

EDISON'S STORIES OF HIS INVENTIONS

Funny Experiences in Development of His Incandescent Light.

TRIUMPH AFTER MANY ERRORS

Reminiscences of His Experiences in the First Central Station.

From the Electrical Review.

Mr. Thomas A. Edison is not an easy man to find at home. During the day, and often far into the night, he is at the big brick laboratory building in Orange, N. J., and this building is surrounded by a very high and discouraging picketed fence, in a remote corner of which is a gate and nearby a push-button. Once through this—and it is hard to get through it—various dragons lie in wait for the bold person who undertakes to interrupt one of the busiest men in the world.

One's visit, the visitor is conducted into a spacious and lofty library, where he waits. Here, after a time, comes to him the genies of the place, and so it was when Mr. Edison talked with one of us the other day about the starting of the Pearl Street station in New York City and the birth of electric lighting as an industry.

The passing of time has left few marks upon the veteran inventor; perhaps his hair is a little grayer, but he entered the library with a springing step that would have done credit to a boy, and hailed his visitor with a dash of the old-time enthusiasm.

"So you want to talk about the old days at Pearl Street," said he. "Well, I hardly know when to begin. It was something like this: The central station idea struck me all of a sudden in 1878. In those days, you know, we had arc lamps. I had been down to see Prof. Barker at Philadelphia, and he had shown me one. A little later I had seen another one. I think it was one of Brush's marks—and the whole outfit, engine, dynamo and one or two lamps, was traveling around the country with a circus. At that time Wallace and Messers. Farmer had succeeded in getting ten or fifteen lamps to burn together in series. It happened that I was comparatively at leisure then, because I had just finished working on the carbon button telephone, and this electric light idea took possession of me. It was easy to see what the thing needed; it wanted to be subdivided. The light was too bright and too big. What we wished for was little lights and a distribution of them to people's houses in just the same way that gas is sent around and burned at your fixture when you want it. I remember, along about then, Grosvenor P. Lowry thought perhaps I could succeed in solving the problem and he raised a little money and formed the Edison Electric Light Company. We started the laboratory at Menlo Park. The way we worked it was that I got a certain sum of money a week and employed a certain number of men, and we went ahead to see what we could do."

MAKING INCANDESCENT LAMPS.

Replying to an inquiry as to how he went at the problem, Mr. Edison laughed and said: "Why, it was easy. It was easy enough to see that the subdivision never could be accomplished unless each light was made independent of every other. Now, it was plain enough that they could not burn in series, hence they must burn in multiple arc. It was with this conviction that I started. I was fired with the idea of the incandescent lamp as opposed to the arc lamp, so I went to work and got some very fine platinum wire drawn. As well as I remember it was made by Johnson, Mathy & Co., in London. We tried to make the platinum work, but it didn't stand. Then we tried mixing in about 10 per cent. of iridium with the platinum, but we couldn't force that high enough without melting it. After that came a lot of experimenting, covering the wire with oxide of cerium and a lot of other things such as the Welsbach people use nowadays. Then I got a great idea; I took a cylinder of zirconia and wound about 100 feet of the fine platinum wire on it, coated with magnesia from the syrupy acetate. What I was after was getting a high-resistance lamp, and I made one in that way that worked up to forty ohms, but the darned oxide developed the phenomena that Dr. Nostrand has run up against lately—I didn't see it then as he does now—and the lamp short-circuited itself.

"After that," continued the inventor, warming to his subject, "we went fishing around and trying all sorts and shapes of things to make a filament that would stand. We tried silicon and boron and a lot of things that I have forgotten now. The funny part of it was that I never thought in those days that carbon would answer, because a fine hair of carbon was so sensitive to oxidation. Finally I thought I would try it because we had got very high vacua and good conditions for it. There were quite a lot of us in those days that used to talk things over together at Menlo Park. There was Charlie Hughes, and Bachler, and Upton, and poor Kruesel. C. S. Bradley came with us a little later, on our central station work.

SIMPLE CARBON THE THING.

"Well, we sent out and bought some cotton thread and carbonized it and made the first filament. We had already managed to get pretty high vacua, and we thought maybe the filament would be stable. We built the lamp and lighted it; it lit up, and in the first few breathless minutes we measured its resistance quickly and found it was 275 ohms—all we wanted. Then we sat down and looked at that lamp; we wanted to see how long it would burn. There was the problem solved—if the filament would last. The day was—let me see—Oct. 21, 1879. We sat and looked and the lamp continued to burn, and the longer it burned the more fascinated we were. None of us could go to bed, and there was no sleep for over forty hours; we sat and just watched it with anxiety growing into elation. It lasted about forty-five hours, and then I said, 'If it will burn forty hours now, I know I can make it burn a hundred.'"

"There we were. We saw that carbon was what we wanted; the next question was what kind of carbon. I began to try various things, and finally I carbonized a little strip of bamboo from a Japanese fan and found that that was what we were seeking."

FIRST DISPLAY OF THE LAMP.

It was evident that Mr. Edison was pleased as he recalled these early days of the incandescent lamp and the joy of creation he must have felt in reaching his desideratum at last, but the lamp was by no means all. He continued: "I had the central station in mind all the time. I wanted to use 110 volts. Now, there is no use for you to ask me why, because I don't know, but somehow that figure stuck in my mind, and I had calculated that, if we could get the voltage that high, the copper cost would be somewhere within sight. I got an insurance map of New York City. Did you ever see one? Many big fat volumes, full of plates, with every elevator shaft, and tower, and house top, and fire wall in town set down and duly colored in its place. I laid out a district, and figured out an idea of the central station to feed that part of the town from just south of Wall Street up to Canal and over from Broadway to the East River; but what I wanted to know was whether my lamps could be made in quantity and depended upon. We went to work and made up a lot of them. W. J. Hammer had charge of the tests, and they seemed to work out all right. Then it was that we invited the Board of Aldermen out to Menlo Park." Here Mr. Edison chuckled. "It was a great day," he said, "or a great night, rather. I have forgotten the exact date, but it was either the 2d or 3d of January, 1880. The Aldermen came out in a special train from New York, and the first thing they saw were the streets of Menlo Park all lit up with incandescent lamps. You know," he explained, apologetically, "that there was a land speculation about there then. We had the lamps strung along on two big wires, and we could light or extinguish one without affecting the others, and this was a thing that seemed magic to the Aldermen. I remember that Mr. Hiram Maxim was at this exhibition."

From the way he smiled at the remembrance Mr. Edison must have enjoyed the Aldermanic visit. He went on: "The station idea was still mighty strong with me. Why, I know where every half-way and bulkhead down in that district of New York was, and what every man paid for gas. How did I know? Simplest thing in the world. I hired a man to start in every day about 2 o'clock and walk around through the district noting the number of gas lights

burning in the various premises; then at 3 o'clock he went around again and made more notes, and at 4 o'clock, and every other hour up to 2 or 3 o'clock in the morning. In that way it was easy enough to figure out the gas consumption of every tenant and of the whole district. Other men took other sections. Simple, wasn't it? "I found there were 750 freight hoists. Like Sellers, I figured, every one would have a motor."

AFTER "IMPOSSIBLE" ENGINES.

"We were now fairly committed to the lighting project and started in to build a central station. You can't imagine how hard it was. There was nothing that we could buy or that anybody else could make for us. We built the thing with our hands, as it were. We went to work at Menlo Park and started a lamp factory. Poor Kruesel [Mr. Kruesel died recently] was set to work making the tubes over in Washington Street, and we hired in a kind of second-class machine shop in Goerck Street and there started out to make the dynamos. We went at it with our own money and credit." Here Mr. Edison's eyes twinkled and he said: "I believe it was mostly credit. Anyhow, we struggled along and we got the money put up for the Pearl Street station by starting the New York Edison Illuminating Company. I planned out the station and found where it ought to go, but we couldn't get real estate where it was wanted. Why, man, they charged us \$75,000 apiece for two old bum buildings down in Pearl Street, where we finally settled. I tell you, it made my hair stand on end. We had very little room and we wanted a big output. There was nothing else for it but to get high-speed engines, and, as you know, there were no high-speed engines in those days. I had conceived the idea of a direct-coupled machine and wanted to hitch the dynamo direct to the engine without belting. I couldn't see why, if a locomotive could run at that speed, a 150-horse power engine could not be made to run 350 turns a minute. The engine builders, when I asked them about it, held up their hands and said 'Impossible!' I didn't think so. Finally I found C. H. Porter and I said to him: 'Mr. Porter, I want a 150-horse-power engine to run 700 revolutions per minute.' He hemmed and hawed a little while and finally agreed to try to build it—if I would pay for it. I believe he charged me \$4,200 for it. He got it finished finally and sent it out to the Park and a fellow of the name of Emmis along with it. He was one of the nerviest chaps I ever saw. We set the machine up in the old shop and we had some idea of what might happen, so we tied a chain around the throttle valve and ran it out through a window into the woodshed, where we stood to work it. Now, if you remember the old shop you know it stood on top of one of those New Jersey shale hills. We opened her up and when she got to about 300 revolutions the whole hill shook under her. We shut her off and rebalanced and tried again, and after a good deal of trouble we finally did run up to 700, but you ought to have seen her run. Why, every time the connecting rod went up she tried to lift that whole hill with her! After we got through with this business we tamed her down to 350 revolutions, (which was all I wanted,) and then everybody said, 'Why, how beautifully it runs, and how practicable such an engine is.' Now, don't you know, I knew they would say that. Didn't you ever find out that trying to do the impossible makes about half the impossible seem easy?"

"We closed a deal for six engines, and I went to work at Goerck Street to build the dynamos on to them. Of course, we built them by guesswork. I guessed at 110 volts—and didn't guess enough. That's why, if you want to know, the extra pole pieces were put on those old machines. They managed to lift the voltage to what I wanted."

THE START AT PEARL STREET CENTRAL STATION.

Going back to the Pearl Street station idea, Mr. Edison said: "While all this was going on in the shop we had dug ditches and laid mains all around the district. I used to sleep nights on piles of pipes in the station, and do you know I saw every box poured and every connection made on that whole job? There wasn't anybody else who could superintend it."

"Finally we got our feeders all down and started to put on an engine and turn over one of the machines to see how things were. My heart was in my mouth at first, but everything worked all right and we had more than 500 ohms insulation resistance. Then we started another engine and threw them in parallel. Of all the circuses since Adam was born, we had the worst then! One engine would stop and the other would run up to about a thousand revolutions, and then they would seasaw." Mr. Edison's eyes twinkled with animation at the thought.

"What was the matter? Why, it was those darned Porter governors! When the circus commenced the gang that was standing around ran off precipitately, and some of them kept running for a block or two. I grabbed the throttle of one engine and E. H. Johnson, who was the only one present to keep his wits, caught hold of the other and we shut them off. Of course, I discovered then that what had happened was that one set was running the other one as a motor. I then put up a long shaft, connecting all the governors together, and thought this would certainly cure the trouble, but it didn't. The torsion of the shaft was so great that one governor still managed to get ahead of the others. Well, it was a serious state of things, and I worried over it a lot. Finally I went down to Goerck Street and got a piece of shafting and a tube in which it fitted. I twisted the shafting one way and the tube the other as far as I could and pinned them together. In this way, by straining the whole outfit up to its elastic limit in opposite directions, the torsion was practically eliminated, and after that the governors ran together all right."

SOME TRIALS IN EARLY LIGHTING OPERATIONS.

"About that time I got hold of Gardiner C. Sims and he undertook to build an engine to run at 350 revolutions and give 175 horse power. He went back to Providence and set to work and brought the engine back with him to the shop. It worked only a few minutes, when it busted. That man sat around that shop and slept in it for three weeks until he got his engine right and made it work the way we wanted it to. When he reached this period I gave orders for the engine works to run night and day until we got enough engines, and when all was ready we started the engines. The date was Sept. 4, 1882—a Saturday night. That was when we first turned the current on to the mains for regular light distribution, and it staid on for eight years, with only one insignificant stoppage. One of those first engines that Sims built ran 24 hours a day, 365 days in the year, for over a year before it was ever stopped."

Questioned about the details of the work in those now ancient days, Mr. Edison said: "Of course, we had the whole thing to design in gross and in detail and everything to standardize. There were meters, safety catches, fuses, and all the rest of it, but somehow we managed to work it out. At first we had horrible mismanagement. The only title to existence that such a concern had was its ability to make money, and we didn't seem to make any at first. Finally I went to Chinnock—of course you know who C. E. Chinnock is and told him that if he would take hold of the thing and make it work I, personally, would give a good bonus besides his salary. Well, Sir, that man pitched in, and inside of eight or nine months had earned and received his bonus."

"I don't remember who it was that wanted to connect in a lot of places that used the light only occasionally, but some such establishments were on our mains, and one of them was the Stock Exchange. Now, the Stock Exchange isn't lighted very often, and there were a good many lamps there. I remember that one day—along in the holidays, I think it was—we were loaded pretty well up to our limit, and I was terribly afraid that that Stock Exchange would have its lights turned on and overload us irremediably. I was in that part of the town, and all at once noticed that the Exchange people had turned on their lights. I got to a telephone and called up Chinnock and asked him how things were."

"How is it with you at the station?" said I.

"Oh, bully," says he.

"Are the machines standing up to it?" I asked him.

"Sure," says he; "but everything's red hot, and the ammeter has made two revolutions!"

PRIMITIVE METERS IN COLD WEATHER.

Mr. Edison went on to recount some of the details of the work. Those were the days of the old chemical meter, which, as every one remembers, contained two jars of a liquid solution which might, of course, if the weather became cold enough, freeze. "Those meters," said the inventor, "gave us a good deal of apprehension. I was afraid they would freeze especially in the water-front neighborhood, where the commission houses are. You know those people there keep the front door open all the year round, and it gets pretty cold inside their places in the Winter time. So I went to work and put an incandescent lamp in each meter case, with a thermostat strip that would make a contact through the lamp when the temperature fell to 40 degrees. Well, you ought to have seen the trouble that that simple thing got us into. There came along a cold snap of weather, and the first thing I knew the telephone began to ring about every five minutes and people would say:

"Our meter's red hot; is that all right?"

"Then another one would call up and say:

"Our meter's on fire inside and we poured water on it. Did that hurt it?"

Asked about measuring instruments and

methods of keeping the station up to an accurate and uniform voltage, Mr. Edison said: "Voltmeters? We didn't have any. We used lamps. Once, down there, we found our insulation resistance had gotten down to 100 ohms; the Directors seemed to be scared, but I told them that if it didn't get below one ohm we were all right. I used to have a good deal of trouble with the mathematicians at that time, but I found after a while that I could guess a good deal closer than they could figure, so I went on guessing. Why, in our early work there we used to hang up a shingle nail, tie it on a string alongside one of the feeders, and use that for a heavy current ammeter. It worked all right. When the nail came close to the feeder we screwed up the rheostat a little and kept the lamps in the station looking about right."

"That was the time that I conceived the notion of pressure wires running back from the distribution centres of the various feeders. You know, in those days," Edison said with an apologetic smile, "our lamps weren't rugged at all. What they wanted was just 110 volts, and not another volt."

DEVELOPING THE DYNAMOS.

Here the conversation turned to dynamos even older than those of the Pearl Street station, and we talked a while about the name building in the Dark Ages. "When I started making dynamos," Mr. Edison said, with an introspective look, "I was told that to get the best effects the resistance of the machine must be equal to that of its load! Did you ever hear of such foolishness? I thought it was darned strange to lose half of the energy I generated in the machine, because what I was after was to get the stuff out and sell it! I had an old Gramme machine, and I worked over it. It had a terribly high resistance. I figured out that if one turn on that armature would give one volt, the way she stood, by making great big magnets I could get more volts. I went ahead on that line, and I remember I made one little machine that had a small armature about as big as your fist and about two tons of cast-iron in its field magnets. It might not look like much to-day, but it worked all right when the outside resistance was thirty times as big as that in the machine. That was what started me on the large field magnets. I remember at a dinner on the other side talking to Werner Siemens and Hefner von Alteneck and telling them that what we needed was a great big magnet to bring the juice out of the armature. They agreed with me, but," and here he chuckled, "do you know, both of them said they had thought of it before? When I got back I went to work and made my magnets big and made them on a machine that was too long. As Dr. Hopkinson found out for me, it was a great man and understood his job. He figured out that making the magnets short and cutting down the air space was the thing, and he was right. After all, in those days all of us were guessing, and I happened to be a pretty good guesser."

EDISON'S BRIGHT ASSISTANTS.

We were led to speak at this point of the recent death of Mr. William H. Moore, who was once associated with Mr. Edison. This started Mr. Edison on some reminiscences of the hunt for materials for the filaments at the time when bamboo seemed the most promising. "Why," said he, "I sent a school teacher from Orange—I have forgotten his name—to Sumatra, and another fellow up the Amazon. He got stuck somewhere up there, but worked his way over through Bolivia and got back. Finally, Moore went to Japan and got the real thing there. We made a contract with an old Jap to supply us with the proper fibre, and that man went to work and cultivated and cross-fertilized bamboo until he got exactly what we wanted. I believe he made a fortune out of it. I tell you, in those days the boys hustled hard. One man went down to Havana, and the day he got there he was seized with the yellow fever and died in the afternoon. When I read the cable message that told of it in the shop about a dozen of the boys jumped up and asked for his job! Those boys were a bright lot of chaps, and sometimes it was hard to select the right ones for a particular piece of work. I once got an order from England to send over fifteen men expert in telephone work, so I went to work and rigged up some telephones and did all sorts of things to 'em. I would stick the point of a jack-knife through the insulation in spots and cut a wire, and in various ways introduce 'bugs' into those instruments; then the boys were set to work to find out what was the matter with them. If a fellow could find out ten times inside of ten minutes what the various troubles were he got his passage paid and was started about for me. It was three of the boys managed to stand this test, and I believe that every one of them who went abroad made money. This was back in 1878 or 1879."

TELEPHONE AND ELECTRIC RAILWAY.

Asked about his early inventions before he began to work on the electric light problem, Mr. Edison said, "When I struck the telephone business the Bell people had no transmitter, but were talking into the magneto receiver. You never heard such noise and buzzing as there was in those old machines. I went to work and monkeyed around and finally struck the notion of the lamplack button. The Western Union Telegraph Company thought this was a first-rate scheme and bought the thing out, but afterward they consolidated and I went out of the telephone business."

Asked about the invention of the fuse wire, Mr. Edison laughed as he recalled the first occasion for its use. "Why," he said, "the night those Aldermen came out to Menlo Park I figured that an interruption would be serious, and had thought out the scheme of putting some fine copper wire in as fuses in various places. There was a fellow in the party—I won't mention his name—and he had a little piece of heavy wire in his hand. While the Aldermen were looking at some lamps strung between two bare mains this fellow walked up and short-circuited the mains with his wire. I believe he was the most surprised man of the party, because only three lamps went out. The reason that led me to think of the fuse wire was that we weren't flush of dynamos in those days. I had burned out two or three and I saw that something was needed to prevent that happening again. After my experience with my short-circuiting friend, I had fuses put in all over."

The talk turned to the early days of the electric railway, and Mr. Edison said: "Yes, I was in that, too. I had a three-mile road out there in 1883, and we used to pull freight cars up to the laboratory on it. We made as much as forty miles an hour at times. Now that railroad project seemed to me to be a mighty good thing. You know I had a Board of Directors in those days—men with bulging foreheads—fellows that thought away ahead into the future, and I went to work and carefully elaborated all the ideas I had for electric railways and submitted them to the board. They considered the subject carefully and fully, and unanimously decided that there was no money in the electric railroad, and that they would let it alone."

SOME INVENTIONS THAT WERE NOT WANTED.

"What was my first electrical invention? You would never guess. It was a machine to record votes in Congress. It was a mighty good invention. I had a lot of iron type, each member's name being set up in a line, and these lines were controlled by push buttons and electro-magnets, so that each man could bring his name up on the 'yea' side or the 'nay' side, as he pleased. I used chemically sensitized paper to record them, and the thing worked fine. A brother telegraph operator named Sam—I have forgotten the rest of his name—and myself were dead sure that we were going to make \$50,000 out of it. He took the thing before a Congressional committee, and the first thing they told him was that if there was anything on earth the members of Congress did not want it was just that kind of thing, because the only right the minority had was to delay the game! After that experience, which was in 1869, I knew enough not to invent anything again until I was sure it was wanted."

Going back to his own early history and the story of his connection with the electrical field, Mr. Edison said that one of the first things he went into was a messenger call box, or domestic telegraph system. "We got the thing into shape," he said, "and made 200 instruments, and then sent two men out to get subscribers, and they tramped around without avail day after day, and our hopes sank and sank further and further. Finally a man named Brown came along, and the first day he tackled the job he got six. This sent our hopes up again, and after he got the lines loaded up with subscribers we sold the scheme out and realized a good profit on it. After that I worked out the stock ticker."

"What were my principal patents? Good gracious, man! Oh, you first and foremost patents—inventions? Why, you don't mean them, the idea of the electric lighting central station; then—let me see, what have I invented? Well, there was the mimeograph, and the electric pen, and the carbon telephone and the incandescent lamp and its accessories, and the quadruplex telegraph, and the automatic telegraph, and the phonograph, and the kinetoscope, and—I don't know—a whole lot of other things."