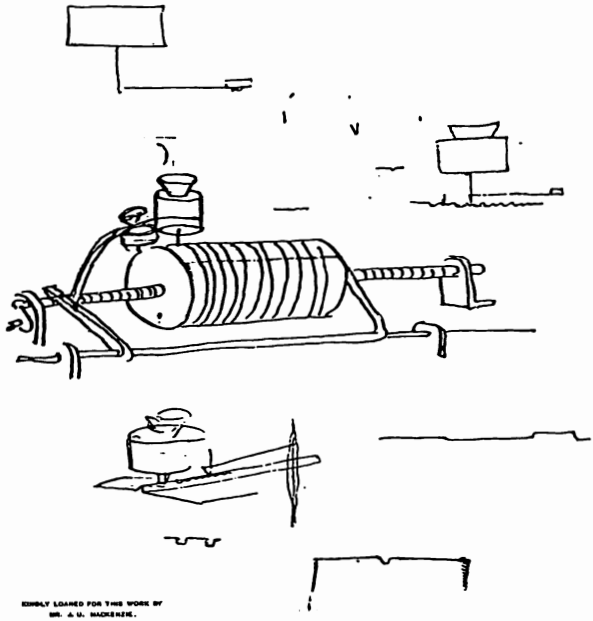


KINDLY LOANED FOR THIS WORK BY
MR. A. U. MACKENZIE.

FIRST SKETCH OF THE PHONOGRAPH.

[From Edison's Original Drawing.]

FROM THE LABORATORY OF
T. A. EDISON,
MENLO PARK, N. J.
U. S. A.

The above sketch was made by Mr Edison at Menlo Park N.J. at the time of the inception of the Phonograph, it was made in my presence and has never been out of my own possession since then

New York A.U. Mackenzie
May 20th 1893

The Edison Invention of the Phonograph

by

Raymond R. Wile

PREFACE

It seems incredible that the invention of a device as pervasive as the phonograph should have its origins shrouded in mystery--Edison himself gave several conflicting accounts and little firm documentary evidence seemingly survived at the Edison National Historic Site. Edison's own surviving autobiographical notes that were prepared for use in the preparation of the Dyer and Martin biography Edison: his life and inventions are silent since the section concerning the invention of the phonograph disappeared sometime after being utilized by Matthew Josephson in his biography of Edison. The tissue letter books for the period 1877 and 1878 were watersoaked at one time so that the majority of the material is now unreadable. Few pertinent letters have survived while the remaining Edison laboratory notebooks begin after the year 1877. (Authors who mentioned laboratory notebooks from this period were in error--in reality they were referring to laboratory drawings that had been mounted in scrapbooks--each of which was devoted to a specific experimental subject.)

Previous published accounts have often been tentative because of the seemingly unresolvable documentary problems arising from the difficulty of connecting a discovery date of July 18, 1877 with an invention date of December 1877. This has also been complicated by a distressing habit of utilizing unreliable sources without proper acknowledgement. As a result we have had a plethora of poor accounts and those generated by the Centennial of the Phonograph were for the most part no exception. In my own work I have attempted to conduct all of my investigations as if there were possible documentary sources that I might have missed. This careful, painstaking, and often plodding method has resulted in the revelation of many new and hitherto unutilized sources--documents filed under subject categories other than phonograph, extensive depositions utilized in patent cases, and previously unutilized laboratory sheets and reminiscences. There are still gaps in the record but it is now easier to prepare an account of the activities that took place in the large second floor room of the Menlo Park Laboratory between July and December of 1877.[a]

I wish to acknowledge with gratitude the partial support of the New Jersey Historical Commission, the Faculty Research Award Program of City University (FRAP 11042) and the Professional Staff Congress/Board of Higher Education Award Program (PSC/BHE 12061). Without such assistance my project would have been unduly delayed and much evidence might

never had been unearthed. The awards also allowed the electrostatic copying of large masses of documents so that the author might examine the documentation at his leisure. All items quoted from exist as electrostatic copies in the author's research archives.

Should further documentation exist the author would be pleased to have the material called to his attention.

April 1982

Raymond R. Wile
Paul Klapper Library
Queens College
Flushing, N.Y. 11367

Note: A previous version of this paper was presented at the Symposium devoted to the Centenary of the invention of the phonograph held at the Royal Scottish Museum, Edinburgh, Scotland on July 2, 1977.

THE INVENTION

Almost from the beginning the development of the first phonograph was surrounded by mystery and controversy. Conflicting accounts circulating in 1878 involve the Edison automatic telegraph, the Edison telephone or a toy that operated from the action of a voice-powered ratchet. The early patents also contribute to this confusion--the first tentative and partial disclosure appears in the Provisional Specifications of an English patent devoted to the Edison telephone while the later American phonograph patent specifically mentions that certain claims were included in the application for the Edison automatic telegraph. The delay in the granting of the telegraph patent, which had been applied for at a time earlier than the phonograph, also tends to confuse matters.

Differing stories circulated simultaneously and sometimes appeared side by side in printed works as if contemporary editors could not themselves sort out the actuality. The individuals involved in the stories also differ--the chief assistant in the earlier versions is James Adams but after his death in the early 1880's he is replaced by John Kruesi. The story of a bet also shows significant variations. In one it is a box of cigars, in another it is fifteen cigars and in still another it is a barrel of apples. All accounts contain one common element--amazement that the conception worked the first time. One of Edison's contemporary accounts stated:

> "I was singing...to the mouthpiece of a telephone, when the vibrations of the wire sent the fine steel point into my finger. That sent me to thinking. If I could record the actions of the point, and then send the point over the same surface afterwards, I saw no reason why the thing would not talk.
>
> "I tried the experiment, first on a strip of telegraph paper and found that the point made an alphabet. I shouted the word 'Halloo! Halloo!' into the mouthpiece, ran the paper back over the steel point and heard a faint Halloo! Halloo! in return! I determined to make a machine that would work accurately, and gave my assistants instructions, telling them what I had discovered.
>
> "They laughed at me. I bet fifteen cigars with one of my assistants, Mr. Adams, that the thing would work the first time without a break, and won them. That's the whole story. The discovery came through the pricking of a finger."[1]

Edison was not alone in conducting experiments in the transmission and theory of sound and its transmission. At the time in question he had been working on a telephonic system and with all the work that was being performed by Alexander Graham Bell, Elisha Gray and others on the telephone in the eighteen seventies it seemed probable that some

individual would either discover or develop a means by which it could be reproduced. From an original conception of Leon Scott de Martinville in 1857 of a means of obtaining sound waves recorded on a lamp-blackened cylinder surface it might only be a matter of time before someone discovered a means of reproducing them. Scott's device, known as the phonautograph,

> "...was provided with a rotating cylinder, which progressed longitudinally at the same time it was rotated, and on the periphery of this cylinder was a covering of lamp-blacked paper. Adjacent to the surface of the cylinder as a vibrating membrane and a funnel, said membrane being set into vibration by sounds produced at the mouth of the funnel. This membrane is connected with a style which is vibrated by the membrane, the point of the style being then in contact with the lamp-blacked covered surface of the rotating and advancing cylinder. The result of the operation of the phonautograph is, that the vibrating style scrapes off the film or layer of lamp black and exposes the surface of the paper covering beneath. The line traced by the style is a spiral line due to the rotation and logitudinal advance of the cylinder, and is a sinuous line due to the vibration of the style under the influence of the sounds impressed upon the diaphragm, the character, extent and shape of the sinuosity depending upon the particular sounds impressed. The sinuous spiral line thus formed is rendered visible by reason of the fact that the style scrapes away the lamp-black coating, thereby exposing the paper beneath. The phonautograph thus makes a visual record of the sounds. The phonautograph, however, is incapable of reproducing sound, and consequently is and was interesting solely by reason of the fact that it gave a visual record which was useful for scientific purposes in demonstrating the wave theory of sound."[2]

It was to take a French poet, Charles Cros, to detail a theoretical method for reproducing the sound patterns that were visually evident on the drum of the Phonautograph. Either lacking the requisite financial backing or impaired by difficulties in reducing his conception to practice Cros was impelled to establish his claim through the method of depositing a description of his method with the Academy of Sciences in Paris. The sealed envelope, to be opened only when requested by Cros, was delivered in April of 1877. Such a deposit was equivalent to the American Patent Office practice involving Caveats. In American practice the document had an operable existence of one year--after that it no longer provided protection for the inventor who submitted it. Impelled by reports of Edison's experiments Cros requested an opening on December 3rd, 1877. The method described was one that was quite similar to one later employed by Emile Berliner in his development of the gramophone. "In brief the proposed plan consisted in converting the undulatory spiral line of a Scott phonautogram into a line of similar form,

in relief or intaglio, in a resisting medium by utilizing the photo-engraving process."[3] The paper was read in open session and Cros later applied for a patent that was granted on May 1st, 1878. This French patent, No. 124,213 had a term of fifteen years, but except for at least one certificate of addition granted on August 3rd, 1878 nothing more was done with it. Cros, however, was careful to specify areas in which he anticipated Edison and which the American could not claim in France. The majority of the claims of the patent were thrown open for the use of the French public.

While Cros was depositing his sealed paper Edison was working on the development of a non-infringing telephone system for the Western Union Telegraph Company. His new Menlo Park facilities allowed him to devote all of his intellectual activities to whatever experimental needs that he perceived at any one time--consequently he was now immersed in the theory and propagation of sound. At the same time he was also experimenting with a method for repeating telegraph messages. In the proposed repeater the instrument cut dots and dashes into a wax-covered tablet. The message was then run under another instrument so that it could be either transcribed or resent to another receiver. The wax disc could be rotated at any speed so as to accommodate the skill of the transcriber in deciphering a message. Within these two activities there were all the necessary ingredients that were to result in the phonograph. As previously mentioned the inventor was supposedly singing idly into the mouthpiece of a telephone in order to determine the flexibility of the diaphragm. As the action of the voice sent the fine wire at the center into his hand he reasoned that if he could record the action of the point he could then draw a recorded substance under the diaphragm in order to reproduce the message. What we do know for certain is that at the bottom of a laboratory sheet devoted to the telephone Edison noted:

> "Just tried experiment with a diaphragm having an embossing point and held against parafine paper moving rapidly the spg vibrations are indented nicely & there's no doubt that I shall be able to store up & reproduce automatically at any future time the human voice perfectly."[4]

Charles Batchelor described what happened in sworn testimony submitted as a portion of one of the numerous court cases involving the conflicting claims of the various talking machines.

> "The first experiment, as I remember it was made in this way: Mr. Edison had a telephone diaphragm mounted in a mouth-piece or rubber in his hand, and he was sounding notes in front of it and feeling the vibration of the center of the diaphragm with his finger after amuseing himself with this for some time, he turned round to me and he said: 'Batch, if we had a point on this, we could make a record on some material which we could afterwards pull under the point, and it would give us the speech

back.' I said, 'Well, we can try it in a very few minutes,' and I had a point put on the diaphragm in the center. This I had mounted on a grooved piece of wood that had been used for an old automatic telegraph. [Strips of waxed paper that had been used for making condensors were then prepared.] I pulled it through the groove while Mr. Edison talked into it. On pulling the paper through a second time, we both of us recognized that we had recorded the speech. We made quite a number of modifications of this the same night....

"We tried a great many different experiments on this machine, such as different thicknesses of wax, different shapes of the knives, and also different depths of the knife for talking. We also put in paraffine paper that was crimped in the middle so that the knife would cut out on the crimp, making its record in that manner. We also took this paraffine paper and placed it edgewise under the same diaphragm, but with another wooden base made to correspond with the thickness of the paper instead of on the flat surface. We also pulled through metallic foils, and made special points for that, and a great many other experiments. This was the only device that we had for trying experiments for at least a couple of days."[5]

Contemporary drawings of this crude device were not prepared or else did not survive. Consisting as it did of cast-off pieces derived from former laboratory experiments, the original phonograph was apparently itself broken up to be used in further experimenting. A drawing was prepared to illustrate the testimony in a case, The American Graphophone Company versus the Edison Phonograph Works, but surviving court materials do not include it. It should exist in a printed record of the case but up to the present only a partial group of uncut signatures have been located. Lacking this, I believe that the "Simple Phonograph" pictured by the Scientific American during the summer of 1878 is quite close to what must have been the original construction.[6]

There must have been a beehive of excitement at Menlo Park at the time of the discovery but the few documents that have survived do not reflect this. In 1906 Charles Batchelor noted that the laboratory staff reacted to the idea with a simple "Of course" and it was not until later that the brilliance of the conception began to sink in. The first individual, not of the laboratory staff, to be let into the secret was Edward H. Johnson, a former telegrapher and business associate who was currently demonstrating the Edison telephone with the Exhibition Company of Philadelphia. On August Fourth he casually mentioned to Edison in a letter:

"Green of the Exhibition Co. did the speechifying the other night & told the audience what you proposed to do in the way of recording speech."[7]

By August seventeenth enough developmental work had been accomplished for the conception to have changed slightly. In one of the first drawings that can be accepted without doubt the device had been modified to have the waxed strip capable of being wound up and in which pulleys move the strip. The device is conceived as a method for recording telephone messages for retransmission. For example a message could be recorded in New York that had originally been sent from Washington. The message could then be repeated, reproduced or copied. The rollers allowed the strip to pass under the recorder at a more uniform rate of speed that could be achieved by merely pulling the strip through. Batchelor confirmed this when he testified that

> "We found on our first experiment that it was quite difficult to pull the waxed paper through the groove twice alike as regards speed, and I remember we put a pair of wheels, one of which had a handle on, in such a position that when you turned the handle it pulled the paper through at a much more uniform speed."[8]

On July 30th Provisional Specifications had been drawn for a telephone patent to be granted in England. In these specifications a vague reference to a method for recording telephone messages occurs:

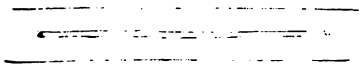
> "To carry out the peculiarities of my Invention under the varying conditions of use, I have devised several modifications of the transmitting, receiving and intensifying devices employed in this sound telegraph; portions of the apparatus are interchangeable, available in transmitting or recording; others are adapted to local use; some are only available in transmitting, and others are only for receiving; and some portions of my improvement can be availed of to make a record of the atmospheric sound waves, or of the electric waves, or pulsations corresponding thereto or resulting therefrom." [emphasis added][9]

Once a subject was disclosed in a Provisional Specification the inventor was forced to accept a time limit in which to complete his conception. At this period the allotted time was six months, at later times a year was allotted. By filing the July 30th Provisional Specification Edison would now be forced to develop his ideas by the end of January 1878 or else lose his invention in England. In order to allow for transit time from America to England this actually meant by the end of December 1877.[10]

The concern with the telephone patent may have limited the Edison horizon during this busy period although details of the phonographic device were constantly changing:

"In my apparatus for recording & reproducing the human voice-- I propose using a paper coated with a substance which becomes very soft by heat & when cold is extremely hard like sealing wax.

"I think a Cork diaphragm both for receiving and sending is the best thing we have yet struck, on account of an absence of harmonics.



"Phonograph Paper is previously embossed and brought to a knife edge then the little point on the diaphragm having a knife edge only has to indent the edge which it ought to do very easily ...

"Another idea. Indent the paper in spiral grooves or on a long strip, cover whole paper with tin foil. The point on the diaphragm will then easily indent."[11]

This was the first indication of the use of tinfoil as a recording surface. Obviously it was to be used because it would be easy for the indenting needle to cope with and at the same time provide a slightly more durable surface than that provided by paraffine wax.

Enough had now been accomplished for Edison to seriously think of publicizing his ideas other than through the medium of the Johnson telephone lectures. During his life the inventor had an unerring instinct for utilizing the press but often managed to create serious difficulties by discussing incompletely developed concepts. His ever fertile mind was often outstripping the practical limitations of his laboratory. This was to be the case with the phonograph after it had been introduced in late 1877 and was to be repeated with other developments such as the Edison nickel-cadmium battery. By September seventh he was ready to commit the error. An announcement concerning the phonograph was prepared but fortunately it was not released and remained inside the laboratory.

"Edison Phonograph. An apparatus for recording automatically the human voice and reproducing the same at any future period.

"Mr. Edison the electrician has not only succeeded in producing a perfect articulating telephone, which comparative tests upon the lines of the Western Union Telegraph Co. have proved to be far superior and much more ingenious than the telephone of Bell and has been adapted for use upon the 1300 private wires operated by the Gold & Stock Telegraph Company of New York but has gone into a new and entirely unexplored field of acoustics which is nothing less than an attempt to record automatically the speech of a very

rapid Speaker upon paper from which he reproduces the same speech immediately or years afterwards preserving the characteristics of the speakers voice so that persons familiar with it would at once recognize it.

"It would seem that so wonderful a result as this would require elaborate machinery on the contrary the apparatus although crude as yet is wonderfully simple. I will endeavour to convey the principle by the use of an illustration which although not really the apparatus used by Mr. Edison will enable the reader to grasp the idea at once."[12]

It is possible that the preparation of the statement caused additional ideas to occur to the members of the Laboratory team. Other drawings from the seventh suggest the utilization of an ink containing such substances as plumbago so that the reproducer might be actuated by the friction. One from September 21, 1877 illustrated a cylinder device. Unfortunately from now on until the latter part of November no laboratory drawing is currently available at the Edison National Historic Site which concerns the phonograph. Some were introduced into the 1896 court case but unless a printed copy of the entire record for final hearing surfaces they are lost to us.[13]

Hints concerning the activities at the Laboratory appear infrequently although Edison must have discussed it with several individuals. An exchange of letters with a political friend, Benjamin F. Butler, mentioned recording. Butler cautioned the inventor to maintain a strict secrecy.[14] By now the requirements of the patent law of England began to press Edison inexorably towards completing his invention. The Provisional Specifications of his telephone patent had been submitted on July 30, 1877 and sealed on October 20th as previously mentioned. Edison would now be forced to provide final specifications in time to be acted upon in England by January 30, 1878. In American law he would also have to key his application to the English one since a foreign specification could not be acted upon prior to an American patent application. If this occurred the American application would be invalid.[15]

In his telephone lectures, Edward Johnson must have frequently alluded to the ideas of recording sound. In a little pamphlet entitled The Telephone Handbook that he designed to interest possible sponsors he reproduced what must have been the text of his lecture. In the printed text there is a two-page description of Edison's proposals for recording.[16] The pamphlet, from internal evidence, was apparently printed in late October or early November. While the pamphlet might be used to prove an Edison priority if necessary Edison's hand was forced when the Scientific American began to print discussions of sound and its representation. Johnson took advantage of the situation and penned a long letter describing Edison's ideas and some possible methods for recording the human voice. It echoes both the booklet and the September

seventh laboratory sheet. Interestingly the device is still conceived of as a strip phonograph. The account appeared in the issue dated November 14, 1877 which went on the newstands November sixth. Reaction was instantaneous as various New York and national papers seized upon the letter and reprinted the text. "Wonderful possibilities of Mr. Edison's latest invention " trumpeted The Sun while another cried out,"A singular invention."[17]

The surviving laboratory sheets devoted to the phonograph commence again on November twenty-third when Edison announced his intention of applying the phonographic principle to clocks and dolls. He also mentioned the possibility of utilizing a plate mechanism to allow for an earlier method of preparing duplicate recordings.[18] On November twenty-ninth a later form of the tinfoil phonograph was depicted although the same drawing also included a side view of what became the first cylinder form.[19] A few detail drawings exist for the first machine but they carry dates later than that on which the first cylinder version was completed. It is possible that the drawings may have been used in the construction and after being used dated and signed. Work slips prepared by John Kruesi still exist and Charles Batchelor in his working diary noted on December fourth: "made phonograph today." On December sixth an additional notation appeared: "Finished the Phonograph --Made model for P[atent] O[ffice]." He also dashed off a letter to one of Edison's associates--George Bliss, a former telegrapher and the manager of the Edison Electric Pen and Duplicating Press business.

> "You probably remember when you were down here about Edison's idea of recording the human voice and afterwards reproducing it. Well we have done it and have today shown it in New York to the Scientific American people who are now sketching the apparatus for a future issue."[20]

Edward H. Johnson was ecstatic as he contemplated the possibilities of the new invention in his lecture hall appearances. He obtained possession, at least temporarily, of the first machine and telegraphed an associate Uriah Hunt Painter:

> "Phonograph delivered to me today. Complete success. Inform [Joseph] Henry and [Benjamin] Butler."[21]

He later penned a full letter in which he mentioned urging Edison to construct a new exhibition phonograph that would be more reliable. He mentioned also that when the first model was operated by clockwork its reproduction improved--else words "were snapped out like a fish-woman's." He gave a long description concerning the method of recording and reproducing and mentioned that it was unique among Edison's inventions in that it performed on first trial. "The Scientific American was all ready to go to press when I took the machine there yesterday. They stopped it--took sketch of the machine. Made an engraving of it last night (Engraver boards at our house & sat up all

night in his room working on it) & will issue one day later in consequence."[22]

Now that the machine had been publicly exhibited work progressed on the preparation of the final American specifications and on the final version of the English telephone patent that included forms of phonographic devices. These were soon delivered to Lemuel Serrel and Theodore Puskas, Edison's American and foreign patent solicitors. An application was filed on December twenty-fourth for an American patent and final specifications for the English patent were dispatched.[23]

With Edison's attention now partially diverted towards marketing phonographs, applying for a patent and selling the rights, the laboratory drawings later in December consist of minor developmental modifications. But several difficulties were at least recognized and described. The main difficulties were in controlling rotational speed, in developing a more appropriate recording substance, in making the diaphragm more sensitive and responsive, in increasing amplification and in providing a method for removing the recording when it was completed. Experiments would also be carried out involving methods for making duplicate recordings.

With the early machines the method of applying the tinfoil was by cementing it onto the phonograph's mandrel by means of shellac. This of course meant that the recording was destroyed by the very act of removing it from the brass cylinder. Edison felt that a solution might be found in adopting a disc form such as was utilized on the automatic telegraph. As early as December third laboratory drawings showed crude disc machines and the previously noted laboratory sheet of November twenty-third mentioned that a disc form would make the preparation of electrotypes or plaster of paris molds simpler.

Johnson was now complaining of the patched-up first born and Edison was promising (and not delivering) a more reliable instrument. Johnson, in several of his letters to Uriah Hunt Painter, mentioned his hope of obtaining a clock-work motor but apparently this was not to occur. Instead the problem of insuring stability of rotational speed and in recording a larger number of words was solved by designing a new and larger machine with a heavy flywheel and a larger recording cylinder. Illustrations of the machine began appearing in periodicals in February while details of the combination recorder and reproducer appear in laboratory drawing towards the end of January although the November 28th, 1877 drawing also showed a preliminary form.[24]

In the absence of a dependable machine it was imperative that a small demonstration machine be produced to supply the widespread public demand. The earliest sketches of such a machine appear as a series of drawings signed on January 8, 1878.[25] That this version was a stopgap was acknowledged many years later in phonograph litigation in which Edison described large exhibition machines that were developed:

"Because it was louder, and by talking loud we could make it reproduce through a funnel very loud, and the demand was for a loud instrument for exhibition purposes as the people traveled through the country giving lectures, and they wanted it so that the audience could hear it, and when we attempted to record upon wax it was very weak, and would not come out of the funnel loud enough, and then it had not any lasting qualities, and you had to listen quite closely to hear it."[26]

In the same case Charles Batchelor echoed the sentiments:

"Mr. Edison never considered that the tin-foil phonograph was good enough in any shape that he made it to act as the commercial phonograph of the future. Almost a year had been spent in the early days in trying to record and reproduce the finest hissing consonants. This we had been able to do, as I remember it, better in the wax than in the tin-foil, but in the reproducing on the wax he finally came to the conclusion that whilst they were there, they would not stand any wear, and probably were gone after the first reproduction. There seemed to be a large market for the tin-foil phonograph in the shape that we had it in 1878, and he allowed them to be put out, and a great many were put out for exhibition and illustration purposes...."[27]

In the original phonograph patent application there was little that impeded its progress through the patent office except for the objection of the examiner that some claims were properly those for another patent. Thus the folklore that the original patent breezed through the office without a single change was incorrect. The additional application involved a means of introducing compressed air to increase the volume of sound. Since the matter had already been considered as a portion of the original application it rapidly passed through the Office. It was applied for on March 4, 1878 and was granted on the twenty-sixth.[28]

Perhaps the most important, and the least known, work was the attempt to prepare a machine that would be driven by a clock-work motor. With a sufficiently strong and dependable mechanism both the cylinder and the proposed disc machines would have surmounted several of the obstacles to improved recording and reproduction. It was not until the nineties that a spring driven machine was successfully used to revolutionize the industry. A series of drawings for the clock work machine began in early January and extends through late April or early May. According to entries in Ledgers maintained at the Edison Laboratory the work resumed briefly in August after being discontinued in June. The amount spent, $702.01, is slightly larger than that expended in developing a disc phonograph. The machine design is quite sophisticated and is close to the modified form introduced into England by the Edison licenses, The London Stereocopic and Photographic Company. Another

version of this machine was constructed by Augustus Stroh, the English technician, and was exhibited before the Royal Society in early 1878.[29]

The conception of a disc machine formed a portion of Caveat 80 and later a patent application--Case 154. The disc form was considered at that time as possibly the most promising form of the phonograph. Models were constructed for patent purposes and a few full-scale machines must have been made. The chief advantage of such a machine was conceived as in the ease in preparing duplicate records. If a process were not developed for preparing cylinder molds a disc would solve the problem presented by the necessity of lining up the grooves of the flattened piece of tinfoil when it was reapplied to the cylinder. With the denial of an American patent and the lessening of the Edison interest after 1879 conditions in the Laboratory were not propitious for the retention of examples of the machine and so these too apparently shared the fate of the early strip phonograph. The need of the Edison Speaking Phonograph Company to recoup its investment also created a situation in which experimentation was discouraged although Edward H. Johnson often experimented with cylinder machines. Even though he sometimes incorporated his improvements financial constraints usually forced him to forgo this.[30]

Early in January 1878 Edison had split the rights to his invention into three parts. One part was assigned to a syndicate that later turned it over to what became the Edison Speaking Phonograph Company, another part covering dolls and music boxes was turned over to Oliver D. Russell. Russell conducted the majority of his experiments outside of the Edison laboratories although the contract specified that Russell was to report at regular intervals concerning his progress or lack of it. Still later Russell became associated with Hilbourne L. Roosevelt, one of the promoters of the Edison Speaking Phonograph Company, the Telephone Company of New York and an organ builder in his own right. As continued difficulties were encountered in miniaturizing the phonograph, Roosevelt eventually purchased Russell's rights. In order to continue an increased rate of experimental work, an electrotyper, William B. Hollinshead, was engaged to carry on the work. Hollinshead had first become known when he conceived of a method for preparing disc phonograph matrices although the Patent Office would not allow him to patent his process. He worked assiduously and made quite a bit of progress in miniaturizing the machines and in preparing records. At the time that he split away from Roosevelt, the miniature machine was almost a reality. In the case American Graphophone Company versus Leeds & Catlin, tried in the first decade of the twentieth century, Hollinshead testified at length and displayed some of his early machines and recordings. After the separation no further work was accomplished.[31]

The rights to apply the phonograph to clocks and watches were acquired by Daniel M. Somers and Henry J. Davis. Work under this agreement was conducted both at the Edison Laboratory and at the Ansonia Clock Company of Ansonia, Connecticut. The tasks were first directed

almost entirely towards clock applications since there were problems in making machines sufficiently small for watches. The machines devised were designed to use the world's first duplicate records and were the first machines designed solely for reproduction of sound. Attempts were first made to cut the recordings in wax but it was found difficult in obtaining a grade that would not adhere to the needle or that remained on the record causing a large amount of noise in later reproduction. The volume was also low and could not be heard in sufficient volume. The softness of the recording medium also meant that the recording was obliterated after a few test hearings. A more promising direction was followed in attempts to cut recordings onto sheet copper that could be mounted onto the clock reproducing phonographs.

> "We had a small machine to make the record, and that record was afterwards transferred to the cylinder of the clock machine. In the majority of those clock experiments at that time the records were made on a separate machine. They were afterwards taken off the cylinder of that machine and placed on the clock cylinders, where they were reproduced automatically by the clock. After it had been reproduced once there was a little release that allowed it to go back ready to begin again....
>
> "The records were circular in form, and made by cutting the record in sheet copper. This was then taken from the machine that recorded it, and put on the cylinder of the clock-work and reproduced....
>
> "The sketch dated February 20, 1878, which is signed by myself, I believe, is a general view of the cylinder with its accompanying screw thread attachment for traversing, and the reproducing cup for giving out the sound....
>
> "As I remember those machines, they were made quite small, with the cylinder at one side of the clock-work, where the record could be put on the cylinder and taken off and another record put there if required. The whole machine was to be made complete, and then the record, made on another machine placed on the cylinder after the whole was assembled. These records were different, inasmuch as one would say one thing, and another another thing. Of course the clock machine was designed to receive the record from another machine, and therefore after it received its record it did nothing but reproduce that record all the time. In later times many thousands of just such a machine as that were made for dolls."[32]

It was in late 1878 that a fatal mistake was made--final English specifications were filed but the American applications were inexplicably delayed. As a result, under the American patent law of that period, the devices covered in the English patent could not be protected in the United States. Later in lamenting this Edison mentioned that only a

specific act of Congress could undo the damage. No court, even the American Supreme Court, could correct his oversight. As a result the materials covered in Caveats 77 and 80 appear in the English patent but remain interesting theoretical exercises in terms of the American situation. This was later to cost Edison dearly in contests with the members of the Volta Laboratory Association and its successors--particularly the American Graphophone Company.[33]

Impelled by his growing involvement with things electrical, Edison ceased all experimental work and by a new agreement with the Edison Speaking Phonograph Company, was released from the necessity of continuing experimental work on the phonograph.[34] Perhaps the best summary of the situation appeared in a long article that appeared in The World for September 5, 1879. The reporter painted a vivid image of the slack business situation of the Company:

> "Much doing in that line?'
> 'Well, we turn 'em out as fast as we have the demand for 'em,' was still the cautious answer.'
> 'And how fast is that?'
> 'Well, eight to fifteen a month.'...
>
> "'Have any improvements been made in the phonograph recently?'
> 'Not specially.'...
>
> "Has Edison ever finished the phonograph which was to have a disk capable of containing an entire sensational novel instead of a phonograph with a cylinder such as those you are making now?'
>
> 'No, I think he's abandoned that idea.'
> 'Don't you make phonographs that will run by means of clockwork?'
> 'No. It was found that clock-work would not be strong enough to keep the instruments going regularly. The mechanical details of the instrument are perfect, but it must be run by hand or steam.'
>
> 'What are the principal improvements made in the phonograph since it was invented?'
>
> 'The fineness of the threads, the diaphragm of the mouthpiece, which is now made of mica instead of metal, and the needle or point, which is now made of steel instead of agate, and which has a chisel edge. Mr. Johnson, the manager of the phonograph company, intended to carry out some further improvements, but he is in England introducing Edison's chemical telephone or electromotograph. I don't believe the phonograph will ever be much further improved.'"[35]

This situation was duplicated at Menlo Park. A reporter for the Philadelphia Record visited the Edison laboratory in February and penned his impressions in an article that appeared on Lincoln's birthday--the twelfth.

"Electric light is the one absorbing subject of thought and the one object of attention at Menlo Park. Of course, no one can detect what additional wonderful revelation of science may be hatching in the fertile brain of the renowned wizard, but to all outward appearances he knows nothing and cares nothing that is not associated with his crowning triumph, the electric light.

"The mysterious phonograph, the capacities of which for receiving messages and transmitting them again, either instantly or a hundred years hence, astonished the world, was carelessly pointed out to a reporter with about the same degree of interest as a boarding-school miss would allude to a discarded doll or that a full-grown man would exhibit a kite made in the days of his boyhood. The instrument laid on a table in the laboratory with innumerable other contrivances, covered with dust, the needle broken out of the dial, presenting generally a dilapidated and neglected appearance.

"'That is the phonograph,' explained Edison as he was conducting the newspaperman through the laboratory and passed on without further comment as if the instrument were not even worthy of the slight mention he had made of it."[36]

In the course of three years the phonograph had experienced birth, growth and demise. It was later to revive when the experimental work performed at the Volta Laboratory created enough competitive pressure for Edison to again devote his attention to it. Once the two groups sorted out their conflicting claims after long and costly judicial encounters, sound recordings became an everyday commodity. As if to underscore this the Census Bureau granted talking machines and recordings a separate classification in the 1900 Census.

FOOTNOTES

a. "The majority of the experiments were tried in one room. It was 100 feet long and 25 broad, but when the experiment required anything to be done by machinery, that was done on the floor below, or in another of the buildings." Deposition of Charles Batchelor in American Graphophone Company versus Edison Phonograph Works. (U.S. Circuit Court. District of New Jersey. In Equity No. 3500.) Answer to Question 162. ED & NARC - Bayonne.

1. See J. B. McClure Edison and his inventions (1878 edition) p. 93. The McClure volume, which was frequently added to, was in reality a paste and scissors production, but it does provide a valuable cross-section of periodical and newspaper stories.

2. Deposition of Arthur S. Browne in American Graphophone Company versus the United States Phonograph Company, Victor H. Emerson and George E. Tewksbury. (U.S. Circuit Court. District of New Jersey. In Equity no. 3616) (printed) p. 75 ED

3. Deposition of Emile Berliner in ibid. (printed) p. 159-160. This case also reproduced a useful selection of documents involving Charles Cros. ED

4. Laboratory sheet 302, July 18, 1877 as reproduced in Telephone Interference Cases Edison's Exhibit 25-12. The document had originally been mounted in laboratory scrapbook volume 12. ED.

5. In his testimony Mr. Batchelor originally stated that automatic telegraph paper had been used. Under cross questioning he corrected himself. Charles Batchelor in loc cit. Answers to Q. 15, XQ 178, XQ 181, XQ 183. In a later recollection Mr. Batchelor noted that the standard test phrase that had been used to test telephone diaphragms was 'Mary had a little lamb.' See Charles Batchelor. Diary for "My recollections of Mr. Edison.X1. The invention of the phonograph" inserted after entry for October 12, 1906, p. 59. Thomas A. Edison in the same case testified that "The first experiment was a telephone diaphragm with a point on the center of it, arranged with a small guide slit and a piece of paraffine paper was pulled through while several words were 'hollered' into the mouth-piece of the telephone and a record was made on this, and then the strip was put back and pulled through again and it was reproduced," Answer to Question 18. ED.

6. See Scientific American, August 24, 1878. Note that the Batchelor description closely matches the drawing from the magazine. The lettering has been changed to match the testimony. Charles Batchelor "Deposition" in loc cit. Answer to Question 9. ED.

7. Letter of Edward H. Johnson to Thomas A. Edison, Philadelphia 8/4/77. The letter has been missed by previous students since it is filed under Telephone. Johnson in a later recollection mentioned that he had been touring demonstrating the telephone. He then supposedly returned to Menlo Park to urge Edison to complete his invention. This is impossible if Johnson or his associates had already discussed the idea in August in Philadelphia. The Fall tour did not end in Buffalo but in Jersey City on October 20, 1877 although he apparently lectured at a few additional towns as the need for money arose.

8. Laboratory drawing Vol. 12, No. 109; Laboratory drawing as Edison exhibit, Vol. 12, No. 115 in Telephone Interference Cases. Charles Batchelor Deposition in loc. cit. Answer to Question 83. All ED.

9. Provisional specification, Sealed the 20th October 1877, and dated the 30th July 1877. (English) Patent 1877-No. 2909. The patent was later challenged on the grounds that the provisional specifications involving the recording of sound were much too vague to result in the detailed regular specifications involving the recording of sound. In order to protect the patent a disclaimer was entered expunging the phonographic portions of the patent.

10. I am indebted to the kindness of the reference librarians of the portion of the British Library devoted to patents for the details of British patent procedure in 1877.

11. Laboratory sheet, August 17, 1877 Vol. 12-108. ED

12. Laboratory sheets, September 7, 1877 Vol. 17-13a, 13b. ED

13. Laboratory sheet, September 7, 1877 Vol. 17-15; September 21, 1877 Vol. 17-4 ED.

14. Edison to Benjamin F. Butler 10/13/77 Letter Book - ED; Butler to Edison 10/23/77 ED.

15. Details appear as a part of the printed patent. (English) Patent 1877 - No. 2909.

16. Telephone Handbook, p. 11-13. A dated testimonial dated October 20, 1877 appears as a part of a section at the rear of the pamphlet. As a result the production, although not the textual portion, must be ascribed to late October or early November. AT. For details of Johnson's activities refer to Raymond R. Wile "The rise and fall of the Edison Speaking Phonograph Company" in ARSC Journal Vol. VII, No. 3 (1976).

17. The clippings had been kept by Charles A. Cheever and were part of a scrapbook devoted to the telephone. AT.

18. Laboratory sheet, Nov. 23, 1877 Vol. 17 ED

19. The drawing was first reproduced in 1969 when it appeared in Allen Koenigserg, Edison cylinder records, 1889-1912; with an illustrated history of the phonograph, 1976, and also Lawrence A. Frost, The Edison Album, 1969. I am indebted to Dr. Philip Peterson for calling the existence of the Frost illustration to one's attention although I generally disagree with the majority of Dr. Peterson's conclusions.

20. Letter Charles Batchelor to George Bliss 12/ /77, Batchelor Tissue Letter Book ED.

21. Telegram Johnson to Painter 12/7/77 located in Painter Papers. Joseph Henry was Secretary of the Smithsonian Institution and Benjamin F. Butler was a former Civil War General who was now a Congressman. PP.

22. For additional details see R. Wile op. cit. p. 8.

23. It is surprising that no one writing about the invention had bothered to examine the original American Patent application. I believe that the National Archives attendant and I were the first individuals to have examined the patent papers since the end of the Nineteenth Century. An exception must be made for the individual who at one time had crudely used pressure sensitive tape to repair the breaking folds. As can be seen changes were made.

24. See Laboratory drawings Vol. 17, No. 39 Jan. 23, 1878; Vol. 17, No. 5 undated ED. See also Phillip Petersen "Early versions of the Edison tinfoil phonograph" in Talking Machine Review No. 26 (February 1974) p. 46-47. Although Dr. Petersen includes a great deal of valuable information his conclusions are often questionable.

25. Laboratory drawing, January 8, 1878. ED.

26. Deposition of Thomas A. Edison in American Graphophone Co. versus Edison Phonograph Works. (U.S. Circuit Court. District of New Jersey. In Equity No. 3500). Answer to Question 92. NARC - Bayonne.

27. Deposition of Charles Batchelor in ibid. Answer to Question 151. NARC - Bayonne; ED.

28. Although the aerophone appeared as part of the original application the earliest drawing now known appears on a sketch of February 4, 1878. Laboratory drawing Vol. 17, No. 48. Sketches no. 9 and 10 for the Patent Office Model, dated February 11, 1878 and signed by Charles Batchelor still exist. They also carry the notations "Finished Feb. 16, 1878, J. Kruesi." ED

29. General Ledger #1 & 2. For details of the London Stereoptican and View Company machine see Philip Petersen op. cit. The meeting of the Royal Society was reported in an unsourced article appearing in one of the Edison scrapbooks. The article was dated February 27, 1878. ED

30. See Raymond R. Wile op. cit. for details.

31. Details of the contracts appear in Raymond R. Wile "Introduction" to the reprint edition of National Phonograph Association. Proceedings of the 1890 convention of Local Phonograph Companies. p. vii & viii. The Hollingshead connection was discovered in testimony entered in American Graphophone Company versus Leeds and Catlin Company, et al. (U.S. Circuit Court. Southern District of New York. In Equity No. 8570_ NARC - Bayonne.

32. See Raymond R. Wile "Introduction" in loc. cit. p. viii. Testimony of Charles Batchelor in op. cit. Answers to Questions 64, 65, 66, 63. The dolls referred to were made in 1890 by the Edison Toy Phonograph Company, a later licensee for toy applications. Relations soon became strained between Edison and the Toy Company resulting in a series of complaints and cross-complaints in the New Jersey State Courts and in the Federal Circuit Court for the District of New Jersey. As a part of the settlement the dolls remaining unsold in 1896 had their phonograph mechanisms removed and were sold at auction. This may account for the majority of the surviving dolls being encountered without the original phonograph.

33. Edison bitterly lamented this fact in a letter to Uriah Hunt Painter 12/5/87. "The phonograph patents are void, they cannot be set right by a decree of the Supreme Court like our electric light patents because they were filed after the granting of the foreign patent while the lamp patent was filed before. The statute is clear, and the foreign patents have expired--..." ED.

34. Thomas A. Edison and Edison Speaking Phonograph Company. Additional Agreement, January 18, 1879. (Printed) pp. 1-2. ED.

35. The World (New York), September 5, 1879. Mounted in Phonograph Scrapbook. Edison National Historic Site. Item No. 54.

36. "The coming light" in Philadelphia Record, February 12, 1880, p. 1. File located as microfilm at the Free Library of Philadelphia.

The Problems of Documentation--the drawings

Anyone attempting to discuss the development of the invention of the phonograph is immediately faced with serious documentary problems. Although Edison had already been faced with patent contests the Menlo Park group seems to have been remarkably lax in the preservation of the supporting papers that might detail the process of the invention of the phonograph. This has meant that after the original conception of July 18, 1877 there are few papers upon which an orderly account may be constructed.

The situation is further confused by two semi-spurious drawings produced sometime after the Summer of 1877. Both drawings were obvious productions of Thomas A. Edison and both present differing problems. The first drawing was produced for J. U. Mackenzie, an individual who had been close to Edison since the time Edison had rescued Mackenzie's young child from the path of a train and the grateful father had taught the rescuer telegraphy. Mackenzie later attested that the drawing had been made for him at the time of the invention. Since it represents several stages of the invention I date it as probably December 1877, a time when Mackenzie was in the Laboratory and Edison was considering placing the business with him.[1] Later in the early 1890's the drawing was borrowed by W.J. Hammer for reproduction in the pages of the Electrical World. It was soon afterwards reproduced in the W.K.L. and Antonia Dickson biography of Edison.[2] From then on the drawing, never returned to the Mackenzies, seems to have disappeared from sight. It again reappears in 1917 when a new version appeared with the addition of the inscription "Kruesi make this" and dated August 12, 1877. Details of the transformation appear in an interview between Norman Speiden, of what became the Edison National Historic Site, and Nelson Durand. Mr. Speiden conducted a series of interviews in the mid-thirties and had enough presence of mind to have them recorded on an Edisphone Telescribe outfit.[3] A more recently discovered drawing has also presented problems. This drawing was first reproduced as part of my article on the Edison Speaking Phonograph Company when I saw no reason to question it. By the time I participated in the Centenary Symposium I began to have doubts and mentioned my qualms in a footnote to that paper. The drawing on first appearance shows nothing to create doubt--it is located in a file of Laboratory drawings at the Edison National Historic Site and carries a date of August 12th--as such it seemed to be the source of the dating of the Mackenzie drawing. On closer examination the documentary problems appear. First: it was found elsewhere in the Laboratory papers and placed among the drawings by the staff of the Site. Unfortunately its original location was not noted so that in the violation of the cardinal archival rule of provenance irreparable harm was done--we do not know the reason for the production. Normally all laboratory drawings had been originally prepared on loose sheets and later mounted in scrapbooks. This was not![4] The drawings themselves are almost always hasty productions, slightly messy, often carrying doodles. In later court

testimony Edison mentioned that they usually were gathered together for the signatures of the workers present.[5] The drawing exhibits none of these characteristics. The lamination of all of the drawings has now made it impossible to see if the paper characteristics are similar to other drawings. The first drawing involving a phonographic device that we can date with certainty is one included on a telephone sheet dating from August 17th, 1877.[6]

A large number of drawings from 1877 no longer exist--some were referred to and slated for reproduction as part of the record in the cases of the American Graphophone Company versus the Edison Phonograph Works and the American Graphophone Company versus the United States Phonograph Company.[7] The drawings are no longer a part of the record and up to the present no complete printed Record has been located--only scattered printed signatures from the two cases. A few other devoted to the telephone has phonographic devices pictured upon them and appear in the exhibits introduced in the Telephone Interference Cases.[8] Many of the originals that were included in these volumes are no longer in existence.

Much of the information concerning the invention can be found in the court cases even though the key drawings meant to illustrate the testimony have not been located. Also there are drawings from August 17th through the end of October and from mid-November on. Interestingly we have a few detail drawings of the original machine of December 1877 but no full scale working rendition. Many drawings exist for 1878 and reflect the winding down of the Edison interest and involvement.[9]

FOOTNOTES

1. Edison to Mackenzie 12/12/77 offered the opportunity to take charge of the exploitation of the invention. Reproduced in Lawrence A. Frost The Edison Album p.66. I assume that the drawing in question must have been prepared at about this time.

2. After appearing in the Electrical World it appeared in W.K.L. and Antonia Dickson The Life and Inventions of Thomas A. Edison p. 123. Hammer apparently then mounted the sketch, or a copy of it, accompanied by a note of Mackenzie attesting to its authenticity, in a jumbo sized scrapbook that he kept. It was either this source, or the Edison papers, that supplied the sketch for modification in 1917. Hammer's papers were later given to the National Museum of American History where they are now housed in the Electrical Division. At some time the scrapbooks were cut apart into smaller pages and the contents of what was considered the primary side indexed. As a result, the little note of attestation had been lost until I discovered it while examining the Hammer papers.

3. Details of the 1917 transformation appear in a telephone conversation between Norman Speiden and Nelson Durand. Mr. Speiden conducted a number of interviews in the 1930's and had the presence of mind to record them on an Edison telescribe outfit. These telescribe cylinders were later transferred to magnetic tape. The taping was accomplished with little concern for the original recording speed and consequently were unusable until Merritt Malvern of Merritt Sound Studios performed the difficult task of retranscribing them.

4. A note in the file mentioned the discovery of the drawing elsewhere, but no details were given.

5. For information concerning the laboratory drawings see the Depositions of Thomas A. Edison and Charles Batchelor in American Graphophone Company versus Edison Phonograph Works (U.S. Circuit Court for the District of New Jersey. In Equity No. 3500) Edison Questions and Answers 35-39, Batchelor Questions and Answers 67-70. ENHS and NARC--Bayonne.

6. There are a few such drawings at the Edison National Historic Site and some were reproduced in Telephone Interference Cases.

7. The typewritten case record is incomplete at the NARC at Bayonne and the materials at the Edison National Historic Site consist of scattered signatures. A few of the illustrative drawings have been located but key drawings referred to in the case cannot be found.

8. Drawings at the Edison National Historic Site often were devoted to more than one subject.

9. The last of the drawings appear in October 1878.

The Publicity of Late 1877

In my account of the Edison Speaking Phonograph Company I also mentioned in particular an unreleased statement that appeared on laboratory sheets from September 7, 1877. (It may date from a day or two earlier since the sheets may have lain a few days before being signed.) At the time of writing I indicated that the statement formed a type of preliminary exercise for the ultimate letter of Edward Johnson which appeared in the issue of the Scientific American for November 7th, 1877. I felt that Johnson was a key figure since he was privy to the ideas of Edison and since he was actively demonstrating the Edison Telephone. I reasoned that he must have mentioned details of the invention in his lectures but could find no account of lectures other than the August Fourth letter that would corroborate this. I discovered a mention of a publication that Johnson distributed at his lectures called The Telephone Handbook in the card file index to materials at the Edison National Historic Site but on checking the Batchelor scrapbook in which it was mounted I found that it had been removed without authorization at an earlier time--it certainly was no longer at the Site. Unfortunately a checking of the National Union Catalog and a diligent inquiry directed towards any possible American library that might own a copy produced negative results. A section finally appeared in an article written by Philip Peterson and eventually in 1980 I did locate copies at the Historical Library of the American Telephone and Telegraph Company--almost an embarrassment of riches since they own three copies. I am indebted to their kindness in providing me with electrostatic copies of the complete document. The account does indeed provide vital information concerning the development since it continued to describe a strip model. The printing can be dated sometime after October 20th, 1877--the date of the last testimonial included.

Johnson, although a key element in the development, has been slighted because of the non-location of his business papers. Should a significant group ever surface I am certain that many additional details will have to be added to any historical account of early developments in the phonograph industry between 1877 through 1895. Lacking these papers we have been forced to rely upon copies of letters to and from him that have been retained at the Edison National Historic Site and among the Uriah Hunt Painter papers.