named Frederick Gower, the editor of the *Providence Press*, I think. As Mr. Gower was a man who loved to appear before

the public and who lectured himself, occasionally, a dual lecture was arranged, I think in Hartford and New Haven. Dr. Bell lectured in one place and Mr. Gower in another; I, in between, at Middletown, furnished simultaneously for both lectures the usual illustrations, organ, cornet, voice, etc. Then the commercial demand for telephones took me away from the lectures and Mr. Gower got others to do the illustrating. At about that time, the day of Dr. Bell's marriage approached and he gave up lecturing, leaving the business in the hands of Mr. Gower, who carried it on a while longer. Soon after, Mr. Bell was married and went to England and my time became entirely absorbed by the commercial development of the telephone and the auxiliary apparatus. Mr. Gower had a contract for the exclusive use of the telephone in New England, but he was not handling the business very well, and one day Mr. Gardiner Hubbard asked me if I had any suggestion to make as to how he could get rid of Mr. Gower's contract. I suggested that he offer Mr. Gower the exclusive right to lecture on the telephone for the whole United States if he would give up his contract, and sure enough, Gower made the exchange. I think that gives one a good idea of the size of the telephone business at that time when a man with a contract for the whole of New England would give up that contract, worth to-day many millions of dollars, for the right to lecture on the telephone, a right that could not be conferred, anyway!

This course of lectures not only made possible Dr. Bell's marriage at that time, but it attracted capital to the telephone business and stimulated the commercial demand tremendously, and, more important than all, I believe it was a most important factor in determining the leasing of telephones instead of selling them outright, Mr. Gardiner Hubbard's plan, which made possible the uniformity of the Bell system to-day.

Ammonium Sulphate from Ammonia and Sulphur Dioxide*

Ammonia and Hydrogen Sulphide from Coal Gas and the Direct Production of Ammonium Sulphate

By Walter Feld

FOR the production of ammonium sulphate the by-product coke oven industry depends at present on the sulphuric acid industry, since the usual method of producing ammonium sulphate is based on the reaction between ammonia and sulphuric acid. This commercial inter-relation is at times very troublesome.

Evidently a great advance would be made if ammonium sulphate could be produced commercially and economically from ammonia and sulphurous acid. The advance would be great if the sulphurous acid were to be obtained from the roasting of sulphides. But the proposition would look even more promising and important if the sulphur contained in gasified coal and a large part of which passes into the gas as hydrogen sulphide, could be used directly for combining with the ammonia in the coal gas for the formation of ammonium sulphate.

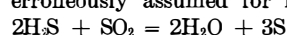
For these reasons it is hardly surprising that for a long time attempts have been made to combine directly ammonia and sulphurous acid. Laming tried it as early as 1852 (British patent 14260). But he and others who worked along similar lines, overlooked that the reaction by which ammonia and sulphur dioxide combine will not proceed until it is complete. Neutral ammonium sulphite $(\text{NH}_4)_2\text{SO}_3$. H_2O gives off ammonia and the quantity of the ammonia given off increases with the temperature. The residue is a wet acid salt $(\text{NH}_4)_2\text{SO}_3$ which, in air, gives off sulphur dioxide, while only a small part is changed into sulphate. This whole behavior of the sulphites is due to the high vapor tension of both ammonia and sulphur dioxide and for this reason it is an impossibility to absorb *completely* ammonia contained in gases by means of an aqueous sulphurous acid solution or to absorb *completely* sulphur dioxide in gases by means of an ammonia solution.

But even if these difficulties could be overcome in practice (which seems impossible) the resulting salt would be of a very unstable nature. To use ammonium sulphite directly as a fertilizer (Lachomette's British patent 17050 of 1887) is impractical for more than one reason, especially on account of its tendency to give off sulphur dioxide and ammonia to the atmosphere. All attempts to change ammonium sulphite into ammonium sulphate by contact with air have been unsuccessful and must be so for good inherent reasons.

ABSORPTION BY TAR OILS.

For many years I have been interested in the reaction between sulphur dioxide and hydrogen sulphide, which

is rather complicated, although the equation usually and probably erroneously assumed for it



is simple enough.

In the course of our extended researches in this field, my collaborator, Mr. A. Jahl, established the fact that certain tar oils are excellent solvents for sulphur dioxide and sulphur.

Pure sulphur dioxide, introduced into heavy tar oils, is eagerly absorbed with a strong evolution of heat. If this is carried out in a closed bottle with shaking, the reaction is so energetic that the atmospheric pressure above the liquid is considerably reduced, while the temperature rises.

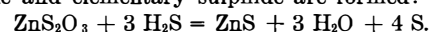
Now, if a tar oil has been saturated with sulphur dioxide and pure hydrogen sulphide is then passed into it, this is also completely absorbed, while simultaneously the temperature increases and the pressure decreases. In this reaction the sulphur dioxide and hydrogen sulphide react, forming sulphur and water, the sulphur dissolving in the hot tar oil.

If now the tar oil is treated alternately with sulphur dioxide and hydrogen sulphide, part of the dissolved sulphur will in time crystallize out of the saturated oil in crystalline grain form.

While this process appears to be very simple, yet it involves great difficulties when applied to gases which contain sulphur dioxide and hydrogen sulphide in great dilution.

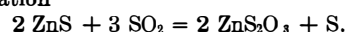
ABSORPTION BY ZINC THIOSULPHATE.

Further experiments showed that hydrogen sulphide decomposes zinc thiosulphate in such a way that zinc sulphide and elementary sulphide are formed:



If concentrated or dilute hydrogen sulphide is introduced into solution of ZnS_2O_3 , the hydrogen sulphide is completely absorbed. In experiments carried out on a large scale with illuminating gas which was practically free from ammonia, one single washing apparatus was sufficient to absorb 80 to 90 per cent of the hydrogen sulphide in the gas by means of zinc thiosulphate solution.

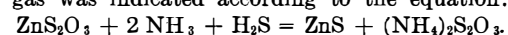
The intention was to regenerate the ZnS_2O_3 from the zinc sulphide by means of sulphur dioxide, according to the equation



But this regeneration process does not work. First, the zinc sulphide is dissolved very slowly only in sulphur dioxide. Second, the regenerated zinc solution has lost most of its ability of absorbing hydrogen sulphide. The reason is that the regeneration process

does not take place as had been supposed, since when zinc sulphide and sulphur dioxide react together, polythionate ZnS_4O_6 , instead of the thiosulphate ZnS_2O_3 , is mainly formed, and it is a fact for which good physico-chemical reasons may be given, that hydrogen sulphide acts strongly on zinc thiosulphate, but slightly only on polythionate.

In spite of these shortcomings, the process indicated a direction in which the work was to be done. It is especially noteworthy that a possibility of absorbing simultaneously hydrogen sulphide and ammonia from the gas was indicated according to the equation:



As a matter of fact, experiments showed that not only hydrogen sulphide, but ammonia could be absorbed in this way.

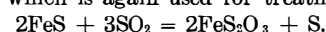
ABSORPTION BY FeS_2O_3 .

The regeneration difficulty in the use of ZnS_2O_3 is overcome by using the iron salt FeS_2O_3 instead of the zinc salt for absorption.

The gases which contain ammonia and hydrogen sulphide are washed with FeS_2O_3 , whereby iron sulphides are precipitated.

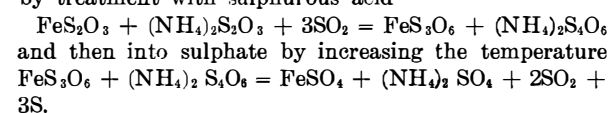


The iron sulphide is dissolved in sulphurous acid forming FeS_2O_3 , which is again used for treatment of gases:



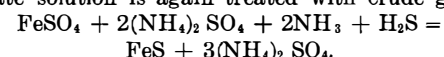
When the alternate treatment with gas and sulphur dioxide has been repeated several times, the content of the ammonium salt has increased to such an extent that the recovery of ammonium sulphate from the solution becomes profitable.

The thiosulphate is now changed into polythionate by treatment with sulphurous acid



The heating may be carried out simultaneously with the treatment with sulphurous acid so that the last reaction takes place practically simultaneously with the preceding one.

The formation of ferrous sulphate is accompanied by the formation of sulphur dioxide and free sulphur. The free sulphur is burned to sulphur dioxide, while the sulphate solution is again treated with crude gas:



The ammonium sulphate solution is separated from the iron sulphide and concentrated by evaporation.

This process has proven practicable on a large com-

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