The Amazing Clement Ader

By Antony Askew

Studio Sound

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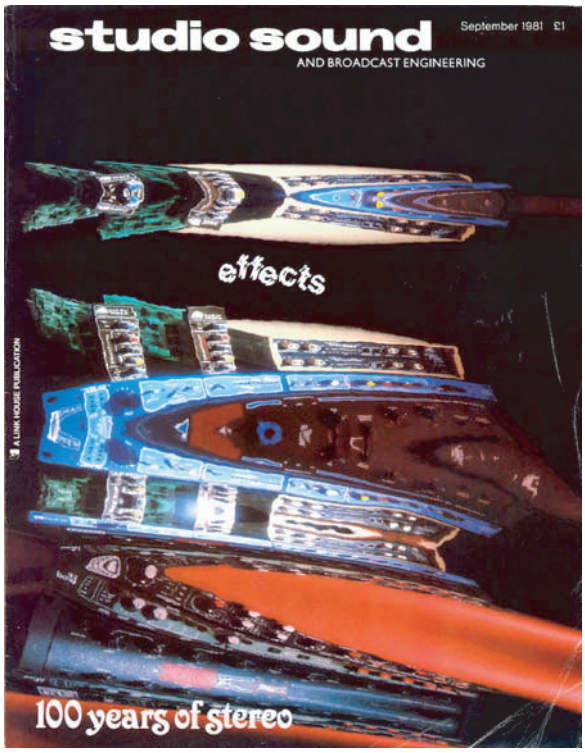
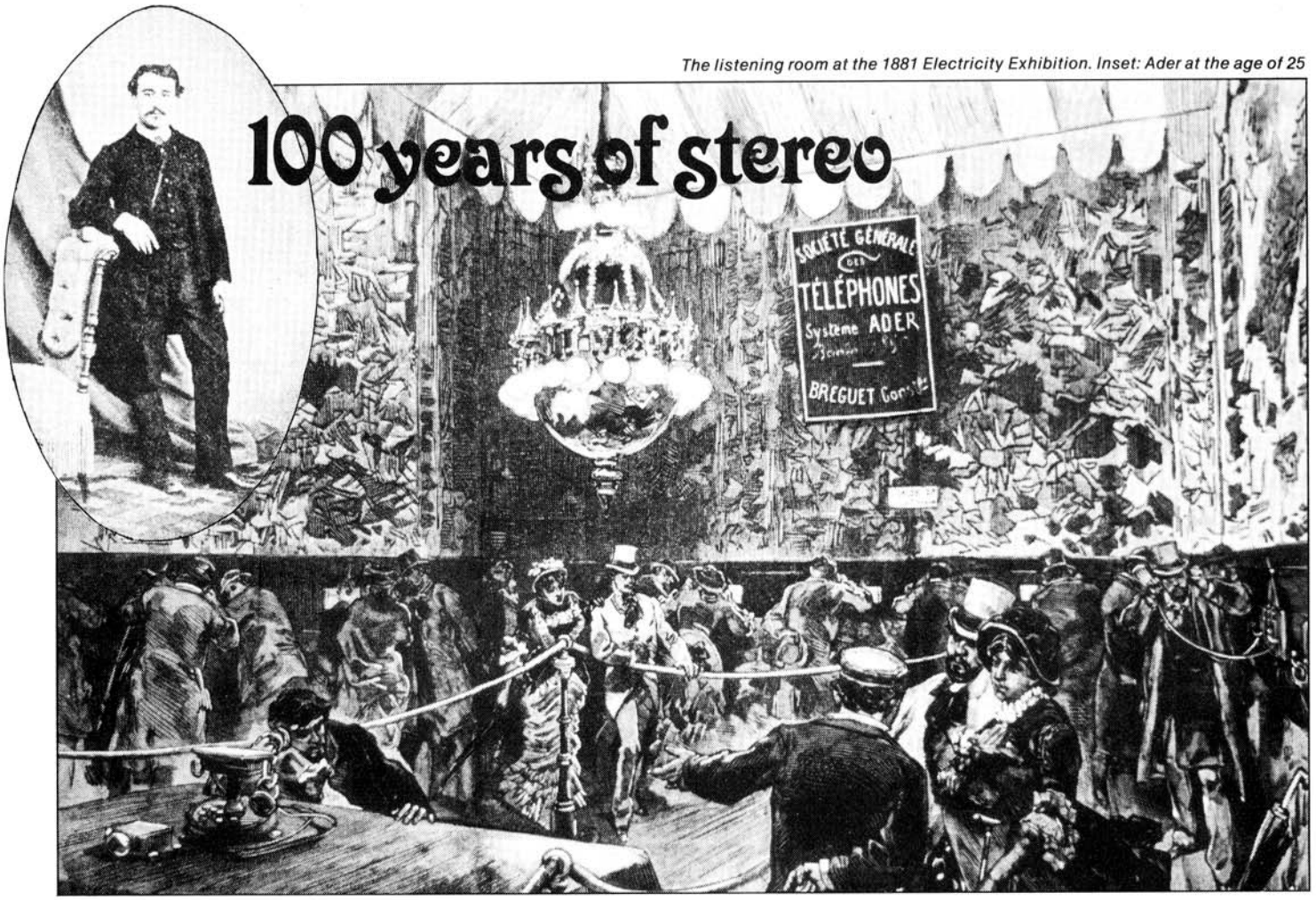




The listening room at the 1881 Electricity Exhibition. Inset: Ader at the age of 25

The Amazing Clément Ader

Antony Askew ARCM, MIBS

The writer had known of the 1881 Ader stereophonic demonstration for some years and had frequently wondered what equipment had been used and indeed what it had sounded like. During an enforced period of a much reduced work-load during the summer of 1980 he decided to look into it more closely. As documents, mostly in French, were translated, it became clear that not only were the demonstrations very successful in the context of the then 'state of the art', but they had become the outstanding attraction of what had been a dazzling international exhibition.

This article attempts to convey not only the techniques Ader used, but also something of the man himself and his other activities as well as a hint of the aura of the Exhibition, of which the "Auditions Téléphoniques" formed only a very small part, and of the reactions of those people who went to hear for themselves.

ONE'S immediate thoughts about the genesis of stereophony go to the Bell Telephone Laboratories and to Alan Blumlein. In America, Bell with their spaced omnidirectional microphone approach and their association with Leopold Stokowski, that doyen of electronically-minded conductors, led to some fascinating experiments—the cartoon feature film *Fantasia* and von Braunmühle's work with the stereophonic *Magnetophon* in Berlin in the '40s—they leave, too, an inheritance that can sometimes be the despair of certain schools of thought. At the same time the Gramophone Company at Hayes had Alan Blumlein on its research staff. This multi-handed electronics genius went on to become a key member of the team that produced the H_2S airborne radar system during the war. He was killed together with four of his colleagues when their Halifax *V9977* crashed near Ross-on-Wye on Sunday, June 7, 1942. An enormous blow to that particularly vital project but the tragedy could have been greater. Their take off from Defford airfield had been watched by the team leader.

It was his flying test laboratory and he should have been on it, but was over-tired. Had he gone we would not have the Jodrell Bank radio telescope today, for he was Bernard Lovell.

In the thirties, Alan Blumlein was working on stereophony and in December 1931 lodged his provisional patent that became Patent No 394,325. It was a classic document that covered very nearly every aspect of the subject almost exactly 50 years ago.

Thus 1981 is a very fitting anniversary for stereo. However, you may be forgiven for raising your eyebrows when you learn that 1981 is also the centenary of the first demonstration of broadcast stereo. Broadcast? Well, yes, in the sense that the relays were intended to be heard by a large number of people simultaneously.

This article is about that first demonstration—and the man behind it, but there are several personalties and sub-stories with a bearing on it. Alexander Graham Bell, the Scot who went to seek his fortune in America, takes credit for inventing the telephone. Indeed, today we refer to a 'phone call as 'giving someone a bell'! Bell lodged his patent for "an improvement in *Telegraphy*" (author's italics) at the US Patent Office on February 14, 1876. The patent was for an instrument that had yet to work. That same day, a Mr Elisha Gray deposited specifications and drawing in the form of a caveat for a similar device. An omission on the part of the US Patent Office resulted in the expiry of the caveat and gave Bell the lead.

(Had Gray won might we today speak of 'giving someone an elisha'?!) Bell's device was made to work the following month. It was born on March 10, 1876, uttering the words: "Mr Watson, come here! I want you!"—a phrase that could almost rate alongside "Dr Livingstone, I presume".

Professor David Edward Hughes, Canadian born, was living and working in London. A discovery of his contributed greatly to telephone technology and it was he, incidentally, who first showed, in 1879, the existence of radio waves up to nearly half a mile from a transmitter at his home at 40 Langham Street, London, a stone's throw from the site that would, nearly 50 years later, become the headquarters of the BBC. No one believed him at the time and it is another who has had the immortality thrust upon him—Hertz, who described and demonstrated the phenomena 10 years later, in September 1889, at the same time averring that *they could be of no practical use.* (Vote now for the One kilo-Hughes LU tone and the insanity of 27 MegaHughes!!)

Hughes' part in the story is his finding that when loosely coupled bits of carbon (or earlier, 3in nails) were connected in series with a battery and a Bell-type earpiece a very sensitive acoustic/electric transducer was formed. He gave a lecture to the Royal Society on May 9, 1878, and showed his devices to which were attached box resonators in which insects could be trapped. The scratching sounds were so 'amplified' by the apparatus that Hughes likened them to the microscope as they acted for the ear as did the microscope for the eye. He thus coined the word *microphone.*

One newspaper account of the demonstration was very coloured:

. . the breathing of a fly was heard through the instrument as an elephant bellowing through his proboscis in an Indian Jungle . . .

It was Bell's invention that took the world by storm. It was exactly what the world had been waiting for for centuries. It fired the imagination of many—and the avaricious thoughts of not a few. One man who was fired by a little of both was our hero—Clément Ader.

Ader, notable *and* notorious

Notable, for he was an imaginative and competent engineer in many fields and, as we shall see, contributed many devices and ideas to society. He became the first man in the world to get a piloted flying machine to take off under its own power from level ground and coined a word that has become the generic name in French for any aeroplane—for he called his flying machines *Avions.*

Notorious, for he became the centre of one of the greatest scandals and *causes celèbres* in aviation history.

Clément-Agnes Ader was born in Muret near Toulouse on April 2, 1841. The family was artisan; father was a carpenter and his two grandfathers were a weaver and a miller. He went to school in Toulouse where he developed his aptitude for drawing and things mechanical. He wavered in his choice of career, uncertain whether to become an artist or an engineer. He chose the latter, but the former served him well throughout his life and indeed there is a creditable self-portrait in oils he painted when 25.

He went to work for the railways in 1862 as a superintendent of bridges and tracks and was involved in the construction of the railway line from Toulouse to Bayonne. He devised and patented a machine for setting up rails, which was used extensively; he brought new ideas to bridge building. In 1868 he patented the world's first bicycle with rubber tyres—the *Modélé Trés Elegant* sold for 200 francs. One of his customers was the celebrated acrobat Leotard.

The Franco-Prussian war of 1870 interrupted the bicyclemaking and Ader turned his inventive mind to the war effort; steerable balloons for the siege of Paris and a vehicle with an endless rail track which was rejected by the reactionary War Ministry—thus they threw away the tank nearly 50 years early!

He was also a very keen ornithologist and became fired with an obsessive dream—to fly himself. In 1873 he constructed a tethered man-carrying glider with wings made from goose feathers—an indication of the monomania with nature that would continually lead him along the wrong aviation road.

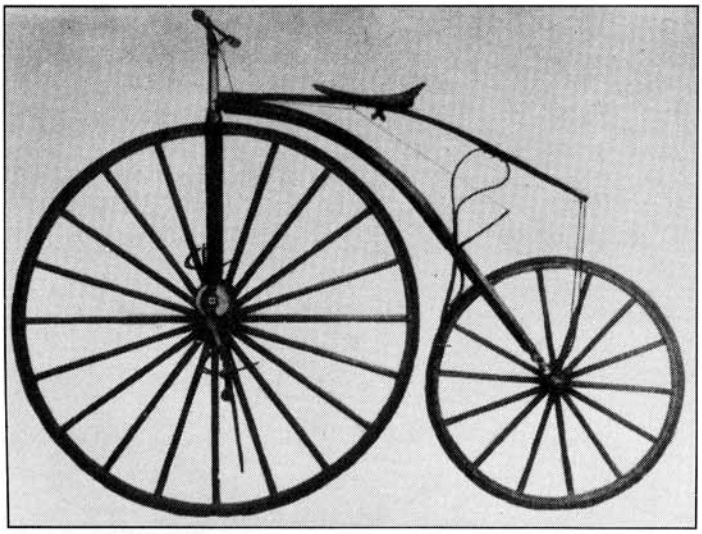
He realised that the large sums of money needed to finance 'The Great Dream' would not come as long as he remained a salaried minion. He resigned from the railway in 1876 and went to Paris to seek some sphere of engineering that would bring him a fortune.

But to what branch of Science should he turn? Which would become the 'wet nurse' to aviation? The Fairy seemed to be electricity. Enthralled by accounts of what had just been discovered in America by Bell, he threw himself into the development of the telephone.

In 1880, under an agreement with the Minister of Posts and Telegraphs, M. Cochery, a company called the Société Générales des Téléphones (The General Telephone Company) was set up and used Ader's discoveries. The new communication revolutionised the life of Paris and the company prospered, being the only one in the field. An installation was put in the office of the President, M. Grévy, with whom Ader became friendly. They dined and played billiards together and, following the success of the music relays at the Exhibition, a 'Théâtrophone' (as it became known) was fitted into the Elysée Palace connecting it with the Opéra, the Théâtre Français and the Odéon Theatre. The press had a little snipe at Grévy, for he had a reputation of being somewhat mean and this was seen as a means of entertaining at the Palace without having to pay artistes!

In 1880, the Academy of Sciences had awarded Ader the Prix Vaillant for his work on the telephone and after the Exhibition he was made a Chevalier of the Legion of Honour. At the same time his interest appears to have been 'bought out' by the bankers involved and his connection with telecommunications came to an end. But he was now famous and sufficiently wealthy to finance The Dream.

Ader's bicycle with rubber tyres (1868)



The father of aviation?

His first flying machine, Avion I, carried the name *Éole*—God of the Winds. It took him eight years to build and a model of it may be seen today in the Science Museum in London.

Based on his preoccupation with nature, it was built like a bat—the wings were folding like an umbrella and could change shape by means of levers and wheels—some might say a forerunner of the variable geometry aeroplanes of today—but far too many controls for the pilot, Ader himself, to operate successfully. Neither was there any forward vision, the pilot being placed behind the boiler—for this was a steam-powered machine and the engine designed by him was the best part of it. It had an extremely good power/weight ratio for its day, developing 20hp, and drove a single propeller made of bamboo constructed like a bird's feather.

On the afternoon of October 9, 1890, *Éole* struggled into the air some 8in and 'flew' about 165ft in the grounds of a chateau at Armainvilliers near Grez. The 'flight' was due more to the power of the engine than its aerodynamic capabilities. But a small aviation 'first'. A flying machine carrying a man *had* left level ground under its own power for the first time. But:

> "The whole conception of the machine—except for its engine—seems to have been the result of a romantic fantasy of flight that Ader harboured, unrealistic in every particular. Enginewise the *Éole* was a brilliant achievement: aeroplane-wise it was . . . a freak."(1)

Ader was then commissioned by the War Ministry to build an improved model. Avion II was never completed and a new commission for Avion III was obtained. This was finished in 1897. The wing movements of *Éole* had been simplified and there were now two steam engines, each driving a propeller. Ader had also demanded that a special *circular* runway, 450m in diameter, be built for the trials on the military camp at Satory. To anyone with the most rudimentary knowledge, this must seem very silly, for any wind would, to a machine trying to achieve takeoff, have appeared coming from the full 360°; let alone giving the pilot, again Ader, the added problem of having to steer round the track whilst, at the

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Ader

same time, attempting something 'Man Had Never Done Before'.

Two officially observed tests were made on October 12 and 14, 1897. On neither occasion did Avion III fly, and on the second day was blown off the runway and seriously damaged. The officials departed and wrote their report. The Ministry refused further money; Ader had already had more than 650,000 francs. The report, stating that Avion III was a failure, was kept secret until some years later.

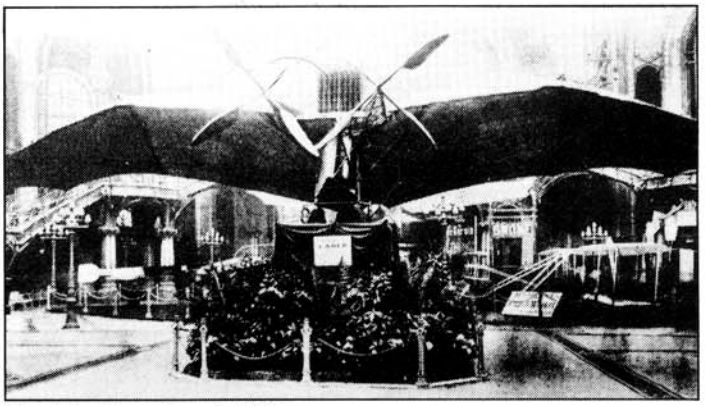
He was embittered, destroyed much of his aviation research work and turned to other matters: a Bateau Glisseu design anticipated the hydrofoil craft of today; a submarine telegraph system which was used to link Brest and Newfoundland; some fearsome aerial torpedoes; and he designed the first V-engine which powered the 'Voiture Ader' which was shown at an exhibition in 1902.

However, he exhibited Avion III in the years following the abortive trials; indeed, at one viewing, the Exhibition of 1900, the sight of it was to be the inspiration for Gabriel Voisin.[2] But it was the success of the wealthy Brazilian living in France, Santos-Dumont, with a 'hop' lasting 21⅛s in 1906 and this being hailed as the first in France, that put Ader on the road to notoriety.

He was furious and claimed that he, Ader, *had* flown, *not* in 1890 with *Éole,* but at Satory with Avion III on October 14, 1897, and had in fact achieved a controlled flight of 300m. Later, he claimed further flights at Satory *with Éole.* The myth was given substance by a number or articles he wrote and by pressurising one of the official observers at the 1897 trials, the by now ageing General Mensier, who later gave an interview to a journalist supporting Ader's claims. Three weeks after the interview, the secret report, signed by Mensier himself, was published but ignored.

For the French were looking for a French hero. They had an obsessive desire to maintain, into true flight, the inheritance of the Montgolfiers. This warped their outlook and sense of objectivity and the Ader claim became first-rate fodder for their need for 'La Gloire'. The myth grew, was fed, and flourished.

Present-day investigation of the Avion III, preserved in the Air Museum in Paris, has proved conclusively that it *never* could have flown. However, Charles Dollfus, the eminent French aviation authority, has looked at the steam engines and has reported that they are a brilliant design. He knew Ader and had the task of examining all his papers following his death. Ader



The Avion III *on show in 1908*

emerges as a very stubborn and intensely chauvinistic man. "He was no one's pupil and he had no disciples."

In 1924 he was made a Commander of the Legion of Honour and he died the following year on May 3, still regarded by the French as the Father of Aviation. In 1936, his mendacious claims were further bolstered by the publication of a 'deplorable' biography written by his son-in-law, Georges de Manthé. By this time there was a monument by Landowski at one side of Le Square Clément-Ader at his birthplace, Muret; and a Salle Clément-Ader in the local museum.

In 1948 Charles Dollfus produced for the first time documentary evidence that Ader's claims were a fabrication. This was disregarded by the French for, in 1950, they erected a plaque at Satory.

HERE, ON THE PLATEAU OF SATORY, ON OCTOBER 14th, 1897, CLÉMENT ADER SUCCEEDED, ON THE AVION—A MACHINE CONCEIVED AND CONSTRUCTED BY HIM—IN SPITE OF RAIN AND WIND, IN LEAVING THE GROUND AND MAKING A CONTROLLED FLIGHT OF 300 METRES

The real story was not brought to light properly until 13 years ago when, in 1968, Charles Gibbs-Smith published his magnificently researched and elegantly argued Science Museum book.[1]

It seems a pity that Ader had his obsession with flight so directed by fantasy as to become little more than a distant relative to aviation. Had he stayed in telecommunications he might have become rather more than a grandfather to stereophony.

The Exhibition of Electricity

The year 1881 was eventful. An American president was assassinated. There was a comet, which was thought to bring a fine vintage; and things augered well for the Paris International Exhibition of Electricity to be held in the summer and autumn. Many countries were going to exhibit: Great Britain, America, Belgium, Austria-Hungary, Russia, Sweden, Norway, Italy, Spain, Switzerland, Holland, Denmark and even Japan, as well as the host country, France. And people were interested in 'Things Electrical'.

Everybody is interested in Electricity, that babe in Swaddling clothes . . .
. . .on the point of outstripping his elder sister, Steam.

Times

An electric lighthouse, fitted with Fresnel's lenses, was a centrepiece of the Exhibition in 1881

The venue was to be the Exhibition Hall near the Champs Elysees. It was 660 × 160ft with an upper gallery divided into smaller rooms. It was to be converted as soon as possible after the closure of the summer art exhibition, the Paris 'Salon'. The centrepiece of the main hall was to be a great electric lighthouse complete with Fresnel's lenses and surrounded by a basin of water on which an electrically propelled boat would move. Above, Gaston Tissandier's electrically driven balloon would fly. The Palace would be illuminated by electricity using many different systems some with still familiar names: Edison, Brush, Swan, Lane-Fox, Maxim, Crompton, Werdermann, Brockie, Pilsen—some arc, others incandescent—all to be powered by steam-run generators. Edison also had two entire rooms devoted to displaying his various light fittings. Every conceivable use of the new wonder was to be displayed—civic, domestic, agricultural, medical and industrial. Telegraph and telephone systems, fire alarms, clocks, sewing machines, measuring instruments, batteries, insulating materials, dynamos, motors, theatrical lighting, electric photography, historical items, trains and tramways—there was to be one such tramway installed by Siemens

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to convey visitors to the Palace from the Place de la Concorde, a quarter of a mile away. There were to be lectures and demonstrations. A wonderful attraction for Paris in 1881.

Every square yard of the huge building has been claimed for exhibits, and there is only too little ground left for the perambulations of the public.

Telegraphic Journal

Ader and the Telephone Company wanted to lay on something very special. Those interested in the telephone in those days were, very definitely, a pre-'Busby' lot; they had not grasped the fact that its *real* use as we know it today is "to make somebody happy"—they tried all sorts of things. In 1878:

The opera "Don Pasquale" was heard well by means of the telephone in Bellinzona and, in its travel, the charming music had lost none of its delicacy . . .

Du Moncel

In fact this idea was developed afterwards when a number of European capitals had a service of wired broadcasts via the telephone system. Paris naturally had such a one; Budapest had some 14 hours a day of scheduled news, stock market reports and music; and London telephone subscribers could participate in the 2-tier tariff *Electrophone* service, at £10 or £5 a year, and eavesdrop on concerts, music halls, theatres or church services. The London system ran from 1899 until radio finally killed it in 1925. (Bournemouth, incidentally, had its own system which finally came to a halt when the last subscriber died in 1937.)

Theatre relay problems

Ader had been involved in theatre relays prior to the Exhibition and had run into a number of problems which are outlined in his patent of 1881:

"The telephone allows us to convey songs, music and the spoken word to distant places and interesting experiments have already been carried out. But, if with the aid of telephonic devices, one seeks to reproduce singing, music, discourses and theatrical productions, one encounters a great number of obstacles and the means of overcoming these are the subject of these intended improvements aiming at establishing telephone networks for theatres.

"First of all, there is the fact that the batteries will not supply power for the entire duration of a theatrical presentation.

"One therefore has to be able to change the cells in the course of a performance. This change will however cause interruptions in the receiving apparatus which will be unpleasant for the listener. This drawback may be avoided by using a special device."

Ader goes on to mention one of the other principal problems encountered:

"The transmitter must not be affected by any shaking of the stage caused by the footsteps of actors or ballet dancers since when transmitted by the telephone, the resulting noise would have a disagreeable effect. For this reason, the transmitter is placed into a little box, the bottom of which is filled with a mass of lead which inhibits the vibrations; moreover, these boxes rest on the floor with rubber feet."

He also sets out the 'stereophonic' aspects of the Improvement, but disregards any significance in maintaining the correct left/right relationship; this was to be noticed by a music critic who wrote about the exhibition demonstrations.

"If equipment is set up so that the listener's earpiece is connected to a transmitter on the stage, the sounds heard through the system would vary in loudness depending on whether the performer is close to, or distant from, the transmitter. In some cases the sounds will be very loud and in others very soft, or even inaudible.

"The inventor seeks to avoid this defect by arranging the transmitters and receivers in a very particular manner.

"The transmitters on stage are placed in two groups, one group on the left, the other on the right and one of the subscriber's earpieces is connected to a transmitter of one group, the other to a transmitter from the other group. This way, the listener is able, using both ears, to follow the various sounds, and the variations in loudness heard by the listener will correspond to the movements and displacements of the actors on the stage. This double hearing via the equipment is, in effect, analogous to the visual effect produced by a stereoscope.

"The details of the construction of a telephone network for theatres are illustrated in Figs 1 to 10. *(Diagrams not reproduced here—Ed)*

"Fig 1 illustrates the whole installation in section and, in Fig 2, in plan, indicating the way in which a theatre may be connected to a subscriber's dwelling."

The last proposition indicates that Ader had some kind of 'broadcasting' network in mind. A charming drawing was produced showing actors waving swords, etc.

He summarises his claims as follows:

PATENT CLAIMS:

1. The arrangement of the open boxes filled with lead and resting on rubber feet which house the transmitters and whose purpose it is to counter crackling noises resulting from vibration.

2. The grouping of the transmitters into two series so that a transmitter of one series is connected to one of the subscriber's receivers and a transmitter from the other series is connected to the other receiver with the intention of rendering the stage effects and actors' movements audible.

3. The arrangement of battery and switching apparatus so that instantaneous changeovers may be made of the batteries to the spare cells.

4. The arrangement of the circuit breaker in the lines connecting transmitters to receivers.

To lay on a demonstration in keeping with the scale of the Exhibition—this herald of a new era, and of a new power that was to revolutionise the way men thought and lived—the Telephone Company invested some 160,000 francs in equipping the Opéra, the Opéra Comique and the Théâtre Français.

They ran some preliminary trials some months beforehand and invited various people to take part as listeners. The journal *La Nature* wrote:

"We have the good fortune this week to be involved in an experiment that M. C. Ader organised in the vicinity of the Théâtre Français. Thanks to M. Ader's perfected equipment, we heard almost the whole of one act from the witty play by M. Pailleron, *Le Monde ou l'on s'ennuie.* The voices of each artiste could be perfectly distinguished as could the frequent applause of the audience. The truly admirable results obtained will, without doubt, contribute greatly to the success of the Electrical Exhibition."

Gaston Tissandier, whose balloon was going to fly over the heads of the visitors to the Palace of Industry was also invited to a preliminary hearing: *"It is marvellous; it is magic."*

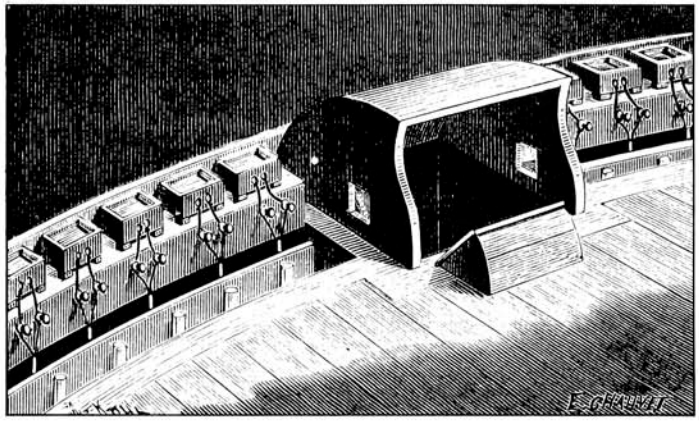
Count Theodore du Moncel, the distinguished electrician and writer on matters electrical had known Ader for some time. Indeed, it was he who by showing Ader an article on the very early work being done in America, had started Ader thinking about telephonic communication. In his book *Le Téléphone* he describes the preparations:

"Since it was necessary to satisfy a large public demand—it is always avid for these sorts of experiences—it was necessary to install many microphones to energise a great number of earpieces and, since one wanted to listen by means of placing one telephone to each ear, it became necessary to install transmitters for one hundred of these double telephones.

"Experience had shown that, over the distance that separated the Opera House and the Exhibition Hall (about 2km), one of these transmitters was, once connected to a suitable battery and a 2-wire circuit, able to energise eight telephones and thus 24 transmitters, each with its own battery and induction coil, were installed in the Opera House. They were set along the footlights on each side of the prompt-box and connected by twin wires that ran underground or in convenient gutters, to rooms fitted out for the purpose in the Exhibition Palace." ■

To be continued

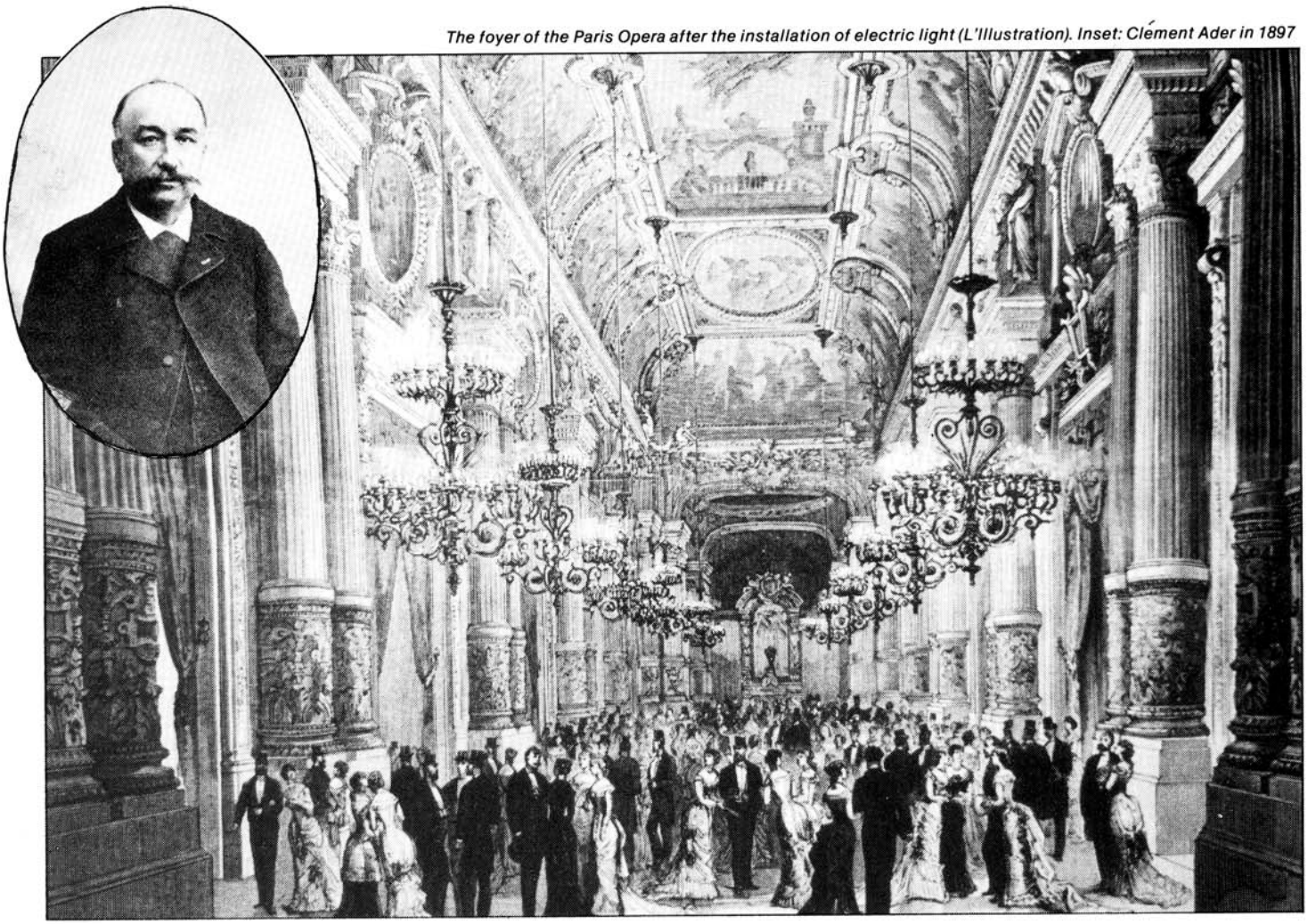
Ader's microphones installed along the footlights



Notes

(1) Charles Gibbs-Smith: *Clément Ader—His Flight Claims and his Place in History.*

(2) Gabriel Voisin: *Men, Women and 10,000 Kites.*



The foyer of the Paris Opera after the installation of electric light (L'Illustration). Inset: Clément Ader in 1897

The Amazing Clément Ader

Antony Askew ARCM, MIBS

Part one of this series covered the early inventions of Clément Ader and events leading up to the Paris Exhibition of Electricity in 1881. We take up the story again with the opening of the Exhibition and consider arrangements for the transmission of performances from the Opera House via telephone lines.

THE Exhibition was late opening:

"The opening . . . has been deferred . . . it has been found impossible to be ready in time, the organisers . . . having barely a month in which to transform the vast superficies of the Palais d'Industrie into a palace of wonders and marvels that remind one of the splendours of the *Arabian Nights*. The exhibition promises to be an immense success, and both exhibitors and commissioners are now straining every nerve in order to be ready for Thursday week. The English commissioner, Lord Crawford, and Balcarres may be seen any day setting an excellent example to the others, and working away with laudable zeal."

wrote the Paris correspondent of the *Illustrated London News* in his weekly column 'Paris doings and sayings'. Many of the artists and sculptors were slow in removing their exhibits from the hall on the closure of the 'Salon'. An enormous quantity of equipment, much of it from abroad, some of it unexpected, had to be installed and persuaded to function.

"At the time we write there are many signs of heavy engineering work being done, but the machines which are to be driven have either not arrived, or are still securely packed in the numerous cases which strew the exhibition building in (apparently) hopeless confusion."

had reported the *Telegraphic Journal* on August 1st. It did open on the 11th, with a Preview on the 10th inaugurated by President Grévy.

The inaugural ceremony took place at 10 am and, as there would have been no performance from the Opera at that time of day to provide material for the hearings, a special programme was laid on from the Opera House stage. The Opera Chorus started with a couple of items including the *Huntsmen's Chorus* from *Der Freischütz* followed by *Crépuscule* and *Marche Tartare* played on the piano by the conductor of the Chorus, Jules Cohen. The programme ended with two rousing contributions from the Band of the Garde Republicaine.

Preview

Grévy did his inauguration bit and then went round the exhibition. He spent rather a long time examining an electric scoring board for billiards.

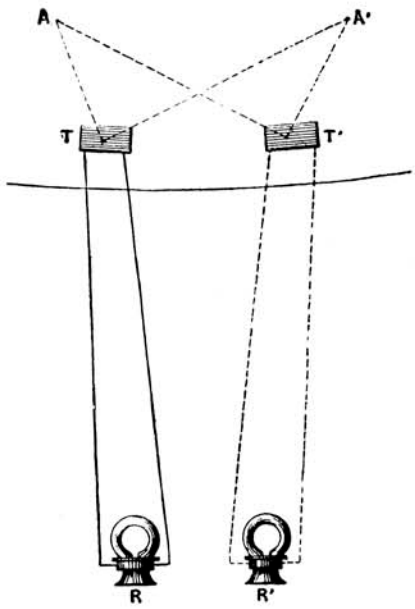
"Then he disappeared into one of the telephone rooms with his entourage . . .

The people invited to the preview wanted to rush in behind him, but had the door slammed in their faces. . ."

reported *Figaro*, whose correspondent then wrote:

"I do not know whether the concert . . . was given in its entirety, but I can assure you that the hearing was little more than five minutes. M. Grévy placed his ear *(!)* to the telephone . . . he said: 'It is very curious.' After which, as if he might miss a train, he left the telephone room at a trot, as indeed he had entered."

As the generators, which were to supply the lighting, were still not ready, it could only open during the day and little interest was shown by the public until evening openings



occurred from August 26th onwards when:

> **Only on leaving the building did a visitor fully appreciate the brilliancy of the illuminations, for the gaslamps in the Champs Elysées appeared by contrast very yellow and feeble, while the gas devices of the 'cafés chantants' seemed a miserable attempt at a display. The electric tramway is nearly ready. The attendance at the Exhibition will now doubtless, especially at night, be considerable.**
>
> **Times**

The French magazine *L'Illustration* covered the happenings at the Palace in detail giving explanations and engravings of all the new marvels. Time after time in these contemporary accounts one reads rave reviews of the stereo demonstrations:

"The telephone hearings from the Opéra at the International Exhibition of Electricity attract a great crowd each evening which is avid to discover for itself that the proclaimed marvels are not exaggerated . . . They are an indisputable and undisputed success . . ." *(L'Illustration).*

"It was sufficient to establish beyond doubt the immense success of the theatrical telephone hearings . . . to go to the Palace of Industry at around 10 o'clock on an evening of a performance from the Opéra. An interminable and dense queue crowded the approaches of the telephone hearing rooms and it was not unusual to see people who had already been in once to try again to hear another two minutes of this curious and unprecedented show. All the sounds were relayed with a marvellous delicacy, with none of the spitting sounds that have been the despair of all those who, up till now, have tried to relay soloists, choirs and orchestras." *(L'Électricien)*

Perspective listening

Du Moncel was at pains to make clear the principles of 'perspective listening' as some called it — the actual word stereophony never appeared. *(See above, left.)*

"Suppose that two transmitters of the type described were placed at T and T^1, and that wires relayed their output to two receivers R and R^1 each of which was placed to each ear; we would get the same sound from a performer placed at A that we would have got from both ears had we been in the position of the microphones. It is easy to understand that as the distance of the performer to transmitter T is less than the distance to transmitter T^1, his words will be louder on transmitter T than on transmitter $T^1$and it will be the left ear that will get the louder impression. If, on the other hand, he leaves position A and moves to A^1, the opposite effect will occur and it will be the right ear that will get the louder sound. A definite sensation will take place of a change of sound intensity from one ear to another, which will be equivalent to a receding sound for one and an approaching for the other, that is to say, a displacement of the sound source from the actor from left to right, and it will be the same for several one believes to be on the stage."

Du Moncel then described the scene at the Palace of Industry:

"The theatrical hearings were arranged not only in four specially fitted rooms in the Palace of Industry, but also in a small room, called the Imperatrice, located in the foyer of the Palace. It was quieter in this room and in there one could more conveniently savour the charming songs from our 'lyric scene'. As for the telephone listening rooms in the Exhibition, they were hung with carpets on all sides to deaden the noise from outside and the earpieces were hooked in pairs to wooden desks, there being twenty to each room. In the middle of the rooms there was a table fitted with a telephone for the attendant so that he was able to let the public know when items were to start and regulate entry to the room; he also broke the circuit when the time came to renew listeners; this occurred every five minutes, to the great disappointment of the entire crowd.

"As the receivers were connected in sets of eight to the same pair of microphones and as each of the pairs occupied different positions on the stage, different effects occurred at different listening points in each room. Those microphones that were furthest from the centre of the stage were more affected by the large orchestral instruments than those towards the middle; but on the other hand, those in the middle were more prone to pick up the voice of the prompter. *(Little improvement noted 100 years later!)*

"To even things out, M. Ader arranged the transmitters of each set at diametrically opposed locations. Thus the transmitter at the extreme left hand end of the footlights corresponded to one placed closest to the middle of the stage and it was the same, but in a reversed sense for the transmitter at the extreme right-hand end; but the set that produced the best results was, understandably, the pair placed half-left and half-right. These considerations account for the differing impressions gained by certain listeners relating to the predominating sounds that they had heard and explained why several people, having listened in different parts of the same room, did not have the same impressions. Naturally we suspected the telephone devices, but since they turned out to have been functioning well, the differences they showed can only be attributed to the positions occupied by the microphones that fed them."

This must be one of the first recorded comments about microphone balance — shades of McKenzie to come! *(See above, right.)*

Du Moncel concluded with:

"Whatever follows, the success of these theatrical hearings has been very great. Every evening we relayed the Opera House, queues

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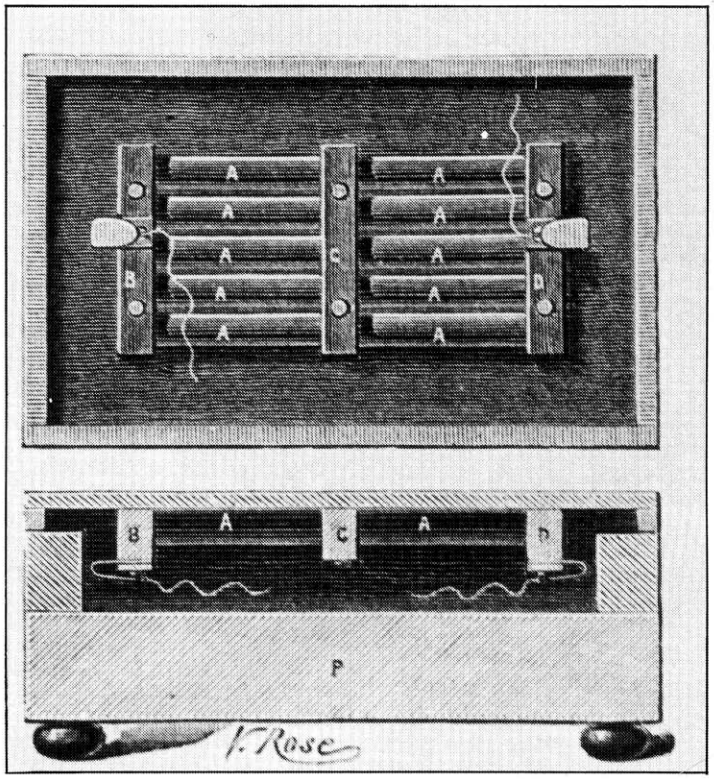
formed up of those wishing to be present and this continued until the end of the Exhibition. Though there were some unenthusiastic people who tried to throw cold water over the achievement, wishing to protest in the name of Art against musical reproduction, almost everybody with an open mind was overjoyed and professed to have heard better than had they actually been present at the Opera House which may be easily understood if you reflect that the transmitters were interposed between the singers and the orchestra and this favoured the singers whose words were heard admirably.

Transmitter

"One may see a longitudinal section through the device and the view from below shows it to be the same transmitter used throughout the General Telephone Company's network. Each is made up of 10 small carbon rods AA arranged in two groups of five and supported on three crosspieces BCD fixed to a small sheet of deal which receives the vibrations and at the same time serves as a cover for the apparatus. It is fixed to a leaden base P and supported on four rubber feet in order to prevent vibrations from the floor of the stage getting to the transmitter.

"The receivers of M. Ader are electromagnetic, the magnet being curved into a circle which serves at the same time as the handle for the instrument. Up to this point the receiver is the same as the Gower and Seimens telephones. M. Ader has added to these telephones a soft iron ring F placed in front of the vibrating diaphragm, to which he has given the name *superexciter*. The presence of this superexciter has the effect of modifying the character of the magnetism to give perpendicular direction to the lines of force towards the surface of the diaphragm rather than allowing them to take a diverging direction. As a result, the variations produced in the magnetic attraction by the inductive currents which occur in the coils have a maximum effect on the diaphragm, the centre of which is placed in the intense magnetic field perpendicular to the lines of force. The telephone is thus more powerful and more sensitive to the delicate nuances of telephone transmissions."

The opera that gains the distinction of becoming the first to be relayed in 'stereophony' is, without much doubt, Meyerbeer's *Robert le Diable*, which was, according to the Paris Opera schedules, presented on August 26th, the first night of evening opening and this is confirmed by *L'Illustration*. A happy coincidence, for it was the original production of that work in 1831 that made the Opera House's fortune.



Ader's microphone design showing rods (A), crosspieces (B) and lead weight (P) sitting on four rubber feet (L'Illustration)

Problems

Little has been recorded about any transmissions from the Opéra Comique; this was in fact shut until September 1st. The relays from the Théâtre Français ran into technical trouble, although mention is made of hearing some speeches from *Le Monde ou l'on s'enemie* which was still running.

Up till now it has not been so successful as the relays from the Opéra, principally caused by the conditions around the footlights, where, at the Francais, they are close to flaming jets which produce loud and annoying currents of air.

L'Électricien

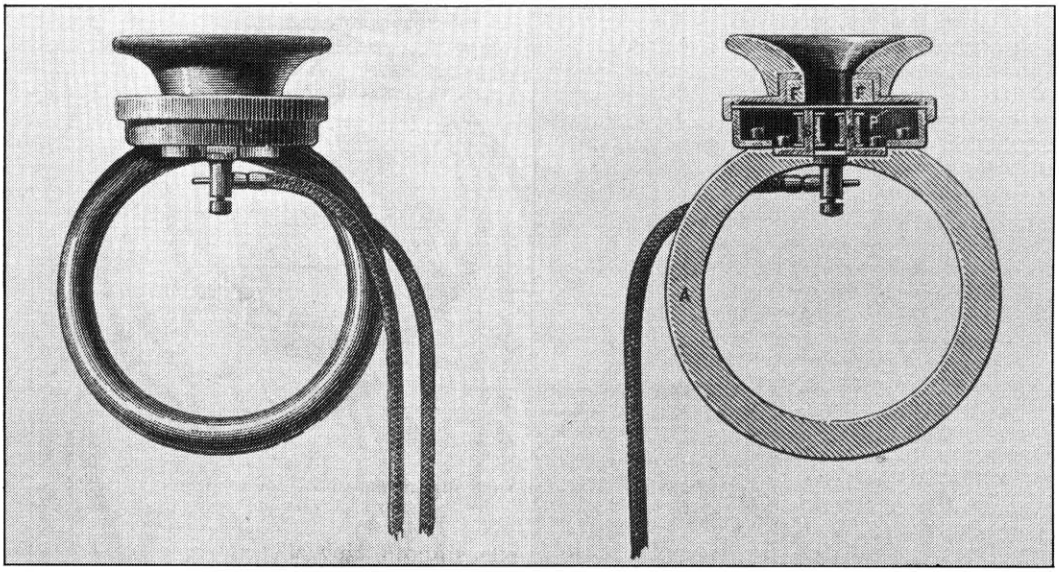
wrote M. Hospitalier in *L'Électricien*. That particular account ends:

"How can one give an account of the impressions gained by the visitors to the telephone hearing sessions? One needed to have heard the indescribable effects to really have gained an idea and we sympathise with all those who were unable to take part in this demonstration, the only one of its kind in the world.

"Several people played a part in its success, but the highest praise must go to M. Ader who had developed the Hughes microphone to its practical state. The Minister of Posts and Telegraphs who had kindly allowed M. Ader the use of the lines necessary for this memorable demonstration, M. Berger and the General Telephone Company who had organised the demonstrations and M. Bréguet who had constructed the equipment also merit our thanks and commendation. Without wishing to diminish in any way the worth of the numerous marvels that were contained within the Palace of Industry, one may say that *the telephone hearings constituted the greatest attraction for the public and would have alone assured the success of the Exhibition*, though this was never for one instant in any doubt." (Author's italics.) ■

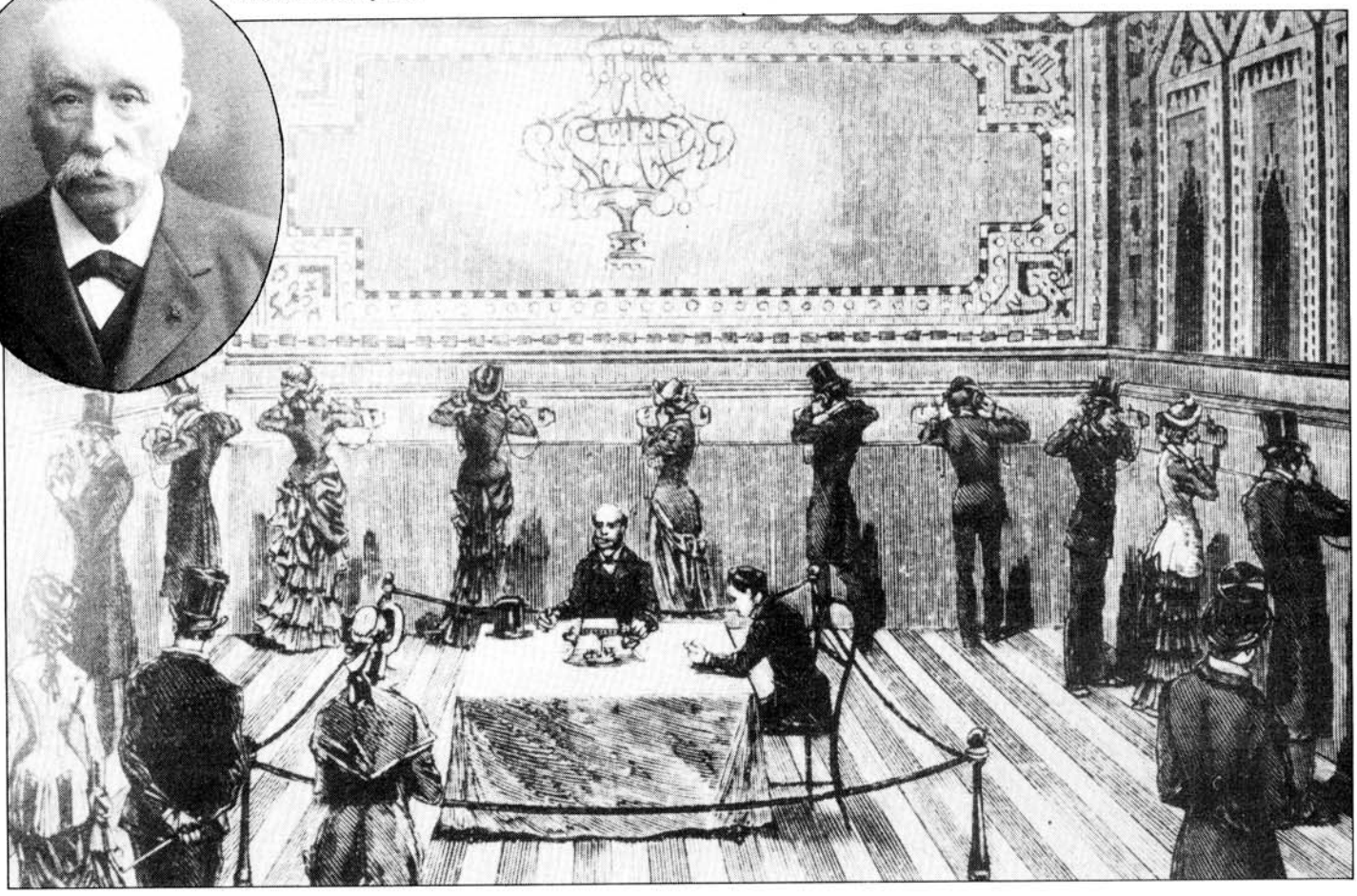
To be concluded

Full view and cross section of the receiver



Antony Askew is senior music studio manager, BBC Radio and editor, Institute of Broadcast Sound.

Clément Ader aged 81



The Amazing Clément Ader

Antony Askew ARCM, MIBS

One hundred years ago this month, the first demonstrations of stereophony, the relaying of opera performances via telephone wires to the Paris Exhibition of Electricity, were coming to a close. In the final part of this article, we hear the critics' reactions to the hearings, and uncover the makings of a scandal.

SO FAR we have seen comments from technical writers. How did musicians react? One music critic, M. Weber, was reported to have stayed away rather than make too rapid a judgement on such a brief listening period. But the critic of the *Political and Literary Review,* Leon Pillaut, did go:

"What is really extraordinary is that the music is perceived, not only with all the pitches and rhythms which make up musical phrases, but also the timbres of the voices and instruments that go with them. If one could eliminate the rumbling of machinery which fills the Exhibition Palace and which pervades the listening room and, if one were allowed to listen long enough, one would end up by having a complete impression of the performance. The cause of this fidelity of musical reproduction is that none of the multiple relationships of the sounds of a large orchestra and numerous voices is altered by telephonic transmissions and the ear soon re-establishes aural sensations into their true perspectives.

"In the five or six minutes during which we were allowed to listen . . . we heard two fragments of the second act of *Le Prophète.* The first of these fragments contained Fides' Aria "O mon fils! sois beni . . .", which was unfortunately cut short by the ringing of the bell which times the listening period . . ."

These demonstrations were, being heard on earpieces, a kind of 'binaural' stereophony, and the major problem encountered today was perhaps noted by him even during the brief time he listened:

". . . During the whole of the first section of this Aria, the singer's voice could be heard as clearly as in the hall itself, and the words as distinctly *as if one's back were turned to her* (my italics). The timbres of the accompanying instruments were perfectly recognisable, especially those of the wind instruments; in particular, a chord played by the oboe, clarinet and bassoon linking the Aria to the preceeding Recitative, stood out above the others. Possibly there are certain harmonies and timbres whose sound make-up is better than others for the little metal plate which acts as a diaphagm for the telephone. As for the clarity of the words and the singing, it was complete . . . one can work out exactly the location of the people singing on the stage by the greater or lesser intensity of their voices. This sonic perspective is even more pronounced than in the Opera House itself and must be more or less that which exists near the prompter, that is the voices of the singers approaching the footlights . . . ring out proportionately far too loudly in comparison with the voices which are further away.

"In such instances one hears not only the singing very loudly, but also all the involuntary movements of the larynx, such as vibrato and even the sudden intake of air . . . ."

He also established another of the 'truths' of reproduced music:

". . .The telephone lacks indulgence; out-of-tune intervals, so frequent in ensembles, can be heard more cruelly still than in real life."

It is also apparent, as we saw in Ader's Patent, that no importance was placed on the left/right aspect:

". . . a trombone chord exploding in the left ear-piece, which is a little disquieting since these instruments, placed to the right of

the conductor, normally affect the right ear . . ."

Pillaut also, in his closing comments, anticipated the need for 'Balance and Control':

". . . and finally the noise of the applause, which rose at the end of a soprano aria, signifying an enthusiastic admiration was mixed with an increase of sharp sounds and appeared more than a little strange."

But, having seen that the transmissions were not only very successful, but captured the imagination of the majority who experienced them and became the principal attraction in a very significant international exhibition, why did not stereophony 'take off' from that moment? Why did about 50 years go by before any significant work became undertaken? For had not the demonstration with all this favourable reaction taken place at such an early stage in the development of telephony as to make the stereophonic ingredient almost indispensible, particularly in the wired broadcasts that were established and which continued for nearly 50 years until being killed by radio.

The investment of double lines to many subscribers would have been a major stumbling block and it has also been suggested that the 'quest for quality' could have been resolved in other ways, but there was another possible influencing factor.

The Paris network was, as we have said, set up and monopolised by the General Telephone Company under a concession granted by the Minister of Posts and Telegraphs, M. Cochery, and the monopoly had been under some criticism from some of the journals of the day, indeed one, *L'Électricité*, had been sniping at the entire Posts and Telegraphs administration — which also was involved in the running of the Exhibition — so much so that the sale of it was banned within the confines of the Palace of Industry. It proclaimed however:

. . . we are convinced that our voice will be heard there because no means has been found of applying the puerile ostracism to our readers to which our journal has been subjected, and against which we are protesting simply for the dignity of the Press.

L'Électricité

Despite their hostility towards the administration the paper wrote a glowing account of the hearings. Incidentally, I had been puzzled by a discrepancy in several accounts about the actual duration of the listening periods allotted to visitors — some say five minutes, others two. *L'Électricité* clarified this point by hinting at VIP treatment received by people with special passes. The poloi, who had to pay some 5 francs to get into the telephone rooms, were also rather unfamiliar with the way of handling a telephone:

. . . not everyone puts their ears to the correct end of it and the superintendent frequently has to show beginners how to hold it in a way as to be able to hear.

L'Électricité

L'Électricité's account makes entertaining reading — they don't write like this nowadays!:

"Those who had bought admission tickets at the turnstiles had to endure a very considerable wait and, even then were not admitted until those with special passes had been catered for. The crowd persisted throughout the evening and, as a result, the 'real' public did not get into the telephone rooms without having endured a wait which was as lengthy as it was disagreeable. But, despite the discomfort of this wait, we entreat our readers to endure the weariness so that they might enter the Holy of Holies of airy Harmony.

"For, those people who have not taken part in this marvellous experience, which lasts barely two minutes, cannot boast of having known the Exhibition . . .

"During the two minutes, a great silence reigns, interrupted nevertheless by cries of surprise from Opéra habitués when they recognise their favourite performers. The applause especially, is easy to hear, even without having one's ear to the telephone. Nothing is stranger than the sight of 24 people ranged around a table to which they turn their backs and face the wall like the Israelites who, during one of their religious festivals, bemoan the fate of the Temple of Jerusalem. When the two minutes have elapsed, the superintendent throws a switch which brings the miracle to an end with the same swiftness displayed in *The Tempest* when Ariel cuts off his airy music.

"The disappointment of the listeners is no less acute than that of the castaways whose disenchantment Shakespeare describes so poetically in his admirable comedy.

"The earpieces fall from disappointed hands and everyone turns away in silence as if they were trying to preserve the memory of the impressions they had just experienced. It is only after leaving that they give free rein to their expressions of admiration."

The article continues with gradually increasing criticism of the administration of the Exhibition together with insinuations that the Ader telephone system might not be all that it was thought:

"We feel that it is a mistake to stop the hearings during the (opera) intervals. By thus increasing the duration of the hearings, not only would one augment the number of persons who would enjoy the benefit, but those who were admitted during intervals would have no right to complain. Because, during presentations, it is often the (opera) audience that gives the greater entertainment; even more so being overheard more than a kilometre away. Paradoxically, and M. Cochery's Exhibition administration gives us more than one example, it is precisely at the moment when the experience would be most interesting that one is prevented from having it. Since there is a reason for everything, it must be that this apparent lack of intelligence is possibly hiding an imperfection in the apparatus of the General Telephone Company. Are the intervals, perhaps, serving as moments of rest for the batteries which have to work extremely hard and cannot carry on without some time to catch their breath? On the other hand, perhaps maintaining respect for intervals is *de rigeur* for any apparatus of the General Telephone Company."

Rivals

Were other systems superior? The hearings had become so successful that the two original rooms became inadequate to satisfy the demand. More rooms were put aside and *L'Electricité* took this opportunity:

"Some studies on this subject could be undertaken if one of the new opera rooms proposed were to be set aside for this . . . In fact, several telephonic instruments, which deserve a hearing, form part of the foreign exhibits. In taking advantage of the protection of our hospitality and our egalitarian laws, the inventors of these ingenious systems must be treated in a fashion conforming to our national traditions.

"We have in the French section, the Maiche telephone; in the Belgian section, Locht's pantelephone; in the Italian, the Gugliemini; and in the American, the Dobledear telephone, all of these have a right to be experienced."

Reasons, already quoted, had been put forward for the lack of success in relaying plays. *L'Électricité* had its own view:

". . . it is easy to understand without having recourse to the tortuous explanations by certain of our colleagues. Not only do the virtuosi (singers) have an inestimable advantage in launching upon the air rolling runs, which carry more easily than do tiresome tirades, but their acting is not overdone and, when a tenor cries to his companions to fly to the salvation of their country, he takes care not to leave the prompter's box. Which is more than can be said of a juvenile lead (in a play) who really throws himself in front of his enemies, or the villain in a comedy who lurks in the wings before throwing his dagger.

"May we be permitted to sum up our thoughts with a single axiom: an actor on stage cannot at one and the same time concern himself with the audience from whom only the footlights separate him and with the invisible listeners weakly clutching to their ears the telephonic earpieces; one must be sacrificed to the other, for one cannot serve two masters at once."

Plot thickens

The writer ends his piece with this paragraph:

"The General Telephone Company having demonstrated its impotence, then fairness, justice and national honour require us to give its rivals an opportunity to do better. The persistent exclusion of its contemporaries would constitute a gross abuse of power. We doubt that the commission would dare to commit such a strange injustice. In any case this will not happen without our informing the independent Press of the proceedings which we intend to take to further this cause once the new Chamber is assembled. At least one Member will be found to ask M. Cochery to give reasons for his preference in the matter of telephonic apparatus."

The plot thickens — and more is hinted at in the issue dated November 12th.

"The Minister of Posts and Telegraphs has given Deputies the right to attend some telephone hearings free. Monsieur Cochery has evidently yielded to the very legitimate desire to secure the sympathies of those political people on whom he depends, but he has not given a thought to the other side of the coin.

"In the eyes of the Chamber, the telephone does not exist, for in the

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Ader

Budget for 1882 there is no specific chapter relating to it."

What is *L'Électricité* hinting at? Was Cochery allowing a company to exploit the new communication without real accountability?

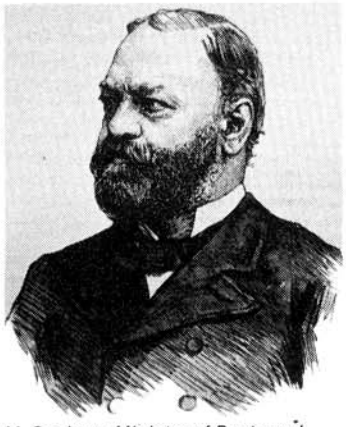
"The receipts accruing to the General Telephone Company are amalgamated —" and here he alludes to another journal apparently equally unhappy about the situation — "the *Intransigent* would say disguised *(dissimulées)* — within the heading of various receipts."

Was the Minister of Posts and Telegraphs attempting some sort of cover-up?

"Despite the promise to enact a special law, the Minister continues strictly to apply our telegraphic laws to telephones.

"Among all those worthies pressing around the rooms where the wonders of M. Ader can be heard, is there not one who, leafing through the Budget on which he must vote, seeks to discover therein the apparatus which M. Cochery demonstrated with such ostentation?

"Must we conclude that M. Cochery finds the pear ripe and ready for picking? Will he finally



M. Cochery, Minister of Posts and Telegraphs

place our Assemblies in a position to choose between two equally unpleasant attitudes, either to confirm by law the "de facto" monopoly granted to the General Telephone Company, or to increase the budget by an honest sum of a few millions which will have to be paid by the subscribers?

"Was not the real practical goal of the Exhibition simply to turn people's minds against the whole area of telegraphy and in favour of new, more generalised developments?"

Was the Minister, with the best intentions, organising a PR campaign to promote what was, after all, a better means of communication but at the same time allowing a monopoly to a Company which used (if *L'Électricité* is to be believed) inferior techniques without confirming their position democratically?

"We therefore entreat the Honourable Deputies and Senators not to let themselves be carried away by demonstrations which would have been more interesting if the administration of the Exhibition (headed by Cochery) had not contrived, *by default*, to ensure a monopoly for an instrument which, despite its qualities, we have no doubts in considering totally inferior."

Strong stuff — but it still continued to report the enthusiasm of the public at the hearings. When the Exhibition was in its last few days it wrote:

". . . . the rooms were thrown open to all-comers for 1.50 francs. Despite the fact that it proved impossible to satisfy all the visitors, there were no noisy scenes" (apparently four days before, one of the rooms had been invaded and had only been evacuated with difficulty) "of people asking for their money back. Nearly three thousand people who had queued for two hours were unable to obtain a place in any of the four rooms. They went away without showing their discontent at having vainly submitted to the tortures of a prolonged wait."

Finalé

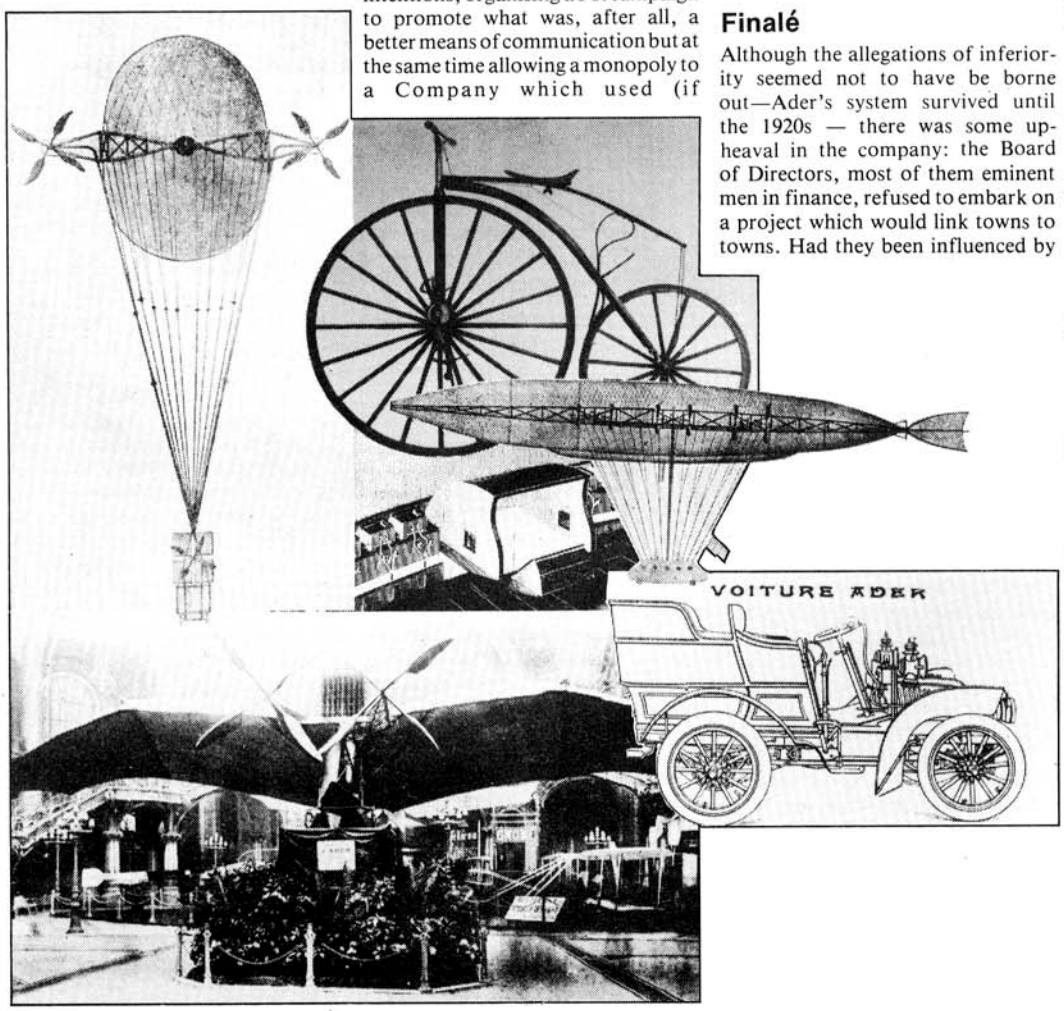
Although the allegations of inferiority seemed not to have be borne out—Ader's system survived until the 1920s — there was some upheaval in the company: the Board of Directors, most of them eminent men in finance, refused to embark on a project which would link towns to towns. Had they been influenced by the remarks made in *L'Électricité* and thus become concerned about the long-term viability of the Company?

The *théâtrophone* idea did catch on, but seemingly in mono only. Ader had left the Company to dedicate himself to aviation. He had been the innovator and as mentioned, the laying of double lines to all subscribers was probably too much to contemplate. A distinguished musician who recently retired from the BBC told me that he remembered hearing the *théâtrophone* in Paris in the 20s at a private house and, although there *were* two earpieces there was no indication of any stereophonic quality.

But, Stereophony *did* first happen in the summer and autumn of 1881 *and* caught the minds and imaginations of ordinary people, music critics, engineers and journalists — as we have seen. Let the last word come from *The Times:*

But here comes the most marvellous thing of all. Behind dark hangings, intended to deaden the sounds outside, Rooms 7 and 8 contain telephones in contact with the Opéra and Théâtre Français. Thus the visitor will be able from the Palace of Industry, to hear Mddle. Krauss or Mddle. Bardet, unless, indeed, they prefer to hear *Hermoza* with one ear and *Phèdre* with the other. I will not say that the voice does not lose some of its qualities in passing through the telephonic wires. Still, it remains distinct and quite recognisable. In such cases, however, all kinds of progress may be expected in the future, and who knows but a few years hence all comfortable houses may not be provided with the means of hearing at the fireside the finest operas, concerts and tragedies, with the additional advantage of being able to exclude the second-rate pieces with a kind of turncock for music and acting, just as they now have a turncock for water and gas!

Times



Acknowledgements

I must record my gratitude to several people who have given help and advice: Keith Geddes of the Science Museum who provided the first French documents and illustrations that hinted that the 1881 demonstrations were rather more than just a curiosity; Charles Gibbs-Smith, whose book on Ader's flying claims is definitive, for his courtesy and interest in my own research; and to two of my colleagues, Paul Hamburger and Peter Sidhom, for their help in translating some of the German and French documents.