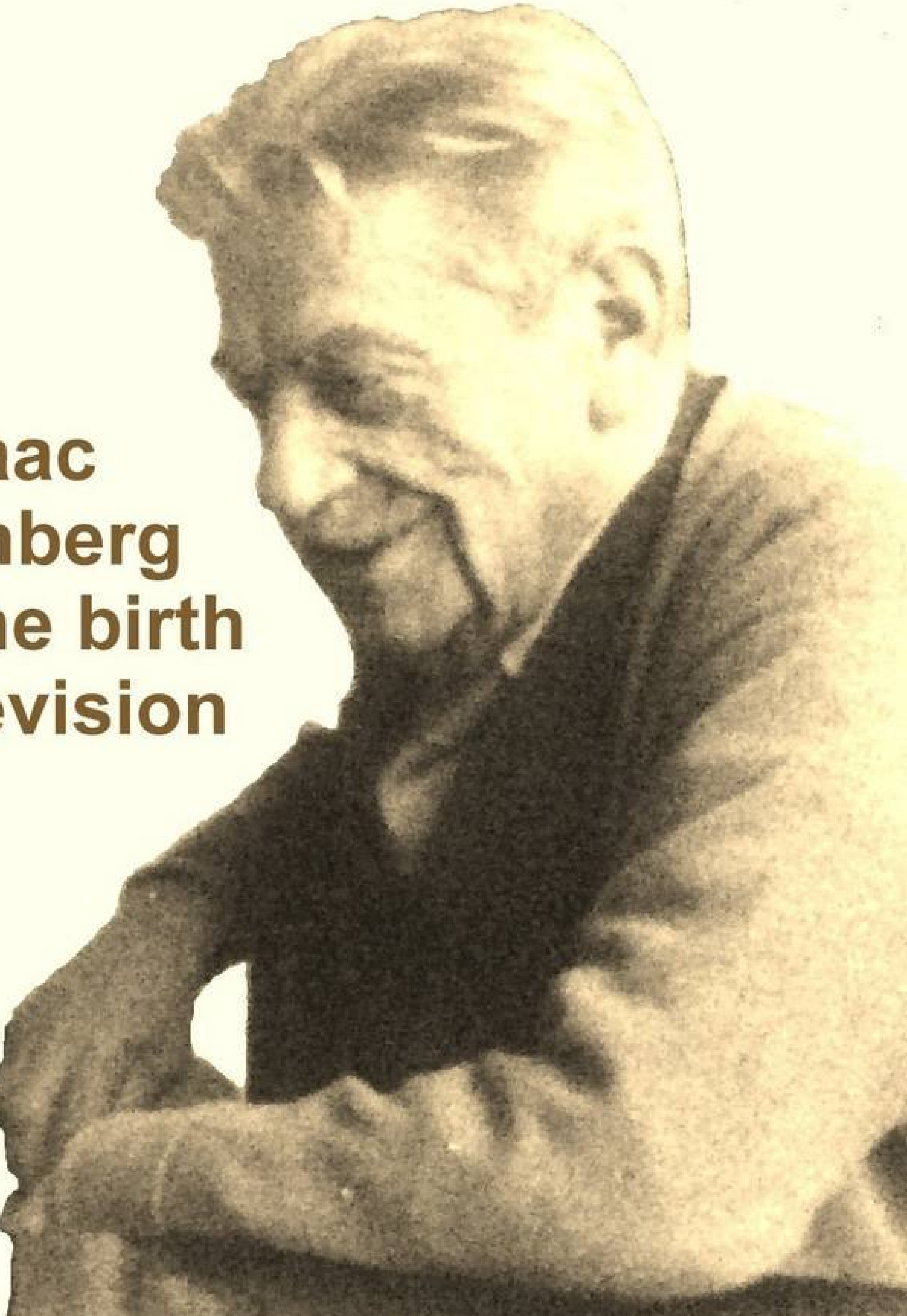
# Pinsk to the Palace

## J B Williams



**Sir Isaac Shoenberg and the birth of television**

# PINSK TO THE PALACE

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# 1 Introduction

On the second of November 1936 in Alexandra Palace, set high on its hill in north London, there was a grand opening ceremony. It was not for the palace itself, though part of it had been refurbished, but the inauguration of the first real broadcast television service. A late change to the intended schedule meant that unusually the actual introduction was performed twice. As there were two competing systems, it was transmitted first on one and then the other.

There were some forty or so invited guests in the audience; representatives of the two companies that provided the equipment, together with the BBC and the great and the good who had been involved with the project. They sat to listen to the rather pompous speeches from the Chairman of the BBC, Mr Norman, the Postmaster General, Major Tryon, and the chairman of the television committee, Lord Selsdon. The speeches didn't improve from being repeated.

Among the guests was a small man with abundant swept back hair and a scrubby moustache. Shrewd eyes peered out through rimless glasses, giving a steely look. This however could easily soften into a benign smile. He was not someone that the casual observer would notice, and that was the way he liked it as he avoided publicity. Usually in his hand, though not today, was a cigarette, as he was a heavy smoker.

His name was Isaac Shoenberg. This was not one that was known widely, but those present knew exactly who he was. What they also knew was that, if it hadn't been for him, this ceremony would have been unlikely to be taking place. It was extraordinary that someone whose background lay on the plains of eastern Europe should have achieved so much in his adopted country. But then again, few people outside those present knew that.

He had led the Marconi-EMI team that produced one of the systems and without his abilities that would not have happened. As only a short time was to tell, this was much the superior system. The competition was from the Baird Company, and John Logie Baird was the name everyone knew, but he had hung on to an idea of mechanical television far too long. As Isaac Shoenberg's team pushed up the performance to a point where it gave true entertainment value, Baird's tried to follow, pushing the technique to its limit. However when they got into the studio there was no real competition in the cameras, the Baird Company had not got a satisfactory solution.

Isaac Shoenberg's achievement began with his ability to convince the management of a company, whose mainstay record business was suffering a serious decline, to invest heavily in developing a complete television system right from the novel electronic camera, through the transmitters, to the receivers for use in viewers' homes. It was an enormous undertaking into completely uncharted waters.

His next task was to break the problem down into manageable pieces and choose the right people from his team to tackle them. As time progressed it was clear where these teams needed strengthening and he carefully recruited talented people with the right skills to fill the gaps. It is reckoned that at the height of the effort the teams had grown to 114 people. There were 32 with degrees of whom nine had doctorates, which were quite rare in the 1930s. But it wasn't just the highly talented people; they were backed up with people of a whole range of skills, everything from technicians to glass blowers.

This large workforce had to be properly directed so that, though they were broken down into groups, they worked with each other where their tasks dovetailed. It is a subtle art to guide and motivate research and development particularly when the going gets tough. This had to be mostly by the leaders of the various teams, but he had chosen these with great care.

His main task was to provide the overall direction and stimulus to ensure that the work proceeded at the best possible pace; again a delicate balance between getting it done quickly, but slowly enough to be thorough. This required setting the environment, the tone, or in modern parlance the culture of the whole department. It was a subtle balance of pressure and encouragement; so much so that the members of the team became largely self motivated. They knew that he would back them, and provide the resources to get the job done.

He would grill the senior members to ensure that they had thought things through completely, but it also meant that he was fully up to speed with all the technical issues. He had to be a good engineer himself to understand it all. This was essential when it came to making the major decisions, on direction or specification.

This was a rare combination of technical ability matched with leadership. A hard skill combined with a soft one is rarely found in the same person, and this was what made him so unusual. In addition he had iron nerves. He could take large calculated risks and not panic when at first not everything went right. In his life he took a number of what appeared to be very courageous jumps, but they had always been very carefully thought through beforehand.

Such skills do not appear fully formed; they have to grow through experience. In his life he had a number of lucky breaks, though they often didn't seem so at the time. His father, being of the Russian merchant class, meant that he had the resources to support his son through the school system, and instead of the classically based Gymnasium it was to be the technically biased Real School. He was also prepared to support him on to university. Then again it wasn't an ordinary university but a new Polytechnical Institute.

He had been keen to study mathematics, but the courses available forced him into engineering. That gave him the background to join another young man in building the first wireless systems in Russia. This was a hard but very useful experience to give him a thorough technical grounding, and achieve that 'feel' that makes a good engineer.

Then came another of those calculated risks. He gave it all up to bring his family to England to study, researching wireless systems, but with courses on mathematics on the side. With the first world war intervening the money ran out and he took what seemed a lowly job handling patents. This was a lucky break because he was to become an expert in the subject and it played an important role in his future work.

His abilities were such that within a decade he was a joint general manager of the company. In a sense this was all his apprenticeship because he now joined a record company and began the role that so suited him of directing technical teams. First this was with the recording of sound and then the development of television.

However, though in a sense the launch at Alexandra Palace was the high point, there was still much to be done to improve the equipment, and this took up the rest of the 1930s and even then it wasn't finished. In the second world war, the magnificent design team that he had built up went on to make an enormous contribution to the development of radar. This was a natural extension as television and radar have much in common.

In the post war world they were still improving things, but he began to step back as he was already beyond the normal retirement age. It was a time of reward; awards, a directorship of the company and a knighthood. Such men do not retire they carry on contributing the wisdom they have built up until they are called away.

To research the life of a man who shunned publicity, presents many challenges. The information that exists is thin, and much of what has been published contains discrepancies, and often things that are just plain wrong. For example, a common error is that he was naturalised as a British citizen in 1919. A quick look at the actual records shows this to have taken place in October 1922. Other matters are less easy to decide which version is right.

Also there is a curious dearth of archive material. In the Marconi archives there is material on most of the senior people in the company. However, despite him being head of patents for about six years and joint general manager for a further three, no file has been found. The only one is for his first few years in the company and appears to be one kept by the Chief Engineer who employed him.

He is curiously absent from most places where one would expect to find information. This is compounded by the confusion with Arnold Schoenberg whose name is sometimes rendered without the ‘c’ and the search systems prefer to give you him rather than Isaac. If it hadn’t been for the documents and letters that have been kept by the family, the time in Russia would have been impossible to reconstruct.

Perhaps this dearth of information is why, despite some attempts, there appears to be no biography of him. This then is an attempt to fill that gap. From the information that does exist it is possible to ‘join the dots’ and get a reasonable picture of the man, his life and achievements. This is the result of that endeavour.

# 2 Pinsk

Pinsk is a town on those infinite plains of Eastern Europe which has been overrun on so many occasions in its history. At various times, often violently and more than once, it has been in the hands of the Poles, the Lithuanians, the Swedes, the Russians, the French and the Germans. By into the nineteenth century it was part of the Russian Empire and was to remain so until the First World War. Today it is in Belarus near its southern border with the Ukraine, some hundred miles or so east of Brest on the Polish border. It is only some 200 miles from the Chernobyl nuclear power plant that exploded in 1986.

The town lies at the confluence of the Prypiat and Pina rivers. Historically its position was favourable as it lay at the highest navigable point on the Prypiat, a tributary of the Dnieper which provides a navigable route all the way to the Black Sea. The ancient trade route then went overland to Brest to pick up the Bug river and hence to the Baltic Sea. In the later eighteenth century the Pina was canalised and extended as the Dnieper-Bug canal, hence forming a complete navigable route between the Black and Baltic seas.

The river, quite wide at this point, ran along one side of Pinsk and was usually full of small boats that plied their trade along it. The town had grown prosperous on the passing trade and also on exporting the agricultural products from the surrounding fertile farmlands. There was considerable trade in grain and meat products and a few merchants in the town became very wealthy. However, there were many others that traded in a more modest way, but nevertheless were comfortable.

Fig 2.1 The Sheinberg family home in Pinsk on Naberezhnaya Ulitsa along the bank of the Pina river

Nearby there are also considerable forests, so being a merchant in the timber trade, like Yehudah Sheinberg[1] was also a profitable business. Naturally he and his wife Malka lived in a wooden house, like many in the town, though theirs was larger than most. On the first of March 1880 they had their first child and called him Isaac, though as a child he was known on official documents by the Yiddish variant as Itsko Sheinberg[2]. Like the majority of the population of the town they were Jewish, and that wasn't always comfortable at that time within the Russian Empire.

Jews were only supposed to live within the 'Pale of Settlement', an area to the west of Russia proper. This included areas of Lithuania, Belarus and Ukraine that had been absorbed into the Russian Empire as part of the expansion westwards, particularly after the final partition of Poland. Even within that area there were numerous regulations that could make life difficult. At any time, the local non-Jewish population, who were under severe pressure themselves, could take out their frustrations on Jews as suitable scapegoats.

This was pointed up the following year on 13th March when Nikolai Rysakov a member of an organisation calling itself 'People's Will' finally succeeded in murdering Tsar Alexander II with a bomb in the streets of St Petersburg. This was after three previous attempts on the Tsar's life in 1867, 1879 and 1880, all of which failed due to poor planning or bad luck.

It was a measure of the strains in Russian society that this relatively liberal Tsar, who had introduced a number of reforms, should be the target of groups so determined to murder him. Quite what they thought they would achieve by this wasn't clear. He was succeeded by his son Alexander III, who, not unnaturally, took a more authoritarian line and was determined to clamp down on revolt and introduce more repressive measures.

Within a month there were rumours that Jews were behind the assassination and this sparked anti-Jewish pogroms in many towns and cities. These rumbled on for the next few years, dying down in one place and then flaring up in another. However, the family was relatively safe in Pinsk when a little later an attack on the town by mobs of peasants from the surrounding areas was easily beaten off by Jewish butchers, coachmen and porters.

Fig 2.2 Isaac (left) with his parents and siblings around 1891. There is an additional boy in the picture. Zlata was not born for another 9 years.

It wasn't long before young Isaac was joined by a sister Genia.[3] Again they were relatively safe in the town as the repressive 'Temporary Laws' introduced by Tsar Alexander III forbade Jews to live in the countryside or small towns, but fortunately Pinsk was large enough. The laws were more an irritation here, rather than the drastic problem for many which led to large scale emigration.

The coming of the railways was a mixed blessing for the town. At first the line went from Moscow to Brest, but later another branch connected the town into the network. Some of its trade disappeared while in other areas it benefited. Gradually the town industrialised with much of this, such as matches and plywood, depending on timber. Yehudah Sheinberg was still able to prosper and soon added another daughter, Fania, to his family. Before long, there was also another son David.

At the time it was usual for children only to go to school when they reached eight. That was hardly the norm as only some half of the children had any schooling at all, even at primary level. This was a country where the huge peasant class was uneducated and only about a fifth of the population could read and write. Fortunately for Isaac his father belonged to the more privileged Meshchanin merchant class and education was expected.

Unfortunately, any records of his early schooling have disappeared, but because of his later achievements we can be certain that he had some. This primary education was only between the ages of 8 and 11. In Pinsk with its large Jewish population, for orthodox Jews there was an option of the Jewish schools. These would have taught in Yiddish or Hebrew and concentrated on religious subjects. As the family were liberal, it is most likely that he was taught at home by private tutors as some of his siblings were. The important thing was that he had a good grounding in Russian, which was particularly important if he was going to progress, as almost certainly they spoke Yiddish at home.

While he was at primary school in 1890 another brother Aaron, known as Archik, was born. He was 10 years younger than Isaac, but it soon became apparent that not all was well. He suffered from epilepsy and later it was found that he also had learning difficulties. He was to be a worry for the family and they continued to search for some effective medical treatment to help him.

Though life was relatively stable in Pinsk, the Russian Empire at this time was not a happy place. In the countryside there was a hunger for land by the peasants which was made worse by an excess population. In most countries it was the towns and cities which absorbed this but in Russia this did not happen to a sufficient degree. Coupled with periodic shortages of grain in years of poor harvests, this brought severe strains.

The Tsar, Alexander III, was determined to maintain his absolute rule and supported the nobility who were the large landowners. To keep control there were a large number of repressive measures, and steadily the population began to kick against these. There was also a policy of industrialisation, but this needed foreign currency to buy equipment, and grain was exported to pay for this, worsening the shortages. It was a situation that was going to explode at some point.

Only a tiny minority of those with primary education went on to secondary, partly because children from lower class parents were forbidden to enter them. The Russian state didn't trust students and limited the access to education and strictly controlled what was taught in an attempt to damp down any opposition to the autocratic regime.

The main provision was in Gymnasia which were akin to the German schools of this name. They were perhaps more like the old English Grammar Schools with their concentration on Latin and Greek. Their objective was to take the children of the nobility and make them useful to the state while trying not to give them ideas which would lead them to oppose the Tsarist regime.

There was some realisation that this wasn't entirely adequate. In view of the increasing industrialisation there was a need for people with more technical skills and this led to the setting up of Real Schools again modelled on the German Realschulen. Here emphasis was placed on natural sciences, modern languages, and the application of technical knowledge, which was a far cry from the traditional sylabus of the Gymnasia.

When the Real Schools were first set up in 1872 they were a second rate education and with a large vocational element. From them there was no access to universities. Luckily for Isaac in 1888, when he was at primary school, the system was changed and time devoted to vocational training was decreased and the courses became more academic. A special extra year was added to prepare students for some forms of largely technical higher education. In Pinsk a Real School had replaced the Gymnasium.

The students were mostly the sons of the middling classes such as merchants who could afford to pay the fees. The Pinsk Real Uchilishche, despite still being classified as a 'second rate' school, had gained a good reputation and many students came from outside the town to study there. Among them in the 1880s was Chaim Weizmann, later to be the first president of Israel[4].

Unfortunately In 1887 the Numerus Clausus, or closed number system for Jews in secondary education, was imposed with a 10% quota. In many places this was not a problem, but in Pinsk, with its large Jewish population this gave extreme difficulties. When this was imposed there was a significant proportion of Jews, but in succeeding years with an intake of about 27 students a year, only three of them were Jews. To make it even more difficult, there was an entrance examination.

There was an additional problem for Jews attending the Real School and this was that they were expected to work on the Sabbath. Writing was included in the normal religious definitions of work not to be undertaken on that day. However the school made no allowances for their Jewish pupils despite government law forbidding such coercion. However, there was one concession and that was that Jewish pupils could study a special subject of Divine Law with a rabbi from outside the school. Perhaps that was the reason why Jewish students had to pay 20.5 roubles a term instead of the 17.5 for other students. Despite that, the cost was quite low.

Those students unable to get into the school were forced to study as 'externals'. They were taught again by private tutors but were tested at the Real School. Some even earned a certificate stating that they had passed the exam in the curriculum of one or more classes. Obviously it was a way to, at least partly, get around the regulations, but wasn't fully satisfactory. However, it did supply a route for many young Jewish boys and girls to still obtain some sort of secondary education.

It doesn't appear that Isaac was one of the lucky ones when he reached the end of the primary education, and we can only assume that he continued with the 'private tutor' route. The only other option was to go to a school in some other town, if he could get in, bearing in mind the Numerus Clausus limitations. There is no evidence that he went anywhere else. Clearly his father believed in education and was prepared to support him and had the means to pay for it.


Fig 2.3 Pinsk Real School

Isaac must have been a bright student because, despite the difficulties of this system, he got into the Pinsk Real School (Realnoye Uchilishche) in 1896.[5] This was one of his lucky breaks, though undoubtedly he worked for it. Without getting into the school he would have been unable to go on to higher education and the whole course of his life would have been different. It is unlikely that he would have become an electrical engineer, or come to England, let alone to make the contributions he did.

How he managed to get into the school isn't known, but it suggests that he must have been studying the syllabus of the school and taking their exams externally to be able to be considered. Perhaps someone dropped out of the school releasing a place for a Jewish student. The only downside was that he entered into the fifth year, even though he was already sixteen.

In 1897, at the end of that year, he received a Commendation Certificate[6] from the school praising his excellent achievement in sciences and good behaviour in the past year. This indicates that he was actually attending the school. It also allowed him to progress from the fifth to the sixth class in the school. So even at the age of sixteen or seventeen he was showing promise in more technical subjects.

The end of the following year was the point at which students normally left the school. He was issued with a report detailing his achievements in the subjects he had been taking. What is immediately noticeable is that he was taking 13 subjects, which is unusual at the age of seventeen and eighteen. It is vastly in excess of the normal 3 subjects at A level taken by students in Britain.

The first was 'Divine Law', but it as this was a Christian subject, as a Jew he was exempted from it. Then, of course came Russian, but this was accompanied by modern foreign languages, and the ones studied were German and French. Next was mathematics and its various branches of Arithmetic, Algebra, Geometry and Trigonometry. Of course, he studied History, Geography and Natural History, and his main science was Physics.

In all of these he had the top mark of 5 out of five. In drawing he only achieved 3, though technical drawing was better at 4. Clearly he was not a sportsman as his gymnastics was only awarded a 3. Despite these lower marks at the tail end, it was a record of very solid academic achievement, particularly so as he had only spent two years actually at the school. There was a further advantage of being at the Real school in that he was able to delay his military service.

Despite having his leaving certificate, he returned for a further year to enable him to be able to go on to further education. He took much the same subjects again with the maximum grade in everything except drawing. The 'Divine Law' was no longer included. His technical drawing and drawing had both gone up a grade, and he had also managed also to drop the gymnastics. This coupled with a comment on good behaviour really meant that he was a model student.

He was now nineteen and qualified to go into higher education; if he could get in. He received his release certificate from the Pinsk Jewish Society[7] with comments again on his good behaviour together with a certificate to say that his military service, for which he had become liable in 1894, was delayed because of his study[8]. All he had to do now was to pass the exams of a higher education institution and be accepted despite the 10% Numerus Clausus restriction on entry for Jews. Not easy.

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1 This is an approximate transliteration of the Russian version of the surname.

2 This is the generally accepted date, though on his gravestone it says 31st March. Until 1918 the Russian Empire still used the 'Old Style' calendar which was 12 days behind in the 19th century and 13 in the twentieth

3 Information on the siblings ultimately from the Shoenberg family. https://artsandculture.google.com/asset/shoenberg-family-portrait/bAE4HbeceK2yhw

4 The Jews of Pinsk, 1881 to 1941, Azriel Shohat, p185 -187

5 This is stated on his leaving certificate two years later – see below

6 School documents from the Shoenberg family but online at: https://artsandculture.google.com/exhibit/sir-isaac-shoenberg-television-pioneer/CwLSPKoOHLbzJQ

7 As above. The document is entitled 'Numerus Clausus' but it does not appear to be that, but a release for the requirements of the Pinsk Jewish society.

8 IET Archives, Sir Isaac Shoenberg papers, NAEST 62/1.2

# Kiev

Towards the end of the nineteenth century, there were only a small number of universities in the Russian Empire. It was felt that these were not suitable for training people in technical subjects, and so it was decided that Polytechnic Institutes were the way forward. In Kiev, now the capital of the Ukraine, but then again under Russian control, local businesses banded together with representatives from the university to establish such an institution.

In 1898 the Kiev Polytechnical Institute of Emperor Alexander II (KPI) was set up, and buildings begun along the Brest-Litovsk Road, in the northern part of the city. In the same year it took its first batch of students. Initially there were 4 departments Mechanical, Engineering, Agricultural and Chemical with a total of around 360 students. To be allowed to sit the competitive examination for entry the applicant had to have a certificate of having passed the final examinations of a Gymnasium or Real school. They also had to have a very good knowledge of Arithmetic, Algebra, Geometry, Trigonometry, Physics and Russian.


Fig 3.1 Kiev Polytechnical Institute (KPI)

In August 1899, having already attained these requirements, Isaac decided to attempt the entrance examination as it was the nearest of these Polytechnics, less than 300 miles from Pinsk. Besides as a new institution the competition might not be as great as for somewhere like St Petersburg which had already established a reputation. Of course, being a Jew he was subject once again to a Numerus Clausus limiting him to a 10% quota of the applicants. In his year, this meant that there were just 8 places, but for these there were around 300 Jewish applicants.[1] Many people would have quailed at the odds, but not him.

Ann, one of his granddaughters, related a story he liked to tell. This was about when he went to take the oral exams for entry to KPI. When he sat down in the waiting room, he discovered there were not one, but four panels of examiners. He had no idea which panel he should present himself to and naively asked his fellow candidates which was the best (i.e. the easiest) one to choose. Of course they all suggested the one they knew had the reputation for being the hardest. He was very proud that he ended up being offered a place by this panel! He was thus one of the eight and joined the Mechanical Department. This again was a lucky break, but he had worked for it.

On the 22nd of August 1899 he telegraphed the news to his father who responded by sending him 50 Rubles on top of the 25 he had sent 5 days before[2]. He obviously was somewhat surprised by his father's largess, but his father responded by sending him 30 more. He wanted to ensure that Isaac should have enough so that he could concentrate on his studies. This shows a degree of magnanimity by his father who was prepared to let his son follow his own path and not try to force him to follow him in his timber business. To support him was quite a commitment as the course was supposed to be for four years; each year being divided into two semesters, though in reality it took even longer..

Isaac settled down to study while, alongside where they took their classes, work continued on the impressive set of buildings for the Institute which were to yet to be completed. The work was not that different from what he had been used to; more mathematics, for which he was generating quite a taste, physics, and a new subject Chemistry. There was also a curious subject of Geodesy, which was probably largely surveying, and then three different sorts of drawing; perhaps not his most favourite occupation, but important for many branches of engineering.


Fig 3.2 Isaac Sheinberg in his student's uniform.

In the late nineteenth century Russia had a fetish about uniforms. Anybody who was anybody had a uniform. This even applied to students at university or an Institute. Later, according to his daughter Elisabeth, her mother used to poke fun at him, that he had joined the particular department because he wanted to wear the glamorous engineers' uniform. However, one of the downsides of these uniforms was that the students were immediately recognisable in the street, and not everyone was well disposed towards students.

He quickly found that being a student in Kiev was a very different matter from being at school in Pinsk. Students were the shock troops for all the groups who wished to change society, and their method was by student strikes and demonstrations. They were usually followers of Marx, but divided into Bolsheviks, Mensheviks, Social Democrats, Social Revolutionaries, and many other fluid factions who were often squabbling with each other. What united them was a distrust, almost amounting in some cases to hatred, of the state and the Tsarist regime. Sometimes the relationship between the students and the professors was not very good, particularly when they tried to impose particular rules.

The second year still featured a large amount of mathematics, but they started to study machines, and even architecture. Now that the buildings for the Institute were more complete they were able to go into the laboratories for both physics and chemistry. It was still a very wide ranging course, and if it hadn't been for the repression of the government and the resulting student unrest, it would have been a good time.

In January 1901 there were still mass rallies of the students, but the authorities hit back by conscripting 183 students from the Kiev University into the army for their involvement. The general repression triggered a wave of protests which exploded into a general student strike which started in Kiev and soon spread to St Petersburg, Moscow, Kharkov and other cities.

In the academic year 1901/2 things became even worse, with mass meetings and the demands becoming more political, seeking the democratisation of higher education. To try to calm the situation, the Administration sent the students home for Christmas, but it didn't work and on 21st January 1902 there was another mass meeting and it was decided to begin a strike and terminate the classes.

Despite the categorical prohibition of the strike by the Minister of Finance, the students did not attend classes. The Institute reacted by closing down in early March until the autumn. To try and stop the student movement, the police arrested the ring leaders and they were expelled from the Institute. The Authorities also tried to introduce some minor sops to the students but these failed completely to change the situation.

Of course Isaac still had his military service hanging over him. Despite the disruption he was still able to get a certificate from the Institute stating he was in full time education and could thus delay it further[3]. Though the Institute was facing many problems due to the students' activities, many of the staff had at least some sympathy with their complaints. They too were unhappy with the repressive regime that they were forced to work under, but some felt that the demonstrations were not the right way to go about it.

With the shutdown of the Institute, Isaac went home to Pinsk and had one of the biggest strokes of luck in his life. He met a young lady called Esther who was working as a midwife. She had been born and grew up miles away in Belaya Tserkov, a city some 50 miles south of Kiev, now known as Bila Tserkva. She was a year or so older than Isaac[4], and had also been a bright student at the Belaya Tserkov Girls Gymnasium school, again for three years, leaving in 1898 with a Silver Medal for gaining top marks in all her subjects[5].

For some reason this was not a Gold Medal, which would have allowed her to study medicine. However, she was able to go to Kharkov University to study midwifery, where she qualified in 1901 ‘cum eximia laude’.[6] However, the lucky break was that during her time at University her father, Solomon Aisenstein, had moved the family to Pinsk where they owned and ran the Varshavskaya Hotel on Bolshaya Kievskaya Ulitsa, one of the main streets of the town[7].

Fig 3.3 Isaac and Esther in Kiev

The relationship rapidly became serious and it was clear that they had fallen in love. In mid-May 1902, before they had had the chance to be together for long, he had to go to Konotop, some 400 miles away to the east, for a two month placement at an engineering workshop. They started to write to each other every day, sometimes more than once, and so the relationship continued to develop as they discussed everything from their everyday lives to cultural, moral and philosophical issues[8].

The difficulty they were facing was that neither set of parents approved of the relationship. Esther’s mother, in particular, was not keen on her associating herself with someone who was younger and still a student, and tried to interest her in another young man she thought more suitable. His parents were even more opposed to the relationship as they disliked Esther’s ‘modern’ ideas of women’s emancipation and were concerned at her liberal attitude to her Jewish faith. Again the age difference seemed to be an issue.

When the work placement was over they could be together again in Pinsk for the summer until he had to return to Kiev for the autumn term at KPI. With the Institute having been shut down, he had lost one semester of study. How he managed to finish his third year of study, with its greater concentration on engineering, is unclear, but probably it was simply moved to the autumn. However, he now had something to motivate him to continue his studies and be very careful of all the student protests. He was later a man who shunned publicity. This might have been innate or a maybe result of his experiences in Kiev when it was dangerous to attract attention to yourself, particularly as a Jewish student.

In the autumn of 1902, after the shutdown of the Institute, things seem to have calmed down a bit. The students started to concentrate more on lectures to the workers and the distributing of revolutionary propaganda. The students of the Institute played an important part in this cooperating with the Socialist Revolutionaries and the Social Democrats in agitating among the workers.

However, as soon as he was back in Kiev, Esther was missing him and wrote to him that she was torn between her plan to go to St Petersburg to apply for a Physical

Education course and the thought of being so far away from him. She wondered if instead she could move to Kiev and find work as a hospital or community midwife. However it didn't happen, and they remained apart with him in Kiev and her in Pinsk with only the constant stream of letters connecting them until the Christmas break. Just before, though, he sent her his photo (Fig 3.2) with the annotation on the back 'To my dearest and closest soul mate, a memento'.

Over this time they clearly decided that they wanted to be together and they began to plan how they could achieve this, but didn't tell anyone, particularly their parents. When he returned to KPI in January, the streams of letters continued, but making precise arrangements. In late February they set the plan into action and she travelled to Kiev. One week later on 5th March 1903 they were quietly married by the official rabbi in front of a few friends[9].

They had realised that there would be some fallout from this and each wrote a long letter to their own parents to explain what they were about to do, but late enough so that nothing could be done to stop it, and then a telegram when it had happened.[10] Her parents, perhaps with some warning that something like this was in the offing when she left for Kiev, wrote back, and while a little distressed that they hadn't known in advance, accepted the result and forgave them. They also welcomed Isaac into the family, which was perhaps better than Isaac and Esther had expected.

However his parents took it very badly and though he had tried to explain everything, they returned the telegram and the letter unanswered a few days later[11]. The rift was serious. The fact that they married secretly showed that they expected opposition, but probably not to this level. Isaac had insisted that Esther's family were also not present as that might have softened the blow for his parents, but it had not helped.

Running away to get married like this seemed a very romantic and rash thing to do, but they had thought it through. They had settled where they were going to live, how they were going to feed themselves and had counted up their resources and worked out that they had enough for him to finish his course with some to spare. This was to be a pattern in his life; to take considerable risks on a dream of something in the future, but always carefully considered.

Esther, on the other hand had so wanted to be with him that she put her plans on hold. It was mostly a lump sum of 1000 rubles that she had, some savings and ability to take up some teaching that could provide the bulk of what they were to live on. She too was adventurous, and prepared to follow her dream. It was quite something to drop everything, and risk a rift with her parents to marry a student, who she would have to support, on the belief that it would all work out in the future.

Isaac settled back into his studies, probably the fourth year's work which had become delayed due to the shut down in the previous year. Here the work concentrated more on electrical engineering and on practical work. This was partly in the laboratories but also took in designs of a steam engine, a hydraulic turbine and a boiler. The course was steadily moving more into practical engineering but the amount of electrical work was limited by the subject not having advanced very far at the turn of the century. The course looked comprehensive even by more western standards.

Normally his course lasted for four years, but he records work in a fifth year, which is annotated 'second half'. This was probably so that they would still finish at the end of the year despite the lost semester. However, it entirely concentrated on electrical engineering. Clearly he had made a decision that that was where his interest lay. In addition to further laboratory work he had to design a three phase alternator, a power station and wiring for lighting and transmitting power in the buildings of the Institute.

This last seems a bit cheeky of the professor to get a student to work this out. Maybe more than one student submitted plans. However, his must have met with approval as all the plans and detailed calculations were exhibited by the Institute at a meeting of Electrical Engineers in 1907. Whether they were used when they came to install electricity in the buildings, is not known.

The student demonstrators had decided that they should seek political freedom and now concentrated on getting their views across to the working class and to achieve this they started clandestinely printing large numbers of revolutionary leaflets. The store for these was in the roof of the main Institute building and this all continued until June 1904 when the police found this store and confiscated a large number of leaflets of many different types.

Despite all this, on the 19th June 1904 Isaac finally obtained his degree as an Engineer Technologist[12]. In his exams he had met the requirements of the Institute and this entitled him to be a member of the XII class in the government Table of Ranks. This enabled him to practice as an engineer and manage factories and suchlike. A measure of how well he had done, and how he had managed to avoid antagonising the staff was in an offer of employment when he finished. Mr Artemjeff, the professor of Electrical Engineering invited Isaac to be his private teaching assistant.

However, later Isaac claimed that he didn't take the position because as a Jew he could not hope to fill any official position, and so there was no future in it, so instead he joined an industrial company. However his letters at the time suggested that it was blocked by Zvorykin, the head of department, as he didn't agree with students being research assistants. However, despite being a married man, the records show that he returned to KPI in the autumn for a further course, possibly working towards a higher qualification[13]. This was even more surprising as Esther was pregnant.

In the summer they went back to Pinsk and when it was time for him to return, she remained with her parents, probably because it was thought she would be safer and better looked after there. He managed to find some translation work and tutoring and also a small amount as a technical draughtsman which helped to get some money to continue studying now that she couldn't work.

For Esther, miles away in Pinsk, it was a difficult time, heavily pregnant and missing him, so it was a relief when he managed to rush back to Pinsk in time for the event. On 4th November 1904 a son was born, and they called him Mark Eli, though he was known by the affectionate version of his middle name, Ilyusha, by the family. Isaac's father, who was away on business in St Petersburg, wrote to Isaac and Esther to say how happy he was and hope that Esther would now "fulfil her duty" to bring up the child to understand and observe the laws of the Jewish faith. He also seemed to be making an effort to build a bridge to his son and daughter-in-law, and his new grandchild.

Isaac now had a young family to care for in very unsettled times. There were constant strikes and demonstrations, and it was just as well that Esther remained with her parents in Pinsk because in the Institute the students were involved in ever more disruption. Clearly the situation was coming to a head.

The spark occurred in St Petersburg where Father Georgi Gapon, a charismatic speaker and effective organiser of the industrial working class, had set up an Assembly of Russian Factory and Mill Workers. However, in December 1904, at the Putilov Ironworks, a railway and artiliary supplier in St Petersburg, four workers were fired for being members of the Assembly. Virtually the entire workforce went on strike when the manager of the plant refused to rehire them, and sympathy strikes broke out in other parts of the city. Soon some 150,000 workers in 382 factories had joined in, and by 21 January 1905, the city was virtually closed down.

On 22nd January Father Gapon gathered his many supporters and they began to march from all points of the city towards the Winter Palace to present a petition to the Tsar for better conditions for the workers. Unbeknown to them the Tsar had skipped off to Tsarskoye Selo outside the city the day before. However, there were large numbers of troops in the city with orders to prevent the marchers from reaching the Winter palace. Though the situation became confused, the result was inevitable and troops ended up firing on unarmed marchers and many were killed and wounded.

The fallout was extreme. The feeling was that the people had been let down. They had seen the Tsar as the 'Little Father', but now there was a surge of bitterness that he had allowed, or even ordered, the killing of his people. Some felt that they no longer had a Tsar. The strike movement now spread across the country with all the major cities involved. It was compounded by the Russian Baltic Fleet, which had sailed around the world, being destroyed by the Japanese less than a week later. This catastrophe was the final humiliation after a string of military defeats.

Fig 3.4 Isaac and Esther with baby Mark

In Kiev, at the Institute, the students were joined by the teachers to protest. The authorities tried to break up the meeting but the students barricaded themselves in. Later the protest moved to the city. The authorities decided to close the Institute down to try to stop the riots, but a few days later changed their minds and recinded this. However, the students and teachers held a meeting and decided themselves not to continue classes until September.

In April Esther came to Kiev with baby Mark. Whether Isaac was managing to study in this climate or whether he was carrying on with some of his other work isn't clear. However at the beginning of July he took a job in a sugar beet factory in Polonnoye (now Polonne) some hundred miles west of Kiev where after a couple of weeks the family joined him. It was a much quieter and safer place than Kiev.

At first the government and the Tsar appeared to be trying to meet some of the demands and there was some liberalisation of the harshest restrictions. This affected Jews in particular and gave them some rights that they had never had before. However, there was a considerable backlash with students in particular, and Jews as well, as the targets because they were considered to be the cause of the problems. While the students were undoubtedly a considerable part of the disruption, the inclusion of the Jews seemed to be merely a piece of antisemitic scapegoating.

The number of pogroms or attacks on Jews had been increasing, but in 1905 it considerably accelerated after the events in January. On 23rd July a pogrom broke out in Kiev and 100 Jews were killed, 406 injured and 100 houses were looted. Fortunately Isaac with his young family had left the city and where safely away in Polonnoye, but in the begining of September KPI was due to start classes again.

However if the authorities thought that things would calm down, they were mistaken. There were continual mass meetings and demonstrations, and even a military lockdown of KPI in the middle of October didn't succeed in reducing the fervour of all this activity. Worse was to follow on 31 October, with another anti-Jewish pogrom. Though a smaller number of 60 were killed and 369 injured, 7000 families suffered and 2000 shops were looted. How the young Sheinbergs managed to avoid being caught up in all this isn't known.

For Isaac it was becoming imposible to study satisfactorily in this climate, and of top of this Esther had become pregnant again.

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1 IET Archives, Sir Isaac Shoenberg Papers, NAEST 062/1.40

2 Shoenberg Family Archives, Money order Coupons with notes on the back, 17th, 22nd and 30th August 1899

3 IET Archives, Sir Isaac Shoenberg Papers, NAEST 062/1.2

4 There are discrepancies in the records of her birth date, but it is likely to have around 23rd to 25th December 1978

5 Certificate in Shoenberg Family Archives

6 Certificate in Shoenberg Family Archives

7 The information comes from the letters in the Shoenberg Family Archives. There is also a drawing of her father's hotel after the first world war with the Polish name of the street.

8 This is the beginning of a vast correspondence between them in the Shoenberg Family Archives

9 The date comes from his form filled in for Who's Who in World Jewry, available at: https://artsandculture.google.com/asset/XwEUlaIHMDQ2ww?childAssetId=WQFJnMyzj6ji2Q

10 Letters in the Shoenberg Family Archive

11 The returned letter is with the others in the Shoenberg Family Archive.

12 Certificate from KPI, 19 June 1904, Shoenberg Family Archive

13 Certificate from KPI, 8 April 1906, Shoenberg Family Archive

# Wireless Telegraphy in Russia

In 1873 the brilliant mathematician James Clerk Maxwell brought together the equations that described the all laws of electricity and magnetism. What came from this was a prediction that it should be possible to send an electromagnetic wave through the air. He even showed that its speed was almost exactly the same as the accepted speed of light and hence light must also be an electromagnetic wave. It was an extraordinary achievement considering nobody had seen such a thing.

It wasn't until 1886 that Heinrich Herz, sitting in a darkened room looking for tiny sparks, was able to prove that these waves did exist and that they behave much like light. In 1890 Edouard Branly, working at the Catholic University in Paris, found that iron filings in a tube clumped together when subjected to electromagnetic waves from a spark generator. Four years later, Oliver Lodge demonstrated a system to the Royal Institution and Royal Society in London using a spark generator and a Branly coherer, as it was now known, which was able to ring a bell the other side of the room, without any connection, by using 'Herzian Waves'.

The transmitter used a Ruhmkorff coil, an induction coil similar to those now used to provide the spark for a petrol engine, with its own make and break arrangement like a buzzer. It produced a series of high voltage signals. The output was connected across a spark gap on each side of which was a large sphere. On each voltage 'spike' from the coil the arc would occur and a short oscillation of power would occur between the inductance of the coil and the capacitance formed by the spheres. This would be radiated by an aerial.

The receiver was based on the Branly coherer but with the addition of a 'trembler' which shook the contents of the tube of metal filings to 'unclump' them. This meant that when the signal disappeared the device would return to a high resistance. This basic arrangement, with suitable aerials, became the standard starting point for all the people interested in wireless communication.

Guglielmo Marconi soon took these ideas and started to get results communicating at greater and greater distances and eventually setting up in business to make wireless telegraph equipment mostly for use on ships. Someone else who read the reports and became interested in this subject was Alexander Sepanovich Popov in Russia. At first Popov used a Branly coherer based receiver to detect thunderstorms which he showed gave off these new waves.

Popov then took up using the 'Herzian Waves' for communication and as he worked for the Russian Navy, as a teacher and head of the laboratory at the Torpedo School in Kronstadt, they soon became interested in his work. This culminated in 1900 with the setting up of a station on Hogland Island to communicate with the battleship General-Admiral Apraksin which had run aground. The communications continued for some months until the ship could be refloated in the spring.

In 1901 he was appointed a professor at the St Petersburg Electrotechnical Institute. His fame had spread around the country and when there was a congress of electrical engineers in Moscow right at the end of December in 1901 he was there to lecture on 'Wireless Telegraphy'. His was only one of a wide range of lectures and demonstrations covering the latest developments in the electrical field.

Among the audience was a young 17 year old student who had obtained special permission to attend. His name was Semyon Moiseevich Aisenstein and he was particularly interested in what Popov had to say[1]. Despite his young age he had been following the developments and had already built his first wireless spark transmitter and coherer receiver and succeeded in transmitting signals between houses in his native Kiev.

In the next few years he studied at Kiev University and spent some time at Charlottenburg. How he found time for all this before he was twenty-one is not clear. However around 1904 or 1905, backed by his father, he set up a small laboratory of three or four people. His objective was to continue to research wireless telegraphy and see if he could develop it into something useful.

Then came a stroke of luck for Aisenstein. General Vladimir Sukhomlinov, who had been the commander of the Kiev Military District, was appointed Governor General of Kiev and the surrounding area. In this time of disruption he must have been a busy man, but through an acquaintance he heard about this young man who was attempting telegraph without wires[2]. Sukhomlinov immediately became interested and didn't rest until he had tracked Aisenstein down. He soon convinced Aisenstein to undertake to expand his work to a much more serious level with a view to military communication.

Fig 4.1 S M Aisenstein around 1914

As General Sukhomlinov had considerable clout with the War Office he persuaded them to support this effort and sites were found for the erection of stations. The first was in Kiev and involved a 50 metre mast for the aerial. To give the system a real test they had to erect another station some 150 miles away and this was to be at Zhmerinka. Later a receiving station was added at Odessa.

What Aisenstein needed was someone with a solid grounding in electrical engineering, and he probably knew about Isaac Sheinberg because Esther was a distant relation. Isaac Sheinberg was ideal for the tasks he had and so in the summer of 1905 started working for Aisenstein but on a part time basis as he was still at the Polytechnical Institute. On his way to Polonnoye he took a diversion to Zhmerinka, presumably to look a potential site for a wireless station.[3] By the end of January 1906 his semester finished, and he didn't return for the following one.[4]

Taking a full time job in this fledgling enterprise was a risk for Isaac. Here was the chance to do something very new and exciting, and the dream of being able to be part of a whole new world. However, would this succeed or would he soon find himself without a job and with no means of supporting his family? Would there be sufficient funds to pay his salary? As at many points in his life, it was a carefully considered risk. What he couldn't know then, was that despite many problems, it would be one of his lucky breaks.

This job would provide somewhere tucked away out of the limelight. Also with permanent employment he would have more secure means to support his young family. However, they were still nervous about further pogroms, despite assurances in the press from General Sukhomlinov, and decided in March 1906 that despite their not wanting to be apart, it would be better for Esther to return to Pinsk to have the second child. On 25th May 1906 a daughter was born and they called her Rosalie[5]. Unfortunately Isaac was unable to join her as he was needed by Aisenstein to.prepare to go and work on the Zhmerinka station.

On 31 May he left Kiev for Zhmerinka and though he had hoped to be able to go to Pinsk in mid June it wasn't until August that he was able to get away. However it was only a brief visit and with him shuttling between Kiev and Zhmerinka where the station was unlikely to be finished before November or December, they reluctantly decided that she and the children would remain in Pinsk until the New Year.

It was just as well Isaac had received a wide engineering education, because the task involved buildings and masts as well as the wireless telegraph devices. However, they had considerable trouble with the receivers and in addition to coherers tried electrolytic detectors and crystals. Eventually they achieved a satisfactory system and demonstrated good communication over this distance, and by February of 1907 they could not only communicate between Kiev and Zhmerinka but were able to receive telegrams in Odessa from either. The War Office were very interested and set up a special commission under Grand Duke Peter Nicolaevich to watch the results.

Fig 4.2 Isaac Sheinberg in a laboratory in Russia

With him no longer in education, Isaac and Esther were worried that he would be called up for military service, leaving her alone with two small children. In September 1906 the military authorities ordered him to attend a hospital in Minsk for a medical examination. He was then declared completely unfit for service and was therefore discharged permanently from service[6]. The only stated reason was that he was short sighted. This seems a trivial reason for not accepting him, so maybe General Sukhomlinov was in some way involved and this as a way of ensuring that he remained where he was helping with the new wireless telegraph work.

Isaac's relationship with Aisenstein was not always a smooth one and he found that Aisenstein's word was not always to be trusted. At one point he even considered leaving. However, he eventually obtained a satisfactory contract of employment up to June 1907, at a salary which allowed them all to be together in Kiev. At the beginning of 1907 they were able to rent a flat in Fundukleevskay Street in the centre of the city. It was not long before Esther became pregnant again and on 14th November 1907 another son was born and they called him Alexander.

Though Aisenstein continued to make improvements, the War Office was very satisfied to the extent that they purchased the experimental stations for 70,000 rubles. They could see the advantage of such a system which would avoid laying long distance cables in the vast areas that they controlled. They approached Aisenstein to construct more stations for them, and other departments of the Russian government soon followed suit.

Clearly this was beyond the resources of people and finance of the small group and it was necessary to put the organisation on a firmer basis. Fortunately Aisenstein's father knew many people and he arranged for Mr Tischenko of Gousakov and Co and other investors that he brought in, to finance a proper company. During 1907 this was set up and now the ambitious Aisenstein could move forward to fulfill these government orders.

By late 1907 the military proposed that the company should move to St Petersburg for the convenience of both sides. Though there were restrictions on Jews there, these were undoubtedly swept aside by their powerful backers in the government. For the company it was also useful to get out of Kiev which was still subject to disruption and there was a growing Ukrainian nationalism. For Isaac and Esther, who had always aspired to go to St Petersburg, it was a definite advantage.

When Isaac arrived there in mid-February 1908 he was staying in the Grand Hotel d'Europe on the company's expense acount, though that didn't last long. He was delighted at last to be at the cultural centre of the country. His days were spent supervising the installation of the equipment and visiting suppliers and when not involved with this he reveled in the the opera, museums and other oportunities that were available.

The company had taken premises at 14 Liniya 73 which was on one of the numbered streets in the grid layout on Vasilevsky Island, near the centre of St Petersburg. There they had a number of workshops which had to do for both office and factory. He soon found himself some cheap lodgings nearby in the student quarter, where he could also eat with the students and he found them better company than the guests at the Grand Hotel. Esther and the family remained in Kiev.

Within a few weeks of his arrival he received a distressing letter from his father. The rift had long since been healed, and now his father was in financial difficulties and appealing to his son for help. While he and Esther felt they must give support, they were distressed by his father's difficulties and that it would take the savings that they had carefully built up.

Despite Isaac making a brief visit to Kiev in March, it was into May before Esther and the children could finally join him in St Petersburg, where Esther could be involved in finding a flat suitable for them all[7]. To get away from Pinsk, and to a lesser extent Kiev, was a relief. It was exciting to be together again, and living in St Petersburg brought a new sense of freedom, despite the rules they still had to live under.

On the 8th October 1908 the company formally became the Ruskoye Obshchestvo Bezprovolochnykh Telegraphov i Telefonov (Russian Company for Wireless Telegraph and Telephone). Tischenko was the chairman with Aisenstein as the managing director. Isaac Sheinberg was the manager of the technical division and in effect chief engineer. This was an unexpected turn up in his fortunes. In this company he could progress, even though he was a Jew, particularly as Aisenstein was one too.

It was somewhere around this time that Isaac decided to learn English. This was probably so that he could keep up with developments in Britain and America. As he had learnt French and German at school he could read papers in those languages, and knowledge of those was a good start for learning English. Of particular interest were the advances Marconi was making in aerials and in the tuned coupling to them. This put more of the output power into a single frequency and so boosted the range of the signal. It also meant that one station was less likely to interfere with another.

The company was now receiving orders from the military and the navy for both fixed and field stations. They were constructing these in their factory and also installing the stations. Amongst these were two high power stations at Bobruisk in Belarus and Urshum some 1650 miles to the east, which must have stretched their technology and needed all the advances they could employ. There were also orders for stations at Tiflis, now known as Tiblisi the capital of Georgia, Kars in an area of Armenia disputed with the Turks, Brest-Litovsk on the Polish/Belarus border, and Helsingfors the old name for Helsinki which was then part of the Russian Empire.

There was another lucky break when in December 1908 their supporter General Sukhomlinov became chief of the General Staff and, better still in the following March 1909 he became the Minister of War. If there had been any doubt that they would be supported at government level, it had now gone. After the first batch of key stations, the orders really began to pour in.

On 6th March 1910 Isaac Sheinberg was elected a member of the Imperial Russian Technical Society in St Petersburg[8]. This was an enormous honour, particularly for someone with his background and only just thirty. It showed how far he had progressed in the five years since he had taken the gamble to join Aisenstein. A couple of days later the company, which already described him as the 'Director of the Works', was extending his authority and he was now delegated powers over factory correspondence, signing orders, building stations and all orders for the Military and Navy Institutes. He was a very important man in the company[9].

The company was growing so fast that it was decided to build a large factory in the middle of 1910. This was a little further out in St Petersburg on Aptekarsky Island, in an area where sufficient land was available. Here they could set up on a scale adequate for the amount of orders that were coming in. This was accelerated by the Ministry placing an embargo on orders being placed abroad for wireless telegraphy equipment. This was a remarkable turnaround as there previously had been a prejudice in favour of foreign equipment on the grounds that local equipment was not of sufficient standard.

By December they were operational in the much expanded new works at Lopuchinskaia No 14 on Aptekarsky Island. The street was later renamed Academician Pavlov Ulitsa after the physiologist famous for his groundbreaking work on the reflexes of dogs, who spent over 40 years as Director of the Institute of Experimental Medicine, on the northern tip of the island. On this island was also the St Petersburg Electrotechnical Institute where Popov had spent his last few years until his death in 1905.

Fig 4.3 General Sukhomlinov (in light coat) visits the works at Lopuchinskaia No 14 on Aptekarskii Island in St Petersburg. S M Aisenstein is on the right with other directors in the front row. At the back in the centre appears to be Isaac Sheinberg.

Isaac, Esther and the family were also living on this island, first on Pesochnaya Street, and later on Karpovka, which was convenient for the works. Isaac's status in the company was also pointed up when he was formally designated to be the company's representative to receive the proceeds from some of the invoices for work on the Bobruisk and Urshum stations[10]. The background of this isn't clear, but it was important enough for him to have kept the document.

Just in the New Year on 4th January 1911, another son was born to Isaac and Esther and they called him David. This time she stayed in St Petersburg where presumably they could get reasonable care and with his increasing importance in the company no doubt he was being paid a respectable salary and things were not as tight as they had been previously.

It was around this time that Marconi's Wireless Telegraph Company in England began to be interested in the Russian company. Its success meant that its activities had come to international notice. Under Godfrey Isaacs, who had been made the managing director in August the previous year, Marconi's were looking to increase their international reach. Isaacs was also keen to exploit the Marconi patents for the company's commercial advantage.

In September 1911 Marconi's sent Adrian Simpson to Russia to negotiate with Tischenko and Aisenstein with a view to purchasing a controlling interest in the company. The bait was access to Marconi technology and for Tischenko and the other investors a way of realising some of the gains that had been made. The growth of the company was also making ever increasing demands for cash to fund the operations so some of them may well have felt that they could no longer support it.

There was also another factor and that was that the Marconi Company claimed that the Russians were infringing their patents and should be paying royalties on them. Marconi's had a view that they would rather negotiate than take companies to court. Here was an opportunity to get control of a growing company in an important market which was seen as a local company and hence obtained the government contracts.

In October Marconi's purchased the controlling interest and Simpson was made the managing director of the Russian company. Adrian Simpson was ideal for the task. He had had an extensive military career much of it in the Indian Army, he had spent time and learnt about wireless telegraphy and was also fluent in Russian. Other senior personnel from Marconi's also filled places on the board of directors, which included Semyon Aisenstein, but not Isaac Sheinberg who remained in charge of the technical department.

In February 1912 Isaac came to England. He sent a postcard of Westminster Abbey back to St Petersburg[11]. As this was not long after the Marconi takeover he was probably visiting the Marconi Company to get up to speed with the latest technology. What was clear was that he got to know some of the people at the Marconi Company in England, particularly Andrew Gray the Chief Engineer. His effort to learn English proved very useful and he liked the country. He was impressed with the liberal way of life and democratic system, and its tolerance of people from other nations and creeds. One thing he particularly appreciated was that people were free to criticise the King and the government without having to look over their shoulder. The visit clearly left him thinking.

On his return to Russia it was back to business, as the government was now making a serious effort to build a wireless telegraphy network to connect particularly to some of the more far flung parts of the empire. This network was to extend all the way to the Pacific and Bering Sea. A start was also made on coastal stations around the Baltic and along the arctic coast to provide communication with ships in the few summer months when it was sufficiently ice free to allow navigation.

Previously most of the orders had come from the Post Office or the Army. The Navy had largely used equipment of foreign manufacture. Now all that changed and they started placing orders with the Russian Company. Of particular significance was that they started replacing the foreign equipment with the company's products. Now the company had an almost complete monopoly of wireless telegraphy in Russia.

The company was starting to make serious profits, but it is a characteristic of a rapidly growing business that it needs ever more capital to pay for the materials and work put into their products until they were paid on completion. The more work, the more money that is required. This was the situation with the Russian Company and part of this increase was found by the Marconi Company.

Though the work was very hard, it did have its lighter moments, like the request from the fortress at Osovets (today Osowiec in Poland) to know whether it would be suitable to house the spark transmitter in a room immediately above the explosive powder store[12]. It was recommended to place it elsewhere! It was also recommended to keep the spark transmitter away from where the explosive powder was being transported.

By 1914 Isaac had seen the company grow from the small group in a tiny laboratory in Kiev to this massive organisation employing hundreds of people in St Petersburg. His responsibilities had grown with it. He was now a respected engineer in charge of a large works which had achieved a great deal both in technical and business terms.

With the great powers in a belligerent mood, the army and navy were equipping themselves for a struggle that was undoubtedly going to come. It was all good business and for Isaac it meant that the future was secure.

Where the company had struggled financially up to 1911, after that it started to make considerable profits. The dividends on the shares were a very respectable 6% for each the years 1912 and 1913, but jumped to huge level of 15% for 1914. Thus the shareholders, the largest one being the Marconi Company, began to see a serious return on their investment. Isaac Sheinberg held 150 of those 100 ruble shares, and he was starting to see some return on them.

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[1] Obituary Mr S M Aisenstein, The Marconi Review, Fourth Quarter 1962

[2] Personalities in the Wireless World – Mr S M Eisenstein, Wireless World, May 1914 (This magazine always spelled his name this way though he used Aisenstein)

[3] Letter to Isaac Shoenberg, 1 July 1905, Shoenberg Family Archives

[4] Certificate from Kiev Polytechnical Institute, 8 April 1906, Shoenberg Family Archives

[5] Isaac Shoenberg's naturalisation document also naturalised the children. Available at: https://artsandculture.google.com/exhibit/CwLSPKoOHLbzJQ

[6] Marconi Archives MS 360, 23 September 1906

[7] The last letter between Isaac and Esther is just before her move to St Petersburg, Shoenberg Family Archives

[8] Isaac Shoenberg, IET Archives NAEST 62/1.5 (In Russian)

[9] Isaac Shoenberg, IET Archives NAEST 62/1.3 (In Russian)

[10] Isaac Shoenberg, IET Archives NAEST 62/1.4 (In Russian)

[11] Postcard in Shoenberg Family archive

[12] Isaac Shoenberg, IET Archives NAEST 62/1.6 (In Russian)

# 5 Imperial College

In July 1914 Isaac Shoenberg, as he now called himself, gave up his good job and everything in Russia, and came to England. He brought his family with him, Esther, Mark Eli now nine, Rosalie eight, Alexander six and David who was just three. At first sight it was an extraordinary thing to do, and he received much counsel against it, but Isaac was following a dream. As usual with him, it was a carefully calculated risk. What he didn't seem to have quite factored in was that war was about to break out.

Fig 5.1 The Shoenberg children soon after coming to England. Mark at the back, with left to right - David, Rosalie and Alexander

He had left Russia of his own free will, there was no forced exit. However, there were some factors that provided a push. In the company his progression was blocked, and there was no real chance of becoming a member of the board of directors once the Marconi Company took over. Also, as he was to write later, he didn't always see eye to eye with Aisenstein, even though the two men had a great respect for each other.[1] Perhaps he had also found the work in such a key position in a growing company a strain. He probably spent a considerable amount of time away from his family travelling around the country to the sites where equipment was being installed.

On top of that he didn't like the repressive autocratic regime he had to live under. This was even more difficult for a Jew where there was always the danger of a pogrom breaking out which they suspected might be tolerated, if not encouraged, by the government. With a sizable young family, this was always a worry, particularly after what they had seen in Kiev. There was a tension in the air with constant strikes and the situation had never really settled down after the revolution in 1905.It looked as though things were working towards a crisis again.

What attracted him to England was the chance to study again. He had arranged with Imperial College in London, to undertake special research in Wireless Telegraphy[2]. This meant that he joined the Electrical Engineering department which was part of the constituent City and Guilds College and not the Royal College of Science to study mathematics as some sources say. He did, however, also have classes in Advanced Mathematics, which is where the confusion may have come in.

Also some of the repression that irked him in Russia was not present in England. He was much freer and being a Jew was less likely to hold him back. Perhaps being away from Aisenstein and the Russian Company was also an advantage. It was very noticeable that the family kept together, despite the risks, and he didn't go and leave them behind. Maybe that was another draw that he would not be absent so often. After their experiences in the past he and Esther didn't want to be parted again.

It is unclear whether he intended to remain for just the three years needed to complete the study and obtain a doctorate, or whether he intended to stay permanently. Esther was keen on the move and one of the reasons was that 'it would be nice for the children to learn English'[3]. This would suggest that they thought in terms of returning, but on the other hand they brought everything with them, including their certificates, which suggests that they also thought of staying.

They had barely arrived when the war broke out. It is unclear whether they realised it was coming but they were probably concentrating on the move. Maybe all the arrangements had been made well before, and they had committed themselves to the move before things went critical after the assassination of the Archduke at Sarajevo. They must have been quite convinced that coming to England was the right thing to do whatever the circumstances. They would be safe in England if it did occur.

The study time was to be funded by the savings he had built up in Russia and also probably by some return from his shares in the company. His miscalculation was that when the war broke out, international transactions froze, and he could no longer get his money from Russia. With the mobilisation for war absorbing all available transport there was no hope of returning to Russia. He was stuck in England and very short of funds. As he knew hardly anyone in the country, where was he to turn for money to tide the family over, and also where could he obtain employment?

One thing he was carrying was an introduction to 'The Manager' at the Marconi Company in England which had been written by Adrian Simpson, the managing director of the Russian Company[4]. The letter ran:

> 'Dear Sir, the bearer of this letter, Mr Shoenberg, is, I believe, already known to you personally having spent some time in England at the Marconi works. Mr Shoenberg who has been with the company since March 1908 has for some time past had charge of our Technical Department and has fulfilled his duties, many of which have been of a most responsible character, to our fullest satisfaction. Mr Shoenberg is now leaving us at his request as he wishes to start on his own account in England. I have the highest opinion of Mr Shoenberg's technical knowledge and capabilities and would esteem it a personal favour if you would kindly render him any advice and assistance in your power in connection with his plans for the future, which he will explain to you personally.
> In conclusion I can only say that I much regret Mr Shoenberg's decision to leave us, and I wish him every success in the future. '

It was to prove a lifeline, because that was where he could go for help. In August he went first to the only person he felt he really knew and that was the Chief Engineer Andrew Gray[5]. Gray took him to Godfrey Isaacs the managing director. Fortunately he was carrying something of value to Isaacs and that was some shares in the Russian Company. Isaacs, though they had a majority holding, found that under Russian law some matters needed a much higher percentage of the shareholding and so he was trying to buy as many as possible. Isaacs advanced him £50 against 25 shares, which wasn't very generous as they were worth many times that. However it tided him over for now.


№11015
РУССКОЕ ОБЩЕСТВО
БЕЗПРОВОЛОЧНЫХЪ ТЕЛЕГРАФОВЪ и ТЕЛЕФОНОВЪ.
Основной капиталъ 1.200.000 рублей.
АКЦIЯ
ВЪ СТО РУБЛЕЙ
НА ПРЕДЪЯВИТЕЛЯ.
SOCIÉTÉ RUSSE
de TÉLÉGRAPHES et TÉLÉPHONES SANS FIL
Capital social 1.200.000 roubles.
ACTION DE CENT ROUBLES
AU PORTEUR

Fig 5.2 Share certificate for 100 roubles in the Russian Company for Wireless Telegraphy and Telephony

Part of Isaac Shoenberg's approach to Gray was a request for employment. However Gray merely responded that he 'would keep him in mind', which was hardly encouraging[6]. What was noticeable in his letter to Gray was the high standard of his English, even if it was slightly formal. He had obviously managed to become quite proficient, and though he spoke it well, it was with a heavy Russian accent. This was quite an achievement for someone who had only spent a short time in the country before.

Despite the financial problems they managed to find a house for the family. They were living at 5 Queen's Club Terrace one of a small row of two storey terraced houses on Normand Road in West Kensington. Despite the name it wasn't very close to Queen's Club and was a rather grand name for a block of terrace houses, though these did have bay windows at the front. It must have been quite a squeeze for all six of them. Esther must have wondered what they had let themselves in for.

There were practical matters to be organised. The three eldest children were of school age in England. With Russian schools only starting at eight compared to five in England and with a new language to learn it must have been a difficult time. While Isaac had learnt English, it was essential for the others to do so as well. They had started before they left Russia, and Esther had learnt a little, but was by no means fluent. Fortunately young children pick up another language remarkably quickly when immersed in it. With Isaac not working he was there to assist until things settled down.

The family must have watched as the Russian armies moved forward much more quickly than expected and attacked the Germans in East Prussia. Here the wireless equipment that the Russian Company had supplied to the Army worked well; perhaps too well. Due to administrative inefficiency the code books were not properly distributed and units took to communicating in clear.

This was disastrous as the Germans monitored the transmissions and had a good indication of the intentions of the two Russian armies. This probably helped

Hindenburg to take the calculated risks with his inferior forces and turn it into a stunning victory. In the south Samsonov's second army was destroyed with some 92,000 prisoners being taken. The Germans then turned on von Rennenkampf 's first army and drove it from East Prussia. Worse still the Germans started to advance into what had been Imperial Russian territory.

Pinsk was not very far away and was seriously affected by all the military operations. All transport had been commandeered which would have had a drastic effect on Isaac's father's business. There was now the worry that the Germans would continue moving eastwards and overrun the town.

The international currency exchange problems lasted for a month or so and then he was able to access his money again. The nasty shock was that the Russian Rouble, which had always been a strong currency, and being backed by gold was absolutely stable against the British Pound, had now devalued by around six percent and looked likely to sink further.

However, he now had access to his funds, which was a relief. He also had another 125 shares in the Russian Company which he used to raise a further loan from The Marconi Company[7]. Altogether this had provided him with enough money to decide to take up his place at Imperial College. As the request for work hadn't produced anything, perhaps luckily, and the immediate problem was over, he could revert to the original plan and go and study again.

From their new home it was a reasonable walk to West Kensington Underground station. Three stations along the District Line took him to South Kensington. From there it was merely a walk around the corner of Thurloe Place and up Exhibition Road to Imperial College. Once he crossed Cromwell Road there was the Victoria and Albert Museum on the right and the Natural History museum on the left. Beyond it was the Science Museum though some of its buildings were still not finished.

A little further took him to Imperial Institute Road and across that was the great mass of the Waterhouse building where he was going to study[8]. The name came from the architect Alfred Waterhouse who had also designed the Natural History Museum. It was similar in style though not as elaborate, but at three stories high plus a basement, and more in the gables, it was still an impressive building.

Imperial College of Science and Technology was made up from three constituent bodies, The Royal College of Science, The Royal School of Mines and the City and Guilds College. They had all be set up many years before but had gradually coalesced on the same site and become basically one college within the University of London, while still retaining a degree of individuality.

The Royal College of Science covered Chemistry, Physics and biological science, but also contained the mathematics department. The Royal School of Mines covered mining engineering and related subjects, while the City and Guilds College with its ancestry back to the foundation by the Guilds of the City of London, covered the engineering disciplines. Electrical Engineering naturally fell within its orbit.

The Electrical Engineering Department had quite a reputation under its earlier Professor, William Ayrton. Originally he had been the Professor of Physics, but as subject of electricity developed the rest of Physics was transferred to the Royal College of Science, while the department concentrated entirely on Electrical Engineering.

Ayrton made a very considerable contribution to the subject and together with Professor John Perry invented many of the basic measuring instruments so important to the exploitation of electricity. After he died in 1908 his place was taken by Thomas

Mather who was also a good designer of electrical measuring instruments. At first sight, though prestigious, this didn't seem a place that would attract Isaac Shoenberg.

However, one of the assistant professors was George William Osborn Howe who was a noted specialist in the field of wireless technology. He had joined the college in 1905 as a lecturer and gained the assistant professor post in 1909. What Isaac Shoenberg had probably seen was a paper he wrote in 1911 on 'Recent Developments in Radio-telegraphy'. The word 'radio' rather than just 'wireless' was beginning to come into use.

Howe wasn't just interested in the theory but also in testing practical equipment. In 1913 he strung a wire from the top of the Waterhouse building to the Imperial Institute's Colcutt tower just along Imperial Institute Road. Using this as an aerial he was able to receive signals from Marconi's transatlantic station at Grace Bay in Nova Scotia the other side of the Atlantic.

Here was a suitable tutor to guide Isaac Shoenberg's researches further into wireless telegraphy. Probably Howe would be interested in Isaac as a student. This was not some fresh young graduate who knew nothing, but an experienced 34 year old engineer who had been building and installing wireless equipment for the best part of a decade. There could be a useful interchange of ideas and knowledge.

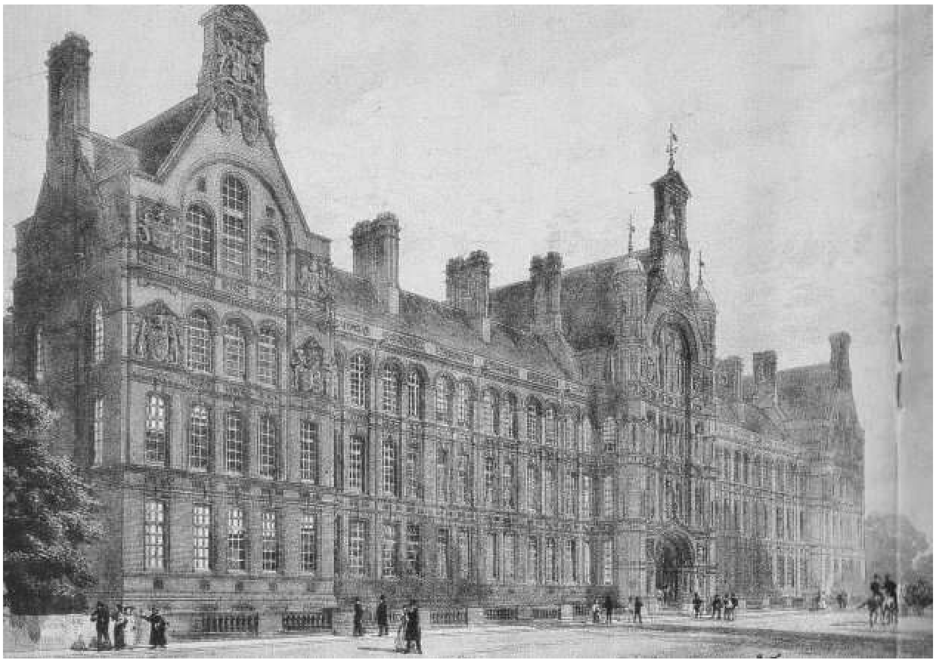

Fig 5.3 City and Guilds College Waterhouse building

Unfortunately, there do not seem to be any records of what he was researching, but some guesses can be made from a patent application he submitted only a little later. Up to this point most wireless transmissions had used spark transmitters, and while these were suitable for the intermittent signals of Morse telegraphy, they could not be used for sending speech. This required a continuous carrier wave at the transmission frequency which would then have to be modified, modulated as it is called, by the speech signal to be transmitted.

The problem was to generate a high power continuous wave at the required radio frequencies. A number of schemes were tried but the one that seemed to hold out the best possibilities was a special high speed rotating generator known as an

Alexanderson alternator. This could reliably produce the required powers but the maximum frequency it could reach really wasn't high enough.

What Isaac Shoenberg invented was a method of multiplying frequency. As this used robust transformers it could, in principle, be used at high power. The possibility was that this could be coupled with an Alexanderson generator to produce higher frequencies than the generator alone could reach thus being valuable for speech transmission.

It would seem likely that Isaac Shoenberg was looking into the possible transmission of speech which was the coming subject at the time, and he realised the problem and found a solution. Whether he and Howe built such a thing is not known, but it seems likely that this was the area of interest. The amplifying electronic valve, which was to take over later, was still in its infancy at this time.

The other aspect Isaac Shoenberg was interested in was an advanced course in mathematics. The person who taught mathematics to the engineers was Professor Andrew Forsyth who was head of the mathematics department in the Royal College of Science. He had had a rather colourful past. He had been the Sadlerian professor of pure mathematics at Cambridge University but had had an affair with Marion Amelia Boys the wife of the physicist C V Boys, and was forced to resign his chair.

After some time in the wilderness, and marriage to her after she was divorced by her husband, he became the professor of mathematics at Imperial in 1913. As a good linguist he had studied other streams of mathematical thought on the continent and took a wider view of the subject than had been common in England. This broader view of mathematics would have suited Isaac Shoenberg who had come from a different tradition.

He would soon have been more encouraged by the conduct of the war. The German attack in the west had been held in France, and the situation in the east looked better. On 21st October 1914 the report in the Times even mentioned Pinsk, or more precisely the marshes beyond that would form a barrier to German progress but might also hinder the Russians. It seemed that the Russian armies were progressing very well against the Austrians but also making modest gains against the Germans. He would have been encouraged by the positive tone of the report regarding the quality of the Russian forces.

Some time before January of 1915, the family felt confident enough to move to a house that was a little closer to the college at 98 Abinger Road, Bedford Park in west London[9]. It was also a little larger with some space in the attics and so not quite such a tight fit for them all. Also things were looking up as letters and postcards were getting through to and from the family in Pinsk.

Over the next few months the Russian Army swept forward on the Austrian front capturing many of the key fortress towns. Despite the problems of transport and logistics with an inadequate railway system, they made excellent progress. The difficulty was that the advance produced a potentially dangerous situation with the Germans on the north flank in East Prussia and the Austrians also to the South. Nevertheless they had held these flanks and driven deep into Austrian territory.

However as 1915 progressed the situation stabilised and then the Germans began to make advances out of East Prussia. The fortress of Osevets, which had enquired about positioning their spark wireless equipment above the explosive powder store, was now in the thick of the fighting. By May the tide was turning, and the Austrians, stiffened by German units started to drive the Russians back from southern Poland.

Slowly but surely the war turned in the German and Austrians' favour. The Russians were being steadily forced back eastwards. Despite this, the cards from his father concentrated on family matters and the money he was receiving from his son's shareholdings in Russian companies which was helping to tide them over in difficult times. His business had not been doing well for a while and now his eyes were giving him trouble some of the time, so life was not easy.

In April there was discussion of Mark's success without specifying what it was. As he was rising eleven one possibility was that he had just been accepted into the Latymer Upper School, where he certainly was later. This was a charitable foundation and was dedicated to helping able pupils whatever their background. As around 4 in 10 of the students were receiving scholarships, and their financial position was precarious, it is likely that he had been awarded one of these.

However there was little discussion about the war with only mention of the Russians abandoning Warsaw coming in August. This must have caused Isaac Shoenberg to worry about his parents and siblings as the fighting moved ever closer to them. Could the Russian Army recover its balance and stem this tide?

The war in the west was also turning into one of attrition with ever higher casualties. Any idea of the glory of war had gone, and the pure awfulness had sunk in. There was little good news anywhere, and those early ideas of 'all over by Christmas' had long gone. Despite the war, Isaac Shoenberg and his wife and children were safe in London, but it was a time of worry, and in this situation could he carry on studying?

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1 IET Archives NAEST 62/1.38 It also said 'we quarrelled frequently' but this was crossed out.
2 Imperial College records; email from Anne Barrett, College Archivist
3 Letter from Elizabeth Shoenberg to Professor McGee, 17 Nov 1970, Shoenberg family Archives
4 Isaac Shoenberg IET Archives, NAEST 062/ 2.02; Marconi Archives, MS360
5 Letter to Gray 11 August 1914, Marconi Archives, MS360
6 Letter to Shoenberg, 18 August 1914, Marconi Archives, MS360
7 Marconi Archives, Oxford, MS Marconi 197 Russian Company
8 The Waterhouse building was demolished in 1962 as part of the rebuilding of Imperial College.
9 Address on postcard 11th January from Isaac Shoenberg's father in Shoenberg Family Archives

# 6 Marconi's Wireless Telegraph Company

Isaac Shoenberg completed his first year at Imperial College, but on 27th June 1915 he wrote to Andrew Gray at Marconi's Wireless Telegraph Company to request employment. On the 2nd July he went to see Gray to press the case further[1]. The reason he gave for this was that in addition to keeping his own family he was trying to keep some near relative, probably in Russia. He thus said he didn't feel he was justified in continuing his studies and applied to the company for 'work of any kind that the company was prepared to offer'.

This is all very curious. Who was the person he felt he should support? His immediate family were all with him in England, and his parents were still with the rest of his siblings in Russia, though his sister Fania had left Russia and gone to Canada. The cards from Pinsk didn't show any particular change in their circumstances and they were receiving some money from his investments in Russia. Did he feel that he needed to do more?

What of his savings in Russia? The rouble had now fallen some 30% against the pound, but though this was a serious loss, the money would still largely be there. The Russian Company was starting to pay significant dividends, though these would he reduced by the declining exchange rate, but would still be useful. In any case some of these funds were being used in Russia where they would have their full value.

Something doesn't seem to add up. He came to England, bringing his family with him, to study, and then after a year is prepared to give it up and accept 'work of any kind that the company was prepared to offer'. The phrase would suggest that all was not quite as he portrayed it. He seemed very keen to get some work – any work. Was his financial position worse than he thought it would be? Perhaps living in England was more expensive than he had assumed.

There is also the possibility that the studies had not worked out as well as he had expected. Maybe the research work had not proceeded as he hoped and he couldn't see it coming to a useful conclusion. He was not the sort of person to waste his time on something he didn't think was of value. There was rapid progress in wireless technology at this time, particularly driven by the needs of the war, and maybe what he had been working on had been overtaken.

Fig 6.1 Isaac Shoenberg around this time

Andrew Gray was not only a good engineer but he had skill in dealing with the men. He was keen to try and help Isaac Shoenberg as he felt that with his experience and abilities he could make a useful contribution to the company. He obviously thought carefully about the situation. Isaac Shoenberg was a Russian but looked and sounded like a foreigner and he didn't need to spell out that at this time that, with anti-German feeling running high, he could be taken for a German, particularly with his name sounding German.

For those reasons Andrew Gray didn't feel that Isaac Shoenberg could be placed in one of the transmitting or receiving stations, or even in the Test Department, where these matters might cause problems. Gray had an idea and that was the examination of patents. As he put it Pletts, who was in charge of this area, was 'otherwise fully occupied'. He sent a memo to Godfrey Isaacs the managing director making the proposal that Shoenberg should be employed to look after this work.

Isaacs wasn't anxious to proceed with this idea, even though he was keen to exploit patents. He did, however, agree to consult Captain Simpson before making a final decision. This was the wartime rank of Adrian Simpson the managing director of the Russian company. Seeing Simpson was supposedly still in Russia this seems rather curious. But clearly he had no difficulty.

The reason was quite simple. Simpson, though the fiction was maintained that he was in Russia managing the Russian Company, was actually in England. He had been recruited to head a military signals intelligence unit called MI1(b) in the usual secretive way they described themselves. Amongst his small staff was none other than J St Vincent Pletts from the Marconi Company. This was the same Pletts that had been looking after their patent department.

Fig 6.2 Captain Adrian Simpson

Obviously Isaacs got a good reference from Simpson because on 27th July, after Isaac Shoenberg had written more than once enquiring whether there was a decision, Gray wrote to him offering employment looking at patents, but only for the duration of the war. He would be based at the headquarters, Marconi House in the Strand in London. The pay wasn't wonderful at £100 per year, more at the level of a skilled workman.

He accepted the offer. It was a job and he could start almost immediately. He was wise enough to accept a job well below his capabilities and hope to make his way forward within the company. He had confidence in Gray that, once he was in the company, his skills would be used properly. Though he couldn't know it at the time, and it certainly didn't seem so, it was a lucky break.

The worry now was that the war in the east was not progressing well for the Russians. They were steadily being driven back and by the beginning of September the name Pinsk was appearing in the reports. The situation in that area was confused, but there was the hope that the marshy land surrounding the town would act as a defence. However, it wasn't until some time later that it became clear that Pinsk had fallen to the Germans on the 15th September.

The situation was as bad as it could be because the Germans had a salient, where their front line bulged forward, with the town at its peak, protected by the rivers and canals, and surrounded on three sides by the Russian Army. It was thus turned into a military area and the population treated badly, though the Jews seemed to be more tolerated by the Germans than the Russian people. Isaac Shoenberg's family was now effectively cut off from any contact and he could have no idea what was happening to them.

If the person he wanted to support was in Pinsk there was no chance of helping them now unless they had fled as the Germans approached. In any case contact was going to be very difficult. If he really had given up his studies to help, then this was a tragic turn of events. However, as was said earlier, that probably wasn't the whole story.

A place was found for Isaac Shoenberg in the Drawing and Designs Department but maybe Gray had ideas of progressing him if he lived up to his expected potential. In his memo to the secretary of the company about Isaac Shoenberg's service agreement he said he was 'temporarily employed on some special scientific studies which require to be made at this time'[2]. This sounds as though he had ideas of using him beyond looking at patents though this was certainly some of his work.

He was set to work looking into patents. For example Gray wanted him to look at the Kleinschmidt Typewriter Keyboard perforator[3]. The comment was that 'it was used by the Western Union and Commercial Telegraph companies in New York and thus there might be something in it'. It was a sort of typewriter that punched holes in a paper tape so that the tape could be used to send the message at high speed. Hence it was an early form of teleprinter, and clearly Marconi's interest was whether this could also be used for wireless telegraphy.

A clue that Gray wanted him to do more that just look at patents, lay in the application to the police on the 7th October, for a pass to visit the Test Department at the works at Chelmsford[4]. The reason for this was that the works had been taken over by the Admiralty and so anyone visiting it needed a pass. To just look at patents wouldn't have required this, so his brief was clearly wider than that. Maybe Gray had intended this all along but had used just the patents line with Isaacs to enable him to be employed.

Isaac Shoenberg quickly proved his worth because a few days later on the 12th October 1915 he submitted a patent application to the Patent Office for a Frequency Multiplier[5]. He had only been employed by the company for a couple of months which is a very short time to come up with an idea, work it all out, and write a patent application and get properly drafted by the patent agents. Contrary to some suggestions that it came from his work looking at patents at Marconi, it would seem more likely that this derived from work done previously and that would have been during his time at Imperial College. The patent was jointly in his name and that of the company.

By late October even Isaacs was beginning to appreciate his usefulness and wanted him to 'study the Valve question at once'[6]. It is not entirely clear what the 'Valve question' was that he referred to but some idea can be obtained from the state of the art at the time. There had been two key inventions. The first was by J Ambrose Fleming who found that a two electrode thermionic 'valve' could be used as a detector of wireless waves. As he was working for the Marconi Company they owned the patent.

The second was by the American, Lee de Forest, and was the adding of another electrode as a 'grid' which meant that the device could be used to amplify signals. His Audion worked, but not very well, and he really didn't understand why or how to improve it. There had been interminable patent disputes between him and Fleming but this had been more or less put into abeyance and he had given up his patent in the UK.

This had given the Marconi Company the opportunity to make some devices themselves. Henry J Round had designed what were known as 'soft' valves. At their best they worked very well, but they depended on a certain amount of residual gas within them and hence the description. The problem was that they were difficult to make and sometimes needed some auxiliary heating to maintain the gas at the right level and so were tricky in use. In skilled hands they performed well.

However work had been underway in America and elsewhere on producing devices without the gas as a 'hard' vacuum and this was producing results. At the beginning of the war the knowledge had found its way to France where improvements had been made and now the results of that work were just becoming available. They didn't perform as well as the soft valves but they were easier to make and didn't need any cosseting to work at their best level.

Fig 6.3 Andrew Gray the Chief Engineer of Marconi's Wireless Telegraph Company

As no one in Europe was taking any notice of patents with the war on, it would seem likely that Isaac Shoenberg's task was to look at the whole subject of 'soft' and 'hard' valves and see which showed the greatest promise for the wireless business. As the Round 'soft' valves were already in production, and there were considerable developments in 'hard' valves, the question needed careful study. They now appreciated that Isaac Shoenberg was just the man for this sort of thing.

By 1916 he was now a trusted employee of the company. When a party of Russian officers came to England and were to visit the transmitting station at Carnarvaon the natural person to accompany them was Isaac Shoenberg. Gray still took the precaution in advance of explaining his background to the station staff, just in case there was any residual anti foreigner feeling[7].

Andrew Gray was well satisfied with Isaac Shoenberg and had already managed to raise his salary to £150 per annum. This wasn't quite as generous as it might seem as inflation, particularly in food prices was eating into the value of his salary. However on 11th August 1916 Gray, at Isaac Shoenberg's request, obtained Godfrey Isaacs' instant approval to raise it further to £250 with the proviso that he remained with the company after the war. Gray said they felt he would be of great use to the 'Research Dept because of his excellent training, mathematical and otherwise, and because of his good knowledge of languages'[8].

Isaac Shoenberg had accepted the condition that he was to remain after the war and made a further agreement with Gray[9]. He had now been in England for two years and obviously felt at home. Perhaps the whole family had settled into this new life and the thought of returning to a troubled Russia didn't hold out much attraction. Pinsk was still in the hands of the Germans and at that stage there was no real chance of the Russians regaining it. The Russian army, that had started so well, was showing signs of disintegration.

Another factor was that Esther was pregnant again and on 25th September another daughter, Elisabeth, was born. Probably it was this impending event that caused him to request a rise in salary. Things were probably still rather tight financially and maybe Elisabeth was right when she described herself, born long after her siblings, 'as a mistake'[10].

Before the end of the year Andrew Gray had another idea how to use Isaac Shoenberg's skills better. He arranged to get current issues of technical magazines, some of them in German, so that Isaac Shoenberg could study them and advise on all items relevant to the business[11]. He then contacted all the main people who could be involved in research in the company, H M Dowsett in the Test Room, H J Round, C S Franklin and W S Entwistle at Carnarvon, G M Wright in the Reasearch Dept, H A E Ewen in the Drawing and Designs Dept, F Newman, and R D Bungay of the Field Station Dept.

What he proposed was that under the difficult war conditions Isaac Shoenberg would advise on whether there were any articles or patents relevant to any new proposals for research work. He could also make a scientific study of relevant matters and advise on the theoretical bearings of the problem if required. He went on to say: 'Mr Shoenberg may be considered as the secretary of the Research Department' and this would include all those working on research wherever they were in the company.

This was a considerable step forward for him and cleverly Gray was now using his skills effectively. Some of the recipients greeted this with enthusiasm as they understood that often a mathematical approach was needed to a problem and not many people had the necessary training to undertake this. He was really proving his worth to the company, and of course all this was on top of his work with the patents.

By March 1917 the strains of the military losses in Russia exploded into strikes and finally a full blown revolution in Petrograd (as St Petersburg was now known to make it sound less German). The result was that the Tsar was forced to abdicate. Power now theoretically rested in the hands of a 'Provisional Government' but this was challenged by the Petrograd Soviet of the workers and the situation became chaotic.

Over the summer, whether as a reaction to the situation in Russia or not, Russian subjects in England were called up to serve in the British Army. Isaac Shoenberg produced his certificate excusing him from military service in Russia and asked whether it was valid under the changed circumstances[12]. Obviously the situation concerned him, but it was soon resolved by the issuing of a Protected Occupations Certificate[13]. There was no way they were going to lose him now.

1917 was a particularly difficult year with the war going badly and German submarines sinking supply ships which caused food shortages. In case the Shoenberg family considered returning to Russia, is was soon apparent that the situation was a great deal worse there. In November a further revolution occurred with fighting in the streets of Petrograd. They were a great deal safer where they were.

Semyon Aisenstein, still trying to run the Russian Company, was in trouble, and as a bourgeois was imprisoned by the Soviets. It is not clear how this information reached England but the Marconi Company looked for ways to get him released. If Isaac Shoenberg had still been there he would probably have been imprisoned too. After a while the Russians decided Aisenstein could be useful and offered him a teaching position. There then followed some years of difficulty before he was allowed to leave Russia in 1921.

On the Eastern Front, the Soviets, early in 1918 came to terms with the Austrians and Germans which resulted in the Treaty of Brest Litovsk. As a result the Germans were able to move large numbers of troops to the Western Front where they used them to break through the Anglo-French trench lines. For a while it looked as though they might win the war, but the offensive petered out and then the western allies regained their poise. As American soldiers began to arrive in ever greater numbers the allies, particularly the British, began to drive the Germans back. By November it was all over with the Germans accepting an Armistice. Germany was on its knees economically with serious food shortages.

With the end of the war life in England looked better though the economic outlook was not good. The Marconi Company was in bad financial shape mainly because it was owed large sums of money by the government for all the services it had provided during the war. However, Isaac Shoenberg was below the level where he would be concerned with such things, and he still had a job.

There was no temptation to return to Russia with its civil war in full swing. The fate of the Russian Company was uncertain, and it was very unlikely that he could be re-employed by them. It was also fairly certain that he would not be well treated in Russia with his bourgeois background, and might well suffer a similar fate to Semyon Aisenstein. There was thus no difficulty in deciding to stay, particularly as he had an agreement with Andrew Gray that he would remain.

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1 Memo from Gray to the managing director, Isaacs, 2 July 1915, Marconi Archives, MS360 Unfortunately his letter is not in the file and is only referred to in Gray's memo.

2 Memo from Gray to the secretary, 4 August 1915, Marconi Archives, MS360

3 Memo from Gray to Isaac Shoenberg, 3 September 1915, Marconi Archives, MS360

4 Letter from Gray to the Chief constable of Essex, 7 October 1915. Marconi Archives, MS360

5 UK Patent application 14423 of 1915.

6 Memo from Isaacs to Gray, 23 October 1915, Marconi Archives, MS360

7 Memo from Gray to Lieut P J Woodward, 15 June 1916, Marconi Archives, MS360

8 Memo from Gray to Managing Director, 11 August 1916, Marconi Archives, MS360

9 Memo from Gray to The Secretary, 6 September 1916, Marconi Archives, MS360

10 Elisabeth Shoenberg letter to Professor McGee, Shoenberg Family Archives

11 Memo from Gray to The Secretary, 11 December 1916, Marconi Archives, MS360

[12] Memo from Gray to Managing Director, 1 August 1917, Marconi Archives, MS360
[13] Isaac Shoenberg IET Archives, NAEST 068/ 1.7

# 7 Head of Patents

Once the war was over, like the country, Marconi's Wireless Telegraph Company needed to recover. It had supplied large amounts of men, equipment and services to the effort and for much of this it hadn't been paid. It now needed to reorganise itself to absorb the returning men, but also to reconfigure its direction from supporting the military to the civilian market.

A change in the management structure led, in April of 1919, to Henry W Allen and William W Bradfield being appointed joint General Managers. These were two senior people who had been with the company for many years. Allen was an accountant and was already the Company Secretary, whereas Bradfield had an engineering background. Presumably the objective of this move was to lighten some of the load that fell on the managing director Godfrey Isaacs.

John St Vincent Pletts who had been in charge of the Patents Department, but in reality had spent much of his time on intelligence work, decided that he wished to leave the company and set up as an independent patent agent. This left a vacancy, and there was really only one candidate for the post, and that was Isaac Shoenberg. With Pletts absent much of the time he was almost certainly largely doing most of the patents work, so it was natural that he should take up the position.

Worries about him being a foreigner, and he was still a Russian subject, seemed to have evaporated. He had taken a very intelligent path. He had accepted a lowly position, kept his head down, and made himself useful if not indispensable. Now his reward was to be made Chief of the Patents Department around July 1919[1]. He now had a proper office on the 4th floor of Marconi House, in the Strand in London, and featured in the directory of the management of the company.

He had spent nearly four years working on patents and had found that it was an area that suited him with his meticulous approach to wireless telegraph engineering. He had made himself into a patent expert, and the job that Andrew Gray had found to squeeze him into the company had turned out to be a lucky break. Even Godfrey Isaacs, who had not been keen to employ him at the beginning, had come to appreciate his skills.

With the ending of hostilities there had been some hope that communications could be restored with Isaac and Esther Shoenberg's parents and siblings in Pinsk. However their nightmare was not over. Under the agreement between the Russians and Germans the area around Pinsk was to be administered by the Ukrainians but they had barely taken over when the Red Army attacked in January 1919 and soon overran the city. At first things appeared to be better but the situation didn't last.

In March the Poles attacked and drove out the Russians and the situation deteriorated again. The Polish soldiers took the view that Jews were Bolsheviks and treated them as enemies, a view that only added to a considerable amount of anti-semitism. Life was now very difficult in Pinsk and the surrounding area. It was only when outside bodies in America and Britain brought pressure on the Poles that things improved to some degree.

However in July 1920 the Red Army again captured Pinsk. They started to impose their rule and suppress anything that deviated from their ideology. For the population it was not really an improvement. In any case it didn't last because in September the city fell to the White Russian forces of Balakhovich who were helping the Poles. They behaved very badly to the population, including murder, looting and rape. Only the next day did the Polish army arrive. Again it was the outside pressure and supplies that ameliorated the worst of the privations for the population.

The area was to remain part of Poland until 1939, but with the new borders the old trading routes could not be re-established. The timber trade, in particular, suffered and business of Isaac's Shoenberg's father would have collapsed if it hadn't already done so through all the wartime upheaval. However, there was now some hope of establishing communication with them again.

It is a sad reflection that technology usually develops more rapidly in wartime than in peace. This was certainly true of wireless technology which was utterly changed by the First World War. There were two main streams to this. The first was the development of thermionic valves or tubes as they are called in America. At the beginning of the war they existed but were hand made and unreliable. By the end they were in mass production and they now lasted for a usable length of time with dependable characteristics.

Some of the developments had been made by Henry Round working for the Marconi Company and others in France which had improved on American inventions at the beginning of the war. The Marconi Company held the Round patent and the rights to the French TM design. This formed a good basis for their post war work as now radio receivers used these valves to amplify the weak wireless signals meaning that greater distances could be worked or lower transmitter powers used.

The second stream was that the trend was now away from Morse transmission to speech; from telegraphy to telephony. For this the spark transmitters, which had been the mainstay before the war, were no longer suitable. These transmissions required the generation of a continuous 'carrier' wave which the spark devices were unable to do. There had been various approaches tried, such as the high speed alternator, but they were limited in the frequencies that they could produce and were not really the answer.

Once again it was Henry Round who provided the solution by developing some high power transmitting valves, the MT1 to MT5 range. With these he was able to construct very satisfactory telephony transmitters. Soon this was to be the standard approach to wireless transmitters. The company was still just about in the lead but the war had brought many more companies into the wireless business and there was considerably more competition than there had been before the war.

The company had also made considerable advances in receiver design and the work of Henry J Round, Charles S Franklin and George Wright produced a stream of innovations. It was the task of Isaac Shoenberg, and the department, to turn these into patents for the company. This was partly to ensure that the company could continue to use these ideas, and designs, preventing others from patenting something similar which would stop the company using the invention.

What Godfrey Isaacs was also keen to do was to use this body of patents as a commercial asset. It was even given a value on the balance sheet of the company. His plan was to use it as a competitive weapon to either hold other companies out of the market or license the technology to them so that they had to pay a royalty on everything they made.

The company was still focussed on communication between two points such as a ship to a shore station. However, there was another idea around. It had all started with the need to test the performance of telephony transmitters. Initially they had just read out some text, often the names of railway stations. Inevitably they soon got tired of this and tried using some music. This was either from records or even with live performers.

They were surprised by the reception to this when experimenters and ships operators sent in appreciative reports. Gradually the idea of broadcasting was beginning to take hold, but the Company still saw its business in point to point communication. However, when the Dutch experimental station PCGG started to transmit concerts from the Hague using Marconi equipment, ideas began to change.

The Daily Mail newspaper was keen to promote new technology and arranged to sponsor a concert with Dame Nellie Melba, the famous Australian soprano, from the company's works at Chelmsford. On the $15^{th}$ June 1920 this took place after some serious work to improve the acoustics of the 'studio' and the performance of the equipment. It was a tremendous success with letters of congratulation coming from all over Europe as well as from Persia and St Johns, Newfoundland. The signal was so good at the Eiffel Tower station in Paris that they made gramophone records of Dame Nellie Melba's singing.

There was one problem with all this, and that was that they were operating with an experimental license from the Post Office which controlled all the air waves. The Postmaster General, Frederick Kellaway, was not keen on this sort of thing as it might interfere with communications traffic. To begin with he shut the transmission down, and then only partially relented. Eventually, in 1922, after pressure from the amateur radio enthusiasts, he allowed transmissions to restart and the company set up a station with the call sign 2MT at Writtle.

Soon afterwards the company received another license which allowed them to set up a station with the call sign 2LO which transmitted from Marconi House in London. There were all sorts of restrictions on this such as not giving publicity to the broadcasts. What Kellaway was concerned about was that if he gave permission to one company many others would want a license as well and so the air waves would be crowded and chaos would ensue as it largely had done in America.

He put a proposal to the companies in the industry, who were interested in this subject, that they should get together and set up one broadcasting network. It was in their interests to do this as then they would have a market into which to sell radio receivers. After a considerable amount of arguing the British Broadcasting Company Ltd was formed by six of the big manufacturers but particularly involving Marconi's Wireless Telegraph Company. Any other bona fide British manufacturer could also become a member of the company by making a payment and taking at least one share.

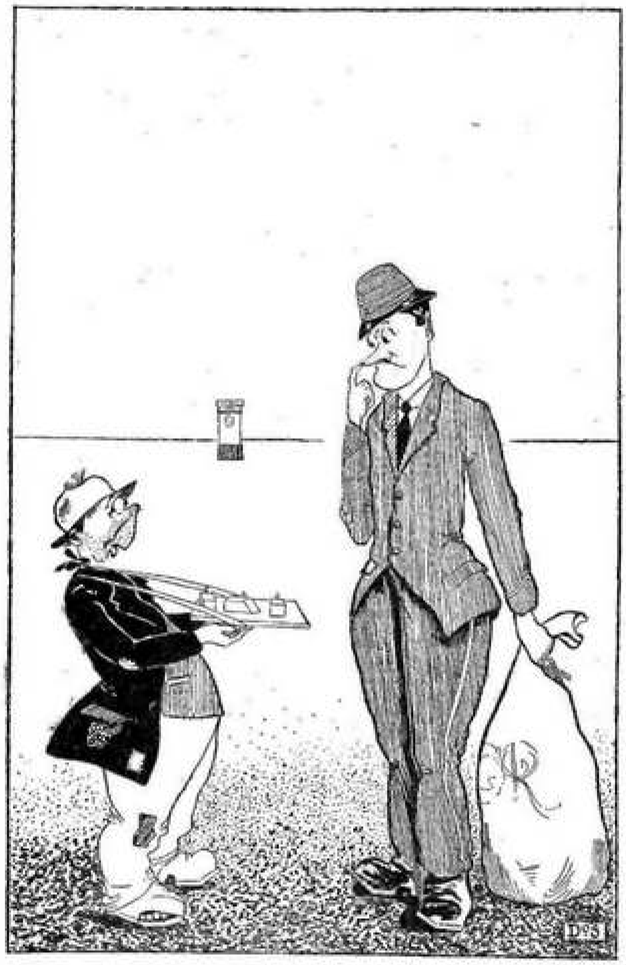

Fig 7.1 The stamp fixed to the approved receivers

The Post Office charged users of radio receivers a licence fee of 10 shillings (50 pence) to have a receiver which had to be of an approved type from one of the members of the company, which carried a distinctive label. These manufacturers also had to pay approximately 10 percent of the price of the receivers they sold to the company. There was also a ban on foreign manufacturers selling sets in Britain. Thus the whole matter was tied up to the satisfaction of those involved.

The BBC Ltd took over the 2LO station in November 1922 and within a few days three other stations were on air. The number steadily increased to nine stations before the end of 1923. This was all a risk as it might have been a nine day's wonder. However, they needn't have worried as the take up of receiving licences was so fast that the Post Office couldn't keep up. By March 1923 the Post Office had issued 80,000 licenses and was sure that there were many with home built receivers that were not paying the license fee.

In 1922 the Marconi Company set up a Marconiphone Department to make receivers and they were sold under the Marconiphone label. By the end of 1923 this had been converted into a subsidiary, the Marconiphone Company. Initially the sets had been made in Chelmsford but rapidly they were overwhelmed by the demand and mass production was set up at the Sterling Telephone Company's works at Dagenham.

'The Great Question'



Postman to Hawker: "'M yes! But can you guarantee that your mousetraps are entirely free from Marconi patents?"

Fig 7.2 Cartoon poking fun at the Marconi patent stranglehold

Of course, the Marconi Company held many of the key patents and they now saw the opportunity to exploit them. To help with the setting up of the BBC Ltd they decided to give the company free use of their patents to enable them to erect the transmitters. This wasn't quite as generous as it appeared as seven of the first nine stations had Marconi equipment. They were in a strong position to take most of this work and appearing generous was a good tactic.

The sting was in the arrangements with respect to the receivers. Here was the chance to really exploit the patents. The Marconi Company would grant a license to any bona fide manufacturer that was a member of the BBC Ltd to use all the appropriate patents necessary to manufacture the receiver. The charge was 12 shillings and six pence (62.5 pence) for each valveholder in the receiver. At the time this was a considerable sum of money, particularly as receivers with more and more valves became popular. For example the Marconiphone V2 receiver, with two valves, was selling for just under £20.

What the patents department had done over the years was not only to ensure that they tied up as much of the wireless technology as they could with their own patents, but also made arrangements with other relevant patent holders in other countries to ensure that they had the rights for Britain. Marconi, at the Shareholders meeting in 1922, made it clear that the patent position 'also covers for many years the right, in the whole of the British Empire and elsewhere to any inventions of the other important wireless corporations of the world'[2].

It was interesting that the announcement of the subsequent arrangements, without of course the detail of the charge, was made not by Isaac Shoenberg, but by Adrian Simpson. He had reappeared after the war, now a Colonel and became a director of the Marconi's Wireless Telegraph Company. He was also the Deputy Managing Director of the Company. This was good news for Isaac Shoenberg as Adrian Simpson had considerable confidence in him after his work in Russia.

Once the initial teething problems had been ironed out, radio (as it was now called) licenses were rising at between 250,000 and 600,000 a year. Many of these sets had more than one valve so the revenue to the Marconi Company was very considerable. Isaac Shoenberg's department had changed from largely a cost to the company, though the patents could be exploited to keep other companies out of a market, to one that was now a significant revenue earner.

He was obviously feeling more settled in England, and the family had given up all thought of returning to Bolshevik Russia, because be became naturalised in October 1922[3]. With him, Mark, Rosalie, Alexander and David were also naturalised. Elisabeth had been born in London so she had British nationality anyway. Esther didn't need to formally do anything because under the law at the time the wife was deemed to take the nationality of the husband! Thus she automatically became British with the rest of the family.

The children had easily assimilated to the new environment, with the change of language not holding them back. It was just as well he had been promoted and was now earning a good salary as they had decided to send the children to fee paying secondary schools, though there may have been some scholarship help. The boys, when of secondary school age, went to the Latymer Upper School in Hammersmith while Rosalie went to the Godophin and Latymer School for Girls, also in Hammersmith.

By 1921 Mark was showing promise and obtained a school certificate, a sort of prize, for mathematics, which must have pleased his father. This was even trumped when in 1923 Mark won a scholarship to St Catherine's College, Cambridge with the subject being Mathematics. This was quite an achievement for someone who had been nine when he came from Russia, only nine years before, and had to learn a new language.

In 1924 Mark was still living up to his promise when he achieved a first class result in the mathematical Tripos Part I. This led to the extension of his scholarship for another year, which must had lessened the financial burden on his father who was now having to support more of his children as they entered secondary education.

Following on from Mark, Rosalie was also showing promise. In the same year she obtained success in the London Intermediate Science examination. The trend for more scientific subjects amongst the children was becoming clear, though, in time, Rosalie's interest veered away from the mathematics and physics in a slightly different direction as later she took up medicine.

Fig 7.3 Isaac and Esther with her four of their children 'relaxing' on a beach in the early 1920s

In 1924 there was a rather bizarre event in Isaac Shoenberg's life; he was called as an expert witness in a murder case. A Frenchman Jean Pierre Vaquier was on trial for the murder of Alfred Poynter Jones who was the landlord of the Blue Anchor Hotel in Byfleet. Vaquier it seemed had been rather friendly with Mrs Jones after he had met her and her husband in Biarritz in France. She had claimed that she was leading a terrible life with her husband.

However Mr Jones suddenly died in the Blue Anchor Hotel and a post mortem had shown a considerable quantity of strychnine in his body. The prosecution had found that Vaquier had purchased some strychnine and some other chemicals shortly before the death. However, he had claimed that he had purchased the chemicals for some experiments in wireless telegraphy.

Isaac Shoenberg was called to give evidence that strychnine was not used in the manufacture of wireless parts that he knew of. He had never heard of it. He was familiar with patents in other countries with regard to wireless, and to his knowledge strychnine did not enter into any of them[4]. Thus the case against the accused was pretty damming and the magistrates had no difficulty in committing him for trial.

What this had shown was that he was now an accepted member of the management of the company for them to put him forward for this. He must also have felt that he had become a respected member of society in England to be called as an expert witness. He had been in the country for a decade and now he and his family had settled down and were quite at home.

[1] Aerial July 1919
[2] Times 16 August 1922
[3] London Gazette 3rd Nov 1922
[4] Times 5 June 1924

# 8 Joint General Manager

In the mid 1920s there were considerable changes in the management of Marconi's Wireless Telegraph Company. It was triggered, initially, by the resignation of the Managing Director Godfrey Isaacs 'on his doctor's orders' in November 1924. His troubles were, at least partly, due to overwork. He had been the Managing Director and Deputy Chairman of the Company for 15 years and had also held positions in many of the associated businesses and also in the British Broadcasting Company Ltd.

He had been employed by Marconi to implement his overall plan for the company. This had two strands; to invest, innovate, and patent so that they kept ahead in the technology. The other was to spread the Marconi system into a worldwide network. Isaacs' role in this was to provide the finance, and there was no doubt that he had the skills to do this. There was less concern to keep the shareholders happy.

Part of the process had been to invest in a large number of other companies; the purchase of a majority of the shares in the Russian Company had been a good example of this. But like that case, not all the investments had worked out. In addition to revolutions there were currency shifts and sometimes simply the failure of a project to succeed. The net result was that many of these investments had resulted in a considerable loss.

This meant that when the company's accounts were made up there was a need to write off these losses. This was one of the places where Isaacs' skill came in and he very carefully wrote off some of the losses, but not so much as to endanger the company and make it impossible to continue with the developments they thought necessary to progress the technology. In the future those advances would be turned into products and then into money, so it would all come right in the end.

There had been some sticky times, but he had managed to keep all the balls in the air for fifteen years. Now he was unable to do that any longer, the strain had just been too great and it was someone else's turn. The trouble was that there was no one who could take on this task and run it the way he could. Things were not going to be the same in the future.

The managing Directors position was taken by Frederick Kellaway. He had already had a career in politics as he had entered parliament as the Liberal MP for Bedford in 1910. During the war, for a time, he was the Joint Parliamentary Secretary to the Ministry of Munitions which was a very stressful position. After the war he was promoted to be the Secretary to the Department of Overseas Trade.

However, after the 1921 election he became the Postmaster General and in that position he displayed some business capability as he managed get the Post Office to earn more income than its working costs for the first time since the war. Perhaps more notable was that he had also been responsible for the negotiations which led to the setting up of the British Broadcasting Company and establishing radio broadcasting in this country.

His tenure of that office was brief as in November 1922 Lloyd George's government suffered a disaster at the polls and Kellaway lost his seat. What caused raised eyebrows, and some comment in the press, was that within days he was made a director of Marconi's Wireless Telegraph Company. This all seemed rather cosy, but the fuss died down and two years later, here he was as the Managing Director.

The next thing that happened was that William W Bradfield, one of the Joint General Managers, who had not been well for some time, was finally persuaded at the end of the year to go and seek medical help. He went off to spend some time in

Switzerland in an attempt to restore his health. The other Joint General Manager, Henry W Allen, had given up the post the previous year and been replaced by Isaac Shoenberg's old friend Andrew Gray.

Both Isaacs and Bradfield had left it too long and they were both to die not long into 1925. Bradfield succumbed first on the 17th March and Isaacs exactly a month later. Amongst other changes the board of the company was now more dominated by accountants and lacked the engineers and linguists that had been the dominating faction ever since the foundation of the company. In a technology company with many overseas interests these were the relevant skills.

Isaac Shoenberg was promoted to the vacant Joint General Manager position, but he also retained his oversight of patents. He had turned himself into an expert of patents and was far too valuable to let go from that duty. That was particularly so as the department was now a considerable revenue earner with the royalties from the broadcast receivers. As the Post Office was issuing licences at rates of anything up to 10,000 a week this had to translate into sales of receivers. Though the average number of valves in the receivers isn't known, a conservative guess is that is more than one, so a revenue of £5,000 to £10,000 per week is not unreasonable.

Fig 8.1 Frederick Kellaway

Isaac Shoenberg was now involved at a higher level in a company where things had changed. Kellaway had insisted on the setting up of a finance committee even before he became managing director. Its function was to examine the investments and ascribe a realistic value to them, particularly as many currencies had slid, hence devaluing the investment. The committee also busied itself with the general costs of the company with a view to reducing them. Kellaway took a strong line on all these matters, and was far more interested in getting the books straight than in the technical advance of the company.

Fortunately Marconi and Franklin had completed some important research on the use of shorter wavelengths for communication and the use of directional aerials hence producing a 'beam' of signal in the direction of the intended receiver. They had discovered that this could produce reliable high speed communication of great distances such as to Canada or Australia.

This 'Beam System' formed the basis of the next stage of the company's development. It had been Marconi's dream to produce a worldwide, or particularly Empire wide, chain of wireless stations to link the countries together. He was now able to begin to build this. The 'Beam system' had another advantage in that because the signal was concentrated in one direction it was generally more secure.

Isaac Shoenberg was concerned with his own finances which had again improved with the promotion. Also in 1925 he was able to finally pay off the loans that he had received back in 1914. Because there had been some dividends on the shares in 1914 and 1915, he ended up with the company paying him 13 pounds 13 shillings and eight pence to settle the account[1]. It was suggested that the 150 shares in the Russian Company were returned to him. However, he left them with the Marconi Company because in reality they were worthless.

When Semyon Aisentein had finally managed to get away from Russia in 1921 he had managed to save some important documents which supported Marconi's Wireless Telegraph Company's claims to recompense for the loss of the Russian Company. In 1922 he lodged these with them[2] and there was still some vague hope that some compensation might be extracted from the Bolshevik Government in Russia. As time went on this was getting less and less likely. Had anything been forthcoming Isaac Shoenberg, as a shareholder would have been entitled to a very small part of this.

Matters were also progressing with the family. Rosalie had gone to study medicine at the Royal Free Hospital in the Grays' Inn Road in London. She was also registered at King's College Faculty of Medical Science as an occasional student. This was a common system for them to teach some courses to students from some of the hospitals. As another of the children born in Russia she had adapted to the English education system and thrived in it. David was also doing well at the Latymer Upper School and was starting to win form prizes. Alexander, though, seemed to be less academic than his siblings, but was progressing satisfactorily.

In 1926 Mark took his finals for his degree in mathematics at Cambridge. As he had won a scholarship to study there and had been placed in the first class for his part 1 of the Mathematics Tripos there were expectations of this achievement continuing. However, when the results were published his name didn't appear amongst the Wranglers, those awarded the first class degrees, or even the Senior Optimes, the second class.

Only amongst the Junior Optimes, the third class, was his name to be found[3]. Something had gone wrong and he had slipped badly from what had been expected of him. However, though the initial reaction must had been of disappointment, he had achieved an honours degree from Cambridge, and could put BA after his name. Considering his history that was still a considerable achievement.

Contact had reliably been achieved with the families back in Pinsk and Isaac Shoenberg's brother David came to England in 1919 and lived with them for a time. His youngest sister, Zlata, who was 20 years younger than him, came to England at some point in the mid 1920s. Their surnames were now spelled the Polish way as Szejnberg, but they rapidly adopted the same spelling as the rest of the family in England.

Neither was to marry and they never returned to Pinsk except for an odd visit. Zlata was to live with them for the rest of her life, as the much loved aunt to his children. In 1933 she became naturalised as British. For many years she was on the staff of Collet's Russian Bookshop in Bloomsburg. She was later to teach and translate classical authors from the Russian. David also became naturalised in 1936 and worked as a translator.

A measure of the family's financial stability and their absorption into English life was that they also had holiday home built; Friston Cottage in the village of that name near Eastbourne. It was somewhere to escape from the bustle of the city and relax away from the cares of the business. Being not far from the sea there were beaches within reach, though by now most of the children were past the sandcastle stage, but Elisabeth had still not entered her teens. Later it was to become somewhere to escape for the whole family of children and grandchildren.

His daughter Elisabeth described him, when not at work, as ‘immensely unsociable’, and almost impossible to get to go to a party.[4] However he was much more relaxed when he went to the cottage and there would share his record collection with friends, go for long walks and work in the garden. He would often go for the weekend as a total change and relaxation from the strains of his work.

At work things were not so happy for Isaac Shoenberg. Kellaway was determined to bring the finances of the company under control and stop some of the more adventurous things that had been happening. He went on an economy drive which always creates an uncomfortable environment to work in. As a Joint General Manager Isaac Shoenberg would have to implement some of these policies, and as an engineer he would be able to see that some of them were counterproductive.

Kellaway was very keen that the ‘Finance Committee’, that he had set up, should control expenditure with the aim of reducing it substantially. At the Annual General Meeting with the shareholders on 1st August 1925 he said: ‘Expenditure in this company has, however, got to come down and come down substantially, not only because it is essential in the interests of shareholders, but where extravagance exists it is inevitably accompanied by inefficiency. Your directors are determined that the expenditure of the company shall be got down to the lowest figure consistent with efficient business administration.’[5]

This seemed to say more about the man than the state of the company. He was still talking more like a politician in charge of a government department than someone trying to run a business that lived by remaining ahead of the field in a fast changing technical world. No doubt, to the outsider some of the things that went on in the company appeared chaotic, but the nature of innovation is not one of tidiness. One crazy idea or development could change the course of the company as the ‘Beam System’ had shown. He was in great danger of killing the golden goose.

Kellaway, at the Annual General Meeting, was just warming up. His real venom was now aimed at the valuation of assets: ‘On the subject of what I would describe as the excessive figures at which certain interests of the company stood in our books, and so made up the great reserve which figured in our accounts three or four years ago, I would say this. A paper reserve is worse than no reserve at all.’

This was a very puritanical view of the subject. It presupposed that it was possible to ascribe an exact value to an asset, whereas in reality it was often a matter of opinion. Even when there was a shareholding with a market value, either that or the exchange rate could alter on the following day. Matters like the value of patents, was very difficult to determine and so this exercise was unsound if not actually foolish. Gone was the subtle manipulation of Godfrey Isaacs.

This was a backward, accountancy, view in a business that was about the future. It was far more important, as Marconi himself had always recognised, to research and invest in the next technology than to count the pencils and paperclips. If the company was about anything it was about creating its future. That future didn’t look bright with someone with those attitudes at the helm.

The situation got worse as Kellaway instituted an investigation by an outside firm of accountants in conjunction with the auditors. The report took six months to prepare and ran to 400 pages. It suggested that the company’s interests were far too wide. That was undoubtedly true in some cases where things had be bought at times for reasons that seemed correct at the time, but were no longer so. However, the policy of Marconi in building up interests around the world, with a view to dominating Wireless Telegraphy was sound, though in some cases messy.

Kellaway's changes took time, and with the report taking time arriving, the results for 1925 were delayed from their usual time in the summer of 1926 to March 1927. He was then able to report that his changes had brought everything under control. All this had certainly done considerable damage to the company's reputation and could have been handled in a more subtle manner and without the collateral damage.

A few months later Marconi himself resigned from his position as Chairman of the company and the Rt Hon. Lord Inverforth took over. It meant that he could spend more time on what he really liked, which was the technical research work. He remained an ordinary director and was now the Technical Advisor to the board. The change would suggest he wasn't entirely happy with the direction things were taking.

As the Radio industry had expanded, the matter of the royalties on the sets was becoming more complicated. Isaac Shoenberg, and the company, took the view that all radio receivers that contained valves infringed their patents, though they never made it quite clear which patents applied. This caused a certain amount of discussion and queries in the industry, but on the whole the position was accepted.

An area of concern was the construction of sets by 'amateurs'. Originally the company had taken the line that while these still infringed the patents they would not apply the royalty as a concession. Probably this was as much to do with the difficulties of collecting these small sums rather than being generous, though it was useful to appear so.

The problem had come with people who could not really be called amateurs, buying kits of parts and assembling them. Did the royalty need to be paid in this case? Isaac Shoenberg was quite clear; the royalty should be paid by the seller of the kit[6]. But then people asked; what if the kit was made up from parts from several suppliers. The situation became more and more complicated as the industry developed. Holding the line in this increasingly grey area was getting more and more difficult.

By 1927 even those who were paying the royalty on the sets they produced were starting to kick back at the level of the charge. What had changed was that as the price of valves and other components gradually fell, and the set makers became more efficient, it was now possible to make sets at lower prices. One manufacturer was complaining that he could make a two valve set to sell at £5 but he was forced to add 25 shillings (£1.25) to it to pay the Marconi Royalty on this.

Another was saying that his two valve set sold for £7 17s 6d (£7.87) which included the 25 shilling Marconi Royalty which was now such a large proportion of the price. The Royalty level was acceptable on some of the expensive sets selling for £30 or £40 but it was far too high on the cheaper sets. The suggestion was that there should be a different level of charge for the low cost receivers. The argument ran that this would enable the sets to be sold more cheaply which would increase the number sold and so the Marconi Company would still receive the same amount of money.

Another supplier proposed that the royalty should be a percentage of the selling price of the set. This even culminated in the Brownie Wireless Company going to court to get the royalty reduced. In the background was another problem in that some of the patents would expire soon and then the whole situation would get even more complicated. It was becoming more and more difficult to hold the line. Isaac Shoenberg could see that this lucrative position was not going to last for very much longer.

In this atmosphere it would hardly be surprising if Isaac Shoenberg was looking for another position away from the Marconi Company. He had made himself a recognised expert on patents and that was a marketable skill, but with his natural caution he would look around carefully before he jumped. It is easy to think that the grass is greener on the other side.

It was around this time he first met a man called Louis Sterling who was the managing director and driving force of the record company Columbia Graphophone. The two men met as they had business dealings with each other over patents. Louis Sterling was to say later that Isaac Shoenberg asked him for a job, and he said yes, but had no idea what to do with him.[7] He knew he was a brilliant scientist, particularly in the electronics field and felt sure he would be an asset, particularly as Columbia were looking at going into radio receiver manufacture.

Early in 1928 Louis Sterling decided that at least Isaac Shoenberg could look after the patents for his company. There was also the possibility of further involvement in other aspects of the business. As Columbia was a very profitable and dynamic business and the two men got on well, this was very tempting. It looked a better proposition than continuing to work under Kellaway's regime at the Marconi Company. No doubt Isaac Shoenberg examined this gift horse very carefully before deciding what to do.

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1 Marconi Archives, Oxford, MS Marconi 197
2 Marconi Archives, Oxford, MS Marconi 197
3 Times, 24 June 1926
4 Letter Elisabeth Shoenberg to Professor McGee, Shoenberg Family Archive.
5 Times 1 Aug 1925
6 Wireless World 3rd February 1926
7 Interview with Sir Louis Sterling 1957, Shoenberg Family Archive

# 9 Columbia

Isaac Shoenberg handed in his notice to Kellaway. He had made his decision to join Louis Sterling at Columbia Graphophone, which again was a calculated risk. Things were deteriorating at Marconis while Columbia was a profitable and go ahead company. However, Kellaway still needed his expertise on patents and on 9th February 1928 they signed an agreement that after he left he would still act as an adviser to Marconi's Wireless Telegraph Company in addition to his work for Columbia[1]. They didn't see that there was any conflict of interest here as the two companies were in different businesses.

It wasn't until 1st September that he started at Columbia working at their research offices and studio in Petty France, Westminster[2]. It would seem that he had to give six months notice, which would not be unusual for someone of his seniority. He was still with the Marconi Company towards the end of July but maybe he took a break between the jobs. By the time September came round he was undoubtedly ready for a fresh challenge. He had been with the Marconi Company for 14 years, working his way up, but there was nowhere left to go. To progress he needed to move somewhere else and so keen was he to make the change that he accepted the same salary as he had been receiving[3].

Louis Sterling had been born in 1879 in Kovno, which is now called Kaunas and is in Lithuania, but was then, like Pinsk, also part of the Russian Empire[4]. Three years or so later his parents took the family to New York, presumably to avoid the anti Jewish pogroms that followed the murder of Tsar Alexander II.

Fig 9.1 Louis Sterling in 1914

In 1903 he came to London with very little but soon proved his worth as a salesman. After a chequered career with some early record companies, largely trying to sell cylinder records when discs were steadily taking over, in 1909 he became the British sales manager of the American Columbia Phonograph Company.

During the First World War the record companies suffered falling sales but Louis Sterling boosted Columbia's in Britain with orchestral recordings and particularly patriotic songs. He had worked himself into a very important position particularly when the company was converted to a British subsidiary, the Columbia Graphophone Company Ltd, though still owned by the American parent.

In the recession, just after the war, the American parent company was in deep financial trouble. In 1922, Louis Sterling organised what today would be called a management buyout. He arranged for his investment partners to purchase the British company from the American parent and install him as the Managing Director. He was now completely in charge and set about driving the company forward.

Around this time Bell Labs, the research facility of the huge American telephone company, was looking into electrical recording. Up to this point all record masters had been made with mechanical cutters that depended on all the performers producing a sufficient volume of sound straight into a large horn. This was connected directly to the actual cutting head and was difficult to arrange for a large body of performers and the results left a lot to be desired.

Fig 9.2 The composer Edward Elgar making a mechanical recording with an orchestra. The horn from the cutter can be seen on the right.

A team at Bell Labs did considerable work on microphones and electrical amplification but the key item was the development of an electrically driven cutter around 1923. This had been designed using electrical circuit theory derived from telephone filter work. The result was patented by Joseph P Maxfield and later improvements to the damping system by Henry C Harrison. The total system was then passed to Western Electric, the manufacturing arm of the company, who made some test recordings.

The telephone company wasn't in the record business and so in 1924 they decided to licence the cutters to companies that were. The two to whom they offered it to were the Victor Talking Machine Co and the American Columbia Phonograph Co. As they required $50,000 up front payment and then a sizeable royalty the companies didn't jump at the opportunity. Columbia was in no fit state as it had been bankrupt twice and only survived after reorganisation.

Somehow, and there are various stories about this, around Christmas 1924 Louis Sterling got to hear some of the test pressings and realised that the quality was so superior that this was going to change the industry. He was determined that he should reap the benefit. However he discovered that Western Electric would only license the system to American companies, perhaps concerned whether they had sufficient patent protection in other countries.

Louis Sterling's next move was to arrange with his investor partners to buy the American Columbia Phonograph Company and also to ensure that it had a license for the Western Electric recording system. Thus the American Columbia became a subsidiary of the British Columbia Company, a complete reversal of the position some three years before. Louis Sterling had also got access to the new electrical recording system for the British company which now also had subsidiaries in a number of other countries. It was quite a coup.

When they heard, Victor, which owned The Gramophone Company, of His Master's Voice fame, in the UK also took out a licence. Both companies only slowly transferred to electrical recordings partly to use up the stocks of old recordings made on the mechanical process. The only downside was the substantial royalties which they had to pay on every record that they pressed that was derived from a master cut with this process.

The royalties were on a sliding scale, but only reduced for the second 5 million units, and then for the third and so on. As Columbia were now pressing anything up to 2 million records a month they were having to pay a royalty of something in the order of £20,000 per year. At the time this was a very substantial sum and it no doubt exercised Louis Sterling's mind a great deal as to how he could avoid this.

It is said that Isaac Shoenberg discussed his ideas on recording with Louis Sterling, but as they already had a reasonably satisfactory system it is difficult to know what that could have been, except that remembering that Isaac Shoenberg was a patent expert, it is likely that he suggested that a way could be found to cut discs without infringing the patents. That would mean that no royalty needed to be paid.

Maybe he already had some ideas on how this could be done. It was convenient that Joseph P Maxfield's patent on the basic cutter, though filed in 1923 was finally issued in March 1928. Also Henry C Harrison's improvements filed in 1924 were issued in May of 1928. Thus by the time the Isaac Shoenberg started at Columbia he could have obtained copies of these key patents and the published descriptions of the system.

In the first few months at Columbia he was able to study this problem and no doubt came to a conclusion that the patent could be avoided and, at least in principle, how it could be achieved. He must have shared this with Louis Sterling because in January 1929 he was made General Manager of the company but his real task was to engineer a recording system that didn't mean that the company was beholden to Western Electric.

His next move was to go looking for an engineer with a specific set of skills. This was a clear indication that he already had a thought out plan. The place to look for this person was in a telephone company because engineers there were likely to have those skills. The company he homed in on to try to poach staff was Standard Telephones and Cables (STC) where he managed to obtain the names of a number of apparently suitable people. Already working for the company was I L Turnbull who had worked at STC.

The one that came to his notice was E K Sandemann who, besides being involved with telephone systems had some experience with record cutters. He seemed ideal, but when approached was not interested. However a couple of more junior people applied for the job and the one that came more strongly recommended was Alan Blumlein. He and Turnbull had been contemporaries at Imperial College. This must had been seen as a positive indicator to Isaac Shoenberg as this was the same department of Electrical Engineering where he had spent a year himself.

In his application Blumlein had said: 'I believe my ability lies more in sound understanding of physical and engineering principals [sic] than in the knowledge of telephone engineering obtained by meticulous reading.' Here was a young man very much to Isaac Shoenberg's taste, and he seemed to be what the task needed. He offered Alan Blumlein the job, but he responded that he might not be wanted because of the salary he required. He named a rather high figure, but Isaac Shoenberg responded by offering him more. He had his man. It was a decision he was never to regret.

Alan Blumlein was born in 1903 in London to a mining engineer father from Alsace and a mother from South Africa. In 1923 he obtained a first class honours degree which was biased towards electrical power distribution and utilisation together with electrical machines. However, he stayed on at the City and Guilds College as a demonstrator in a telephone engineering course before entering the telephone industry. He had thus obtained a very wide background right across electrical engineering.

At the beginning of March 1929 Kellaway was still swinging the axe at Marconi's Wireless Telegraph Company and he decided to sell the Marconiphone radio manufacturing business to The Gramophone Company (HMV). Isaac Shoenberg was furious as the patent agreement they had signed meant that his advice could leak to Columbia's direct competitor. He sent a blunt letter to Kellaway demanding to be released from the agreement and be informed within three days[5]. He received a bland reply releasing him. It also led to the return of those worthless shares in the Russian Company. So ended his involvement with the Marconi Company; at least for now.

Alan Blumlein set to work to try to find a different approach to the record cutter. No doubt he had many discussions with Isaac Shoenberg as the point of the exercise was to find something that didn't infringe the patents, and that, of course was his expertise. There was a secondary objective and that was to produce something where they could obtain patents to protect what they did.

Quickly, Isaac Shoenberg strengthened the team by employing Henry A M Clark a young engineer virtually straight out of college, and also adding Herbert E Holman who had been with the company for a few years. He was starting to use the skills he had learnt from Andrew Gray at Marconi in getting the best out of his staff by carefully fitting them into the roles that most suited them and putting teams together to tackle a particular problem. It was noticeable that Alan Blumlein had not shone up to this point but he was rapidly to start doing so in this favourable environment. It was Isaac Shoenberg's job to create that environment.

After considering some more outlandish ideas, they came back to the basics of the cutter problem. To convert an electrical signal into the movement necessary at the cutting head needed a coil of wire and a magnet or magnetisable material such as iron. There are two fundamental ways of doing this: with the coil on the outside and the iron moving, known as moving iron; or the coil moving and a fixed magnet on the outside.

The Bell or Western Electric (WE) system used the moving iron configuration. This had the advantage that in principle it was easier to construct, but had two disadvantages. The first was that it was non-linear; the same change in the electric signal at different levels didn't produce the same change in movement. This meant that the loudness of the recording didn't correctly follow the magnitude of the electrical signal.

The second disadvantage was that, like all moving systems that have springs and mass, it tended to bounce about and needed some form of damping to faithfully reproduce its input. In a moving iron system this has to be provided mechanically and the WE system used a complicated rubber arrangement which needed adjustments for best performance, was not calculable and was never completely satisfactory.

Isaac Shoenberg and Alan Blumlein settled on a moving coil solution which immediately avoided the patents. It had another great advantage in that the damping could be applied electrically and hence became calculable and consistent. The difficulty was to design such a system where the signal had to be passed to the moving coil which had to be very light to achieve the high frequencies needed in the recording.

The team found clever solutions to this and a highly satisfactory cutter design ensued. The work didn't stop there as they needed also to replace the microphones used in the WE system and the electronics between them. It was quite a task for such a small team.

Alan Blumlein had an approach to his work that items should be 'designable' on paper and should perform in the expected manner. He was keen to work from 'first principles' of basic physics or engineering to produce the results. Isaac Shoenberg would carefully question him to ensure that all aspects had been fully thought through, and also so that he thoroughly understood what was happening. He could then make any strategic decisions that were necessary and watch that they stayed clear of existing patents.

By the autumn of 1929 work was well under way and little more than a year later they were ready to test their new cutter complete with a new microphone also based on moving coil principles. They had also, of course, designed the electronics to connect the two. When tested its performance was noticeably better than the WE system, particularly where piano music was concerned. This small team had engineered this system in a fraction of the time that Bell labs had taken, and produced a series of patents and a superior product. Crucially it was also free of the American patents.

It must have been a source of pride to Isaac Shoenberg that another son, David this time, was showing the same prowess in mathematics. He won the school prize at Latymer Upper School for mathematics in 1928 and later the same year won a scholarship also in mathematics to Trinity College in Cambridge. In 1929 he took up his place and the following year achieved class I in his Mathematical Tripos part I and the extension of his scholarship. There must still have been a certain amount of concern whether history would repeat itself.

Meanwhile in 1930 Rosalie successfully took her final examination in Medicine for the conjoint board of the Royal College of Physicians of London and Surgeons of England. She still had to do a further year of training to receive her diplomas LRCP and MRCS qualifying her as a physician and surgeon. As another one of the family who had come from Russia she had managed to negotiate a different educational system and thrive within it.

Around this time the family moved again. They had been at 98 Abinger Rd for nearly fifteen years but they now moved further north to 203 Willesden Lane. The house has now been pulled down and replaced by flats, but judging by the adjacent buildings, which appear original, it was quite large. The extra space was probably needed because Alexander and Rosalie still lived at home and Mark had returned. Elisabeth was still a teenager and then there was Isaac Shoenberg's sister Zlata and probably his brother David. Son David was, of course, at university but would return in the holidays. It was quite a houseful.

In the autumn of 1929 there was the collapse of the American stock market due to foolish speculation – the Wall Street Crash. Though the effect in the United States was quite rapid it took longer for its ripples to move outwards to other countries. For the record companies the situation was serious because they were also under pressure from the rise of radio and the new talkie films.

Even the efforts and skill of Louis Sterling were insufficient to halt the decline, though it was less severe for Columbia than for HMV. The record industry as a whole saw its sales drop from 105 million units in 1929 to 31 million in 1931, and carried on down. It was obviously a time of serious retrenchment. Many of the record labels were swept away but the effect even at Columbia was drastic.

The company, in an attempt to control their costs, started seeking cuts in salaries. Isaac Shoenberg was asked to accept a 20% reduction in his. He wrote back to the company secretary accepting this, but as he needn't have done so as he was on a contract as a senior person with the company[6]. He did make a number of provisos, the main one of which was that if Louis Sterling ceased to be the Managing Director he would revert to his original amount. He clearly liked working for him.

Despite the company difficulties work continued on the cutters and other engineering work. Isaac Shoenberg obviously convinced Louis Sterling to protect this area because it held the keys to developments which could give the company a future. However, beyond their control there were moves afoot which would change everything.

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1 IET Archives NAEST 062/2/03

2 IET Archives NAEST 062/2/06 This is a later EMI contract but gives his starting date with Columbia.

3 IET Archives NAEST 062/2/05

4 Some sources say he was born in New York but those that have consulted Censuses or Passenger Lists agree he was born in Kovno

5 IET Archives NAEST 062/2/02

6 IET Archives NAEST 062/2/05

# 10 Seeing by Electricity

It is often stated that television was invented in the 1920s with the names of John Logie Baird in Britain and C F Jenkins in America as the claimed inventors. In reality the subject goes a lot further back. There were many steps necessary to produce a satisfactory television system and these were taken gradually over the best part of century before it was practicable to make a working system. Even then it took a tremendous effort of will and skill to turn it into a satisfactory reality.

Probably the first step was taken by Alexander Bain, the son of a crofter from Caithness, who became apprenticed to a clockmaker. In 1837 he moved to London to advance his trade, but soon became interested in the new field of electricity. His first invention was a way of electrically synchronising two pendulum clocks that were remote from each other. The next step was to use this as part of a device that could send a copy of a picture over a telegraph line. He took out a British patent in 1843, though he doesn't appear to have ever built it.[1]

It could only copy something that was made up of electrically conductive and insulating sections and the example he gave was a metal typeface, but having said that, it was brilliantly simple. A pendulum runs a small finger over a strip of the frame holding the partially conductive sample to be copied. After each swing a clockwork mechanism drops the frame a small amount and the pendulum's swing runs over a further strip. The process is continued until all the strips have been covered.

At the receiving end is a near identical device but here the finger on the pendulum passes over a material which changes colour when electricity flows through it. As it does this point by point, it builds up a copy of the image at the other end.

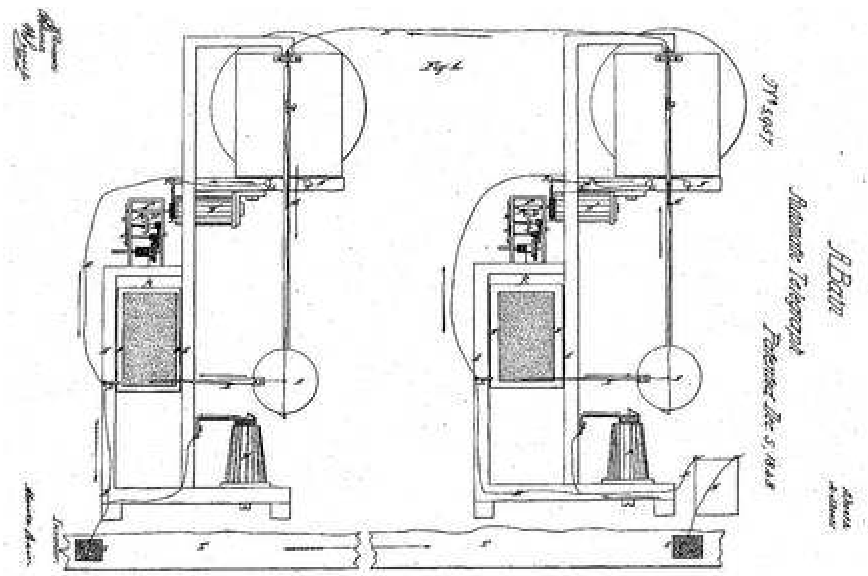

Fig 10.1 Alexander Bain's 'Automatic Telegraph' as he called it in his patent

Though it was going to be some while before satisfactory means of sending images were produced, the first essential step had been taken. Alexander Bain had invented the concept of 'scanning' which was a means of breaking up a picture and sending it bit by bit simply by looking at a strip at a time and working down the image until all of it had been covered. Bain had also understood another key point; the scanning at the transmitting and receiving ends needed to be kept in step or the result would come out a jumble. Some form of synchronising information also needed to be sent.

In 1866 Willoughby Smith and his assistant Joseph May were involved with a cable laying operation at sea. In setting up an arrangement to communicate from the shore to the ship while the electrical tests were conducted they needed a very high value resistor. To achieve this they tried thin rods of selenium, but found the resistance unstable. In 1973 Willoughby Smith wrote to the Society of Telegraph Engineers reporting the results of the investigations into this variability. It was sensitive to light.

It was a short step from this to produce a device which could vary an electric current in step with a change of light falling on it. In the early 1880s this led to a series of proposals on how to build a device for 'distant vision', all using selenium cells. All the experimenters soon discovered that the selenium cell reacted slowly to changes in light level and was nowhere near fast enough to deal with moving pictures.

The invention of the telephone partly stemmed from mimicing the diaphram in the ear, so it was natural for some to think about whether examination of the physiology of the eye would lead to some way of dividing up a picture to enable to to be sent. Unfortunately the eye works by having a vast number of sensors, and if there is going to be a reasonable number of dots in the image this rapidly becomes impractical. It was only by returning to Bain's idea of scanning could any progress be made.

The most significant of these inventors was the German Paul Nipkow who patented a disc with a spiral of holes in it in 1884.[2] With a selenium cell on one side and the item to be scanned on the other, the effect when the disc was spun was to produce a series of scans which worked their way down the subject. The cell output thus was a series of signals corresponding to the light intensity at the points on the scan. At the receiving end a similar disc was placed between the viewer and the light source which varied in time with the output of the selenium cell. His arrangement for adjusting the light source almost certainly wouldn't have worked and there is no evidence he ever tried to build the device.

In 1887 Heinrich Herz, as part of his investigations into the existence of electromagnetic waves, discovered that the size of his sparks was affected by light. Being a meticulous researcher he showed that this was only by ultra-violet light. He published his results and not wishing to be distracted from his main work effectively passed it over to others to investigate.

Wilhelm Hallwachs took up the challenge and soon proved that light did affect the electric charge on a metal plate. Many others including Arrhenius, E. Wiedemann, A. Schuster, A. Righi and M. A. Stoletow all contributed to the background of the interaction of light and electricity. Two German schoolteachers Julius Elster and Hans Geitel took this further and found that alkali metals such as sodium and potassium produced this effect with visible light. This led them to make a photocell.

The Elster-Geitel photocell was a simple device. In a glass envelope was a curved cathode of a film of sodium potassium alloy and a metal anode. With a voltage across the device no current would flow when it was in the dark, but the current would increase with the light shone onto it. Further research showed that alkali metals further up the periodic table, such as rubidium and caesium gave even better results. The great advantage of the photocell was that it responded almost instantly to changes of light compared with the sluggish response of the selenium sensor. However, it still wasn't very sensitive.

Up to the turn of the twentieth century the concept of 'distance vision' didn't even have a proper name. It was only in 1900 at the IV International Electrotechnical Congress in Paris when the Russian engineer Konstantin Persky delivered a speech in which he used the word 'television' for the first time. C P Scott, the editor of the Manchester Guardian, hated the word because he claimed it was half Greek and half Latin, and hence no good would come of it. Despite this distate for its etymology, the word gradually caught on, and it had become accepted by the time it was practicable to make such a device.

Once into the twentieth century it seemed likely that someone would have a serious attempt to make a practicable television system. It was a Russian of Swedish descent called Boris Rosing (Russians feature strongly in the story of television) who was the first, though he talked about 'electrical telescopy' in his 1907 patent.[3] He didn't use a Nipkow disc as the scanning arrangement in his 'camera' but a couple of multifaceted mirrors at right angles to each other, rotating at different speeds, and a photocell as the detector.

The receiver was a form of Braun's tube, an early form of cathode ray tube. The brightness of the spot was controlled from the output of the photocell, and the horizontal and vertical scans from signals generated by magnets and coils attached to the rotating mirrors. By 1911 he was able to demonstrate a practicable device. The disadvantage was that it needed three signals between the transmitter and the receiver, but this wasn't too great a drawback if it was used for what he envisaged which is what we would now call closed circuit television.

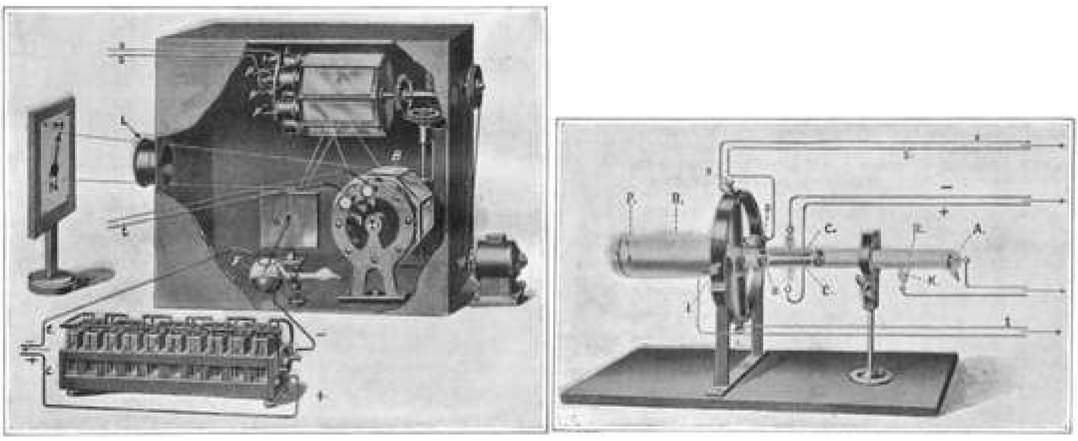

Fig 10.2 Rosing's mirror drum transmitter and his Braun tube receiver

In practice Rosing's device could do little more than transmit silhouette images, but at 40 pictures a second it was faster than the 12 images a second that had been found necessary by the cinema film makers to give a reasonable sense of motion. Though it was recognised at the time that it wasn't a complete solution, it was a useful step along the way. He had understood the need for a receiver that could respond rapidly and that an electronic solution was better than a mechanical one. What he didn't know how to do was to produce a transmitter following the same principle.

Almost at the same time there was a man in Britain who thought he knew the answer. He was A A Campbell Swinton, a well known consultant in the electrical field. As his contribution to a discussion on this subject he proposed that 'kathode rays' as he called them should be employed at both the transmitter and receiver.[4] Some form of cathode ray tube was needed at both ends.

He based his reasoning on a simple piece of arithmetic. To get a reasonable picture there needed to be something like 150,000 points (pixels in today's nomenclature) and this needs to be sent at least ten times a second (in practice rather more). Thus around one and a half million bits need to be sent every second. Even if quality is seriously sacrificed, and this is reduced to say 150,000 per second, it is still far too fast for mechanical systems. He argued that only the electron beams in cathode ray tubes could move at these speeds.

In 1911 he was to outline his ideas in more detail and he proposed a transmitter where light fell onto a grid of separate light sensitive cubes which were then 'read' by the scanning electron beam of the tube.[5] The scanning signals and the intensity were sent to the receiver which was much like Rosing's system. He admitted that it was only an idea, and that it would take a well equipped laboratory to develop it. Unlike most, he was remarkably clear as to what was needed.

There the matter largely rested until after the First World War. During that time electronics made huge strides and with the coming of broadcast radio in 1922, interest in the possibility of television gained ground. What was now the objective was not just 'seeing at a distance' but broadcast television in a similar fashion to radio. Inventors started to have a go to see if they could produce as system, but they hadn't taken note of Campbell Swinton's comments.

Probably the first was John Logie Baird in Britain, who in April 1925 demonstrated a silhouette system in Selfridges store in London. It was very crude with 30 lines and just 5 frames per second. Basically he had taken Nipkow's system and made it work. The main difference was that he used a neon lamp, invented since Nipkow's day, in the receiver which could change its light level fast enough to generate the picture. As he himself said, it was surprising that no one else had done it.

In January 1926 he demonstrated a working system, able to show shades of grey, to the Royal Institution in London. The picture, at the receiving end, was very small, only 1.5 by 2 inches and a dull pinkish colour, but a head was recognisable. Of course, at this scanning speed the flicker was very bad, but it definitely worked.

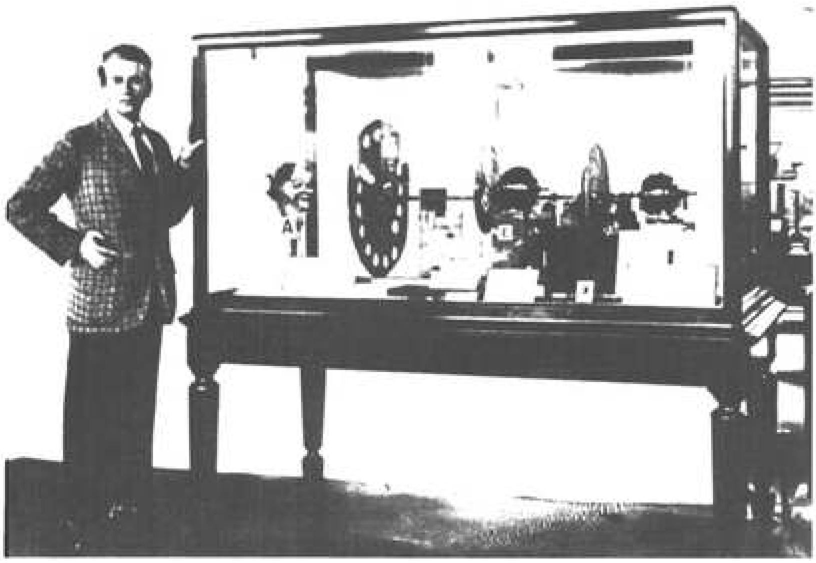

Fig 10.3 Baird with an early television scanner showing the Nipkow disc and the dummy's head he used

Another early one was C F Jenkins in America. In June 1925 he demonstrated a system which showed a slowly revolving windmill but it was only in silhouette. The information was, however, carried by a radio signal between the transmitter and receiver. As scanners at both ends he used elegant bevelled glass prismatic discs, but these were limited in the speed that they could be rotated and so only a picture of a few lines could be achieved.

Also in the US was, what at first sight, appeared a serious contender – Bell Labs. In 1927 they demonstrated a system using both wire and radio to connect the two ends. It was a mechanically scanned arrangement and achieved a 50 line picture at 18 frames per second. It was competent but though it had some merit for showing a picture of the person on the other end of the telephone it was nowhere near suitable for real television.

Baird didn't stand still. In 1927, he broadcast live television pictures from London to Glasgow by telephone line and in 1928, from London to New York using short-wave radio. This was where his skill lay; in publicising himself and television in general. Using the head of steam he had built up with the public, in September 1929 he was able to persuade the BBC to broadcast his television, but it was only after 11 pm when the normal radio programmes had shut down. This used 30 lines but at 12½ frames per second; just enough to give a reasonable impression of movement, but the transmitter could only broadcast sound or vision. The temporary solution was to have 2 minutes of vision followed by the sound.

Six months later signals were broadcast from the new London Regional Station at Brookman's Park, which could transmit both sound and vision simultaneously. By this time Baird had found backers and set up the Baird Television Company. They started selling the receivers, or 'Televisors' as he called them, manufactured by the Plessey company. Some of these were complete at about £26, and others sold as kits as many of those interested were radio experimenters. In all around a thousand were sold.

These were used in conjunction with a radio receiver, and were based around a Nipkow disc of about 20 inches in diameter and produced an image about 1.5 inches square. This was viewed through a lens in a rectangular opening to one side of the front of the set. Unlike most other experimenters Baird used vertical scanning instead of horizontal, which he claimed gave a better picture at this resolution.


Fig 10.4 Baird commercial 30 line 'Televisor' and the sort of quality of the image produced in the opening to the right.

While this was going on, others had taken notice of Campbell Swinton's message or come to the same conclusion. What was needed was an electronic camera based on some combination of the cathode ray tube and the photocell. First into the field was Vladimir Zworykin, another Russian, and even more importantly he had been a student of, and assistant to, Boris Rosing in St Petersburg.

In 1919 he went to America and it was there in 1923 that he filed a patent for a television system.[6] It was remarkably like Campbell Swinton's proposals and was so contested that it wasn't granted until 1938! He worked on trying to produce a system while employed by the Westinghouse labs, but they weren't interested in his rather unpromising results.

Philo T Farnsworth was a farm boy turned inventor. By 1926 he had talked some backers into supporting his efforts financially and setting him up in a laboratory. In 1927 he filed a patent for his television system employing an electronic tube camera, which he called an 'image dissector'.[7] The following year he was able to demonstrate a crude electronic television system which displayed 20 pictures per second and was fast enough to show movement.

Both these electronic systems and all the mechanical transmitter systems suffered from a fatal flaw. They scanned the subject and what was seen at each point was only the tiny piece of light viewed at the instant that the scanning system passed over it. The result was that the camera was very insensitive and vast amounts of light were needed to get a reasonable picture. The more lines and frames per second that were used, the worse the problem became.

What was needed was something that collected the image for the whole frame and then was read very quickly as the scanning system passed over it. In theory this was more sensitive by the number of points in the picture per frame. This could be many thousand times. The person who realised this was a Hungarian Kalman Tihanyi, though it is often claimed that it is implicit in Campbell Swinton's articles. In 1926 Tihany patented his ideas, refining them in 1928. This time he took out patents in a number of countries including Britain, and his essential improvement became widely understood.[8] The American version of his patent, after much discussion, was later assigned to RCA.[9] This 'storage' was the crucial idea to make an electronic television camera practical.

In 1929 Zworykin moved to the Radio Corporation of America (RCA) where the head David Sarnoff, another Russian émigré, really was interested in the potential. Here he started to develop a scheme that seemed remarkably like a development of Tihanyi's, which he called the Iconoscope.[10] Time and effort were put into not only the camera, but a complete system including a cathode ray tube receiver.

In Britain the Gramophone Company (HMV) was interested in widening the field of home entertainment beyond the radios and radiograms that they were already making. Around 1930 they began to be interested in the possibilities of television. What was clear to them was that there was little entertainment value in the low definition system used by Baird and others. They also felt that mechanical receivers had no place in the home.

By 1931 they also appreciated, that apart from the camera there were two further problems. The implications of Campbell Swinton's calculation of the number of picture elements in what they called a high definition system, was at least a hundred thousand.[11] This meant that the radio system needed to be able to handle this rather than the few kHz of the normal radio broadcasts. This required a very high frequency (VHF) transmission of a wavelength around 5 metres (60 MHz). This was new territory for broadcasters, and a considerable concern as the coverage area of the transmitter was reduced to 'line of sight', which would mean many more transmitters to cover the country.

There was a further difficulty that they foresaw; the speed requirements at the receiver. It was quickly realised that only the cathode ray tube had any real chance of achieving this, though a lot of development work would be needed to produce a product that was in any way comparable with a home cine film. By around 1932 virtually all those interested in developing television systems had come to the same conclusion.

The problem that everyone had when trying to make a device to operate as a television 'camera' was that the photocells were very insensitive and required a great deal of light on the subject. With a device that didn't embody storage the amount of light need was formidable, and even with it the level was impracticably high. What was needed was a far more sensitive photocell.

In 1929 Lewis R Koller and his co-workers at General Electric in America discovered a new photoelectric material. It was formed by having a layer of silver on a substrate and then adding a layer of caesium in the presence of oxygen. The resulting complex Cs-O-Ag coating was a vastly more efficient photocathode than anything that had gone before. Its quantum efficiency of turning light photons into electrons was a couple of orders of magnitude better than anything that had gone before. Here at last was something that could make an electronic camera a reality.

At HMV William F Tedham started to experiment with the material and the team there under Cecil O Browne built a 150 line system which used film as its source material. This was achieved by having a 30 line system with five photocell channels so that there was a total of the 150 lines. The problem was that it needed 5 channels to carry the signals. Nevertheless it produced some of the best pictures that had been achieved at that time.

The Marconi Company was also looking at the possibilities but their interest was in sending written information over their radio links. They produced a mechanical system which could read a moving tape with text on it and reproduce it the other side of the world. While this was a rather specialised requirement it did lead them into exploring the high frequency radio transmitters that were necessary to carry the increased information.

This was the position when the record business started to take a tumble in 1931 and both the Gramophone Company and Columbia Graphophone were suffering. With the financial problems starting to bite, would anyone have the resources and the courage to take on the challenge of producing a television system that was really satisfactory in the home?

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1. It was filed on 27th May 1843 and granted 27th November 1843, though it hasn't been possible to find the number. The American equivalent was US patent 5957 from1848
2. German patent number 30105
3. GB version of his patent no 27,570 of 1907.
4. Campbell Swinton A A, *Distant Electric Vision*, Letters to the Editor, Nature 18th June 1908
5. Campbell Swinton A A, Presidential address to the Röntgen Society, as reported in the Times 15th November 1911.
6. US patent No 2141059
7. US patent No 1773980
8. GB patent No 313456
9. US patent No 2158259
10. Zworykin V K, *Television with Cathode Ray Tubes*, Proceedings of the Institution of Electrical Engineers, Wireless Section, 1933, Volume 8, Issue 24, pp 219 - 233
11. In practice it needs to be a good deal more than this – a few MHz

# 11 Electric and Musical Industries

Once into 1931 the fortunes of the Columbia Graphophone and Gramophone (HMV) companies were declining rapidly. Something had to be done and one obvious solution was to combine the two companies and integrate their operations to make the savings necessary in the new climate. The problem with this was that Alfred Clark of HMV and Louis Sterling of Columbia didn't get on.

It was thus outside forces in the shape of bankers and shareholders who brought the two companies to talks. There is a suspicion that David Sarnoff of RCA was behind this though he would have to be very careful in view of the Anti-trust laws in the US with their strong bias against monopolies. Whatever the actual cause, the two companies had come to an agreement by April.

The proposal was to swap shares in the two existing companies for new ones in a joint company which was given the clunky name of Electric and Musical Industries Ltd. (Not Electrical and Musical or other combinations that are sometimes seen, though later they were simply known as EMI). This was put to the shareholders with an objective of getting more that 90% acceptance by the closing date of 29th June.

In the event they received 94% acceptances, and so on 1st July 1931 the new company came into existence. The board of directors was made up from the boards of the two companies but with David Sarnoff also included. This was on account of the approximately 27% holding that RCA now had though RCA Victor which controlled most of the Gramophone Company. Alfred Clark became the Chairman and Louis Sterling the Managing Director.

Columbia Graphophone sold its American subsidiary because it was making losses according to Louis Sterling, but it might also have been because the American Anti-trust laws would have caused problems with RCA Victor and Columbia being in the same ownership.

Fig 11.1 The EMI Central Research Laboratories

With the major matters resolved, it was now time to decide how the two companies could be combined. The decision was taken to concentrate most of the activities on the extensive HMV site at Hayes in West London. Deciding what to do with the duplicated management structures was more difficult. For Isaac Shoenberg this must have been a worrying time. HMV also had some senior people in Research and Development with Adrian D G West and Arthur W Whitaker together with George E Condliffe as the manager. There was going to have to be a sort out, and not everyone was going to be happy.

Isaac Shoenberg at least had a job as he was made the Head of Patents for the combined company. With his expertise in patents it was natural that he should take that position. Stanley Preston from HMV was under him in charge of the department. In some senses it was a step backwards for Isaac Shoenberg as he had been effectively in total charge of the research and development at Columbia, but that position for EMI was still to be fully resolved.

The main objective of the company was survival and to do this they needed to cut costs and boost the business in areas other than records. The record cutter that Blumlein and his team had developed was soon put to use across the whole company. At HMV a team under Arthur Whitaker had been attempting to make a similar device, but had not succeeded. Thus the HMV people had been cautious at first, but when the tried the Columbia cutter they found how good its performance was. It was soon installed in the new studios being built at Abbey Road in North London. The company could now start to cut its royalty payments to Western Electric.

The other side was to continue to develop products such as radios and radiograms. Despite the depressed conditions radios were still selling well and there was still a reasonable market for radiograms. Though sales of records had seriously declined, many people had built up considerable record collections and needed better equipment to play them on.

The other decision that was made was to continue with investigations into the possible making of television receivers. This was to build on the work already undertaken at HMV. To see what progress Zworykin's team had made, in September Adrian West was despatched to visit RCA. Though up to this point the opinion, particularly of Whitaker, had been that the company should develop its own system, now the shortage of money meant that other options needed to be considered.

RCA had already sent the company some of their new television receiver tubes. This all seemed part of a concerted plan to try to ensure that their technology was also used by EMI. Adrian West was shown a demonstration that he found impressive and RCA offered a complete system for $50,000. They had somehow managed to convince Adrian West that television was on the verge of being a commercial proposition and that the following year they would install a transmitter on the Empire State Building in New York.

When Adrian West's report was received at the end of October, the immediate reaction was to authorise the purchase of the system from RCA. This was strongly opposed by Isaac Shoenberg. He reasoned that it was not a good idea to rely too heavily on RCA, and that with the wealth of talent they had available they could, in time, produce a better system. He was encouraged in this by reports, early in November, from George Condliffe and Cecil O Browne describing a programme of work for the advanced development of Television.

There was also a problem with Marconi's Wireless Telegraph Company. Because RCA had grown out of the American Marconi Company there was still a patent agreement that meant that Marconi would receive RCA patents. As there were rumours that the Marconi Company might link up with Baird, this constituted a danger. Isaac Shoenberg's view was that they should try to bring Marconi into some sort of partnership to develop all electronic television.

Isaac Shoenberg won the argument about developing television receivers themselves. He certainly had support from the engineers in the department, particularly William Tedham. Louis Sterling, after the successful work on the record cutters, was likely to have confidence in what he said. He was helped when it became apparent that technical cooperation with RCA was going to be very difficult and unreliable. Quite what infighting went on isn't clear, but the result was at some point around this time he was put in charge of the television development. It might have been a case of 'if you think you can do it, get on and do it'

On the 1st November the Research and Development staff from Columbia were moved to the new HMV Research building at Hayes. These included Alan D Blumlein, P W Willans, Henry A M Clark, E C Cork and H E Holman. Here they joined the HMV team which included the Manager George E Condliffe, William F Tedham, Cecil O Browne and W D Wright. There were also a number of technicians, including importantly, a skilled glass blower. Together they formed a powerful team, but would the two groups merge together happily. It would depend on how the situation was handled.

Alan Blumlein, never a man to stand still, had for some time been developing ideas on what he called 'binaural recording'; which today we would called stereo. He had reached a point where these were well worked out and he received permission, presumably from Isaac Shoenberg, to apply for a patent on these ideas. This was granted some 18 months later and with some 70 claims is reckoned to be one of the greatest patents in sound engineering[1]. At the time no further work was done on this.

Things started to happen quickly in the development of television. On the 19th of November they applied for a patent for an improved method of forming a fluorescent screen on the large end of a cathode ray tube. This was an important step as it marked the point where EMI were no longer dependant on technology from RCA for the receiving tubes and it opened the way to making their own.

Rather than Isaac Shoenberg approaching the Marconi Company himself, George Condliffe did it and arranged to hire a transmitter from them which could easily be modified to the required wavelength of 6 or 8 metres. It was a gentle beginning to trying to establish a connection with the Marconi Company in the field of television. The next step was to obtain a licence to use the transmitter from the Post Office.

If they were going to make a television receiver that had to be sure that it would work with a real transmission and what service area could actually be achieved with these signals at a much higher frequency than had been used for radio broadcasting on the Medium Wave Band. However they had no experience in this field and N E Davis of the Marconi Company spent some time setting up the transmitter.

Isaac Shoenberg was later to describe the position at the time:[2]

> 'When we started our work in 1931, the mechanically scanned receiver was the only type available and was under intensive development. Believing that this development could never lead to a standard of definition which would be accepted for a satisfactory public service, we decided to turn our backs on the mechanical receiver and to put our effort into electronic scanning.
>
> The cathode-ray tube then available used gas focusing and it was not possible to modulate the beam without losing focus… remembering the vagaries and instability of the soft valves of the 1912-16 period, I decided against the soft cathode-ray tube and directed our research towards the development of a hard type with electron focusing.

He was starting to slot into the role he was to take throughout the next few years on the development of television; that of the major decision taker to guide the process in what he felt was the correct direction. He, of course, discussed everything with his team and let them bring up all the relevant matters, but in the end a decision had to be made, and he was the one to make it.

He was to describe the difficulties of this position:

> In deciding the basic features of our system we frequently had to make a choice between a comparatively easy path leading to a mediocre result and a more difficult one which, if successful, held the promise of better things.

He was going to be taking many of those calculated risks that so defined his life and career.

First he needed to strengthen the team with a good physicist and with son David at Cambridge it seemed natural to look there. Fortunately George Condliffe had been a student, years before, with Dr (later Sir James) Chadwick who ran nuclear physics research there. It was natural that George Condliffe should make the contact and there he found a young man who had finished his doctorate, but as funding had dried up, was looking for a job.

This was Dr James D McGee, who really wanted to remain in academia, but had not been able to find a post in the depressed conditions of 1931, even with the backing of Lord Rutherford and Chadwick. He was offered a job at £350 by EMI which was much better than the £250 he was likely to get in a university. Still he hesitated, but Chadwick said: 'I think you had better accept this offer, McGee, because, as you know, jobs are very scarce. I don't think this business of television will ever come to very much but this is a job and it will keep going until we can get you a proper job.' Eventually he decided to accept and started on the 1st January 1932.

Fig 11.2 Isaac Shoenberg (left) and Dr James D McGee (centre) showing a display tube to a visitor.

James McGee had grown up in Australia, but had come to Cambridge in 1928 and took three years researching a rather esoteric subject connected with ά-rays and then obtained his doctorate. He was thus suitably equipped to look into the basic science needed to develop cathode ray tubes into suitable display devices for television pictures. He could thus widen the base of skills in the team looking at this.

When James McGee arrived he was to find that William Tedham had made considerable progress on a cathode ray tube for the television receiver. As Isaac Shoenberg had said they had abandoned the old gas focussing idea and were working on electrostatically focused tubes with a high vacuum. Thus matters had moved on further than he had anticipated, but electron optics was a subject still in its infancy.

William Tedham had also done considerable work on Cs-O-Ag photodetectors and had succeeded in making photocells better than anything they could purchase at the time. These were needed for the scanner section of the system they were working on which used a variant of the five channel system that had previously been built by Cecil Browne. Now they were working on a single channel system of 120 lines at 25 frames per second to provide the pictures.

This still used film as its source material. The reason was quite simple. As they knew, only a system that stored the image, and then scanned it, could be expected to have a reasonable sensitivity and work in normal lighting conditions. With film a very bright arc light could be used as the source and hence adequate illumination could be achieved for the system. This problem became worse as the number of lines increased, though it could be partially offset if the sensitivity of the photocell could be improved.

Thus they were trying to build a system with a mechanical scanner, high frequency transmission of the signal and a cathode ray tube based receiver. Though Isaac Shoenberg knew that a mechanical scanner was not the way to go, they needed a source of signals to test the transmission and receiver parts of the system. The policy still was that they would make television receivers, but would leave the transmission side to others.

Isaac Shoenberg left them for a while after James McGee had arrived so that he had a chance to get familiar with the project, and then made a visit to the laboratory. This was no social call as he thoroughly grilled them on the detail of the way they were operating the cathode ray tubes. It was very clear that he was very interested in precisely how they were intending to do this, and expected to be given satisfactory answers to his questions.

This had the great advantage of making it clear that he was interested in their problems which was very good for morale. It also meant that he was thoroughly familiar with all the key matters during the development so that when it was necessary to make strategic decisions he had the understanding of the issues to enable him to do so.

James McGee was to find that William Tedham was very familiar with the articles that had been written by Campbell Swinton and was thoroughly convinced that using cathode ray tube devices for both parts was the right way to go. He soon convinced James McGee and they started to think about how a scanner, or camera, based on a cathode ray tube could be made.

They clearly understood that it was necessary to 'store' the image for the full cycle and then scan it momentarily. The key to this was to make a mosaic of the photosensitive material on a suitable substrate. The mosaic would somehow have to be divided up into small islands corresponding to the picture elements that were required. They tried a number of methods but one seemed better than the others.

The one that came out best was a mesh screen method, and William Tedham wrote a memorandum on 12th May 1932 to George Condliffe, now settled in as the manager of the department, outlining what they had found and suggesting that this might be a suitable matter to patent. George Condliffe passed the information to Isaac Shoenberg also saying that the method had been tried and appeared superior to an RCA method that they had been informed about.

Clearly Isaac Shoenberg agreed because a patent application was prepared and later in August was submitted to the patent office. What is striking about this was that this was work which had nothing to do with the receiver tubes that they were supposed to be working on, and was clearly an investigation into something basic which would be needed when the time came to try to make an electronic camera.

However, he didn't want them to go further and actually build a camera, which they were keen to attempt. At first sight this seems odd as he, like them, was convinced that an electronic, rather than mechanical, camera was the right way to go. However, the company policy was to make receivers and not to be involved with the transmission side and hence with cameras. He was bending the rules a little by letting them patent the method of making mosaics. He was always keen to patent things that seemed as though they might be useful in the future.

The company was under financial pressure and he had persuaded the directors to invest a considerable sum of money in the development of a television system. He thus needed something to show for this work, and quickly. The basic receiver that they were supposed to be working on was the priority and he didn't want them to be distracted from that. He needed to be able to demonstrate some progress.

There was also the sense that they were in a race. He wanted to be able to demonstrate a system to the BBC as he was concerned that the Baird Company, who had been running the 30 line trials with them, would establish de facto standards which would put EMI at a disadvantage. Early in the year, the Baird Company had been bought out by Isadore Ostrer of Gaumont-British Films and was now on a more sound financial footing. He was aware that they were also starting to look at using cathode ray tubes in the receivers rather than the unsatisfactory mechanical discs.

It was hardly surprising that when Alan Blumlein presented a memo to Isaac Shoenberg on 21st July describing his ideas about binaural reproduction, he was not given permission to proceed. Clearly this was what Alan Blumlein wanted, but with the limited resources available at the time, he was needed to carry on improving the record cutters which was of primary importance to the company.

However, Isaac Shoenberg had received some excellent news about son David. In his course at Trinity College, Cambridge, he had switched from Mathematics to Physics but had been awarded a first class degree in the subject. A few days later he was also awarded a further scholarship to continue at the university and work towards a higher degree. He had managed, despite the difficult times to remain in academia.

All the changes in the management structure had left Adrian West in a difficult position, and it was no surprise when he left the company in July. He took up the post of Chief Recording Engineer for APT Studios in Ealing. However, he was only to stay there for a year as in July 1933 he was appointed technical director of the Baird Television company. This then put him in direct competition with EMI and Isaac Shoenberg and his team. It was only to be expected that there was a bit of an edge to this.

The result was that on 22nd July 1932 Isaac Shoenberg was made the Director of Research. This was perhaps a slightly elevated title as he was not on the main board of the company. However, he was now in complete charge of all the research and development for the company. Like all these things it was a mixed blessing. He could direct the resources at he saw fit, but it also meant that he was in the firing line; he had to deliver.

What had happened to the other contender – Arthur Whitaker? At some point he was slid sideways and was put in charge of product engineering. This was an important task in a company that needed to keep improving its products in difficult times. He was to go on to manage the production of cathode ray tubes when these went into production, but that was still some way in the future.

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1 GB patent 394325

2 I Shoenberg, Discussion on the History of Television, Journal of the Institute of Electrical Engineers, 1952, 99, Part IIIA, pp 41-42

# 12 Mechanical Television

By the autumn of 1932 the team had assembled a complete television system. It started with Cecil Browne's 120 line film scanner which he had coupled to the Marconi transmitter. At the receiving end the signal was processed and fed to a 5 inch by 5 inch cathode ray tube, and this was in a cottage some two miles away from the transmitter on the top of the research building at Hayes.

On 11th November Isaac Shoenberg wrote to Noel Ashbridge the Chief Engineer of the BBC. It was a classic of his style:

> I have tried many times to get you on the phone but I have failed miserably. I would like to give you a private demonstration of the results so far obtained by us, both in the transmission and the reception of television. In my humble opinion, they would be of considerable interest to you.

On the 30th Noel Ashbridge made the visit and was shown a number of silent films including one of the changing of the guard. He was impressed, feeling that this was the best wireless television that he had seen and probably as good as or better than anything produced elsewhere in the world. It had four times the number of lines of the Baird device and twice as many frames per second. He was also impressed by the scale of the effort that EMI was putting into the work.

He was concerned about the lack of the ability to televise a live studio and also some of the implications in the use of the high frequencies for transmission. When Isaac Shoenberg pressed for a service in a year's time, he felt it was premature. His view was that though good progress had been made, the art had not yet reached the stage of a fully acceptable public service. EMI should continue its work secretly.

Isaac Shoenberg probably knew this perfectly well, but the company wanted to get into the market as soon as possible to start earning some return on all this work. However it did represent a milestone, and it was now easier to persuade the board that this was serious work and they were making progress. Interestingly the person who started to support Isaac Shoenberg with trying to influence the BBC was not Louis Sterling, but the chairman Alfred Clark.

Fig 12.1 Alfred Clark, Chairman of EMI

This had an advantage to Isaac Shoenberg as Alfred Clark was now becoming heavily involved in the television business. If he understood the position, and was trying to persuade the BBC to mount a service, then he was more likely to carry on supporting the effort in the company and the large amounts of money needed.

In January 1933 Clark went to visit John Reith the Director General of the BBC for a discussion. What he was trying to discover was what standards, in terms of lines and frames per second the BBC was going to set for television. He was hoping for 120 – 180 lines and 25 – 30 frames per second which was what they had already achieved or was fairly easily within reach. That way they could steal a march on Baird Television Ltd (BTL).

It soon became apparent that the general BBC view was that it was premature to start a service, but they were prepared to house an experimental setup at EMI's expense and Noel Ashbridge invited Isaac Shoenberg to submit a scheme which he did on the 11th January. This had a blueprint showing the layout of the television and transmitting equipment. The BBC started to make preparations to accommodate this equipment in Broadcasting House.

William Tedham and James McGee had been discussing how to make a pick up tube, or camera, throughout the summer of 1932 and patented their ideas[1]. By the autumn they felt ready to have a go at making one. Isaac Shoenberg had disagreed and said they should wait, but they couldn't resist the temptation as most of what they needed was available in the laboratories.

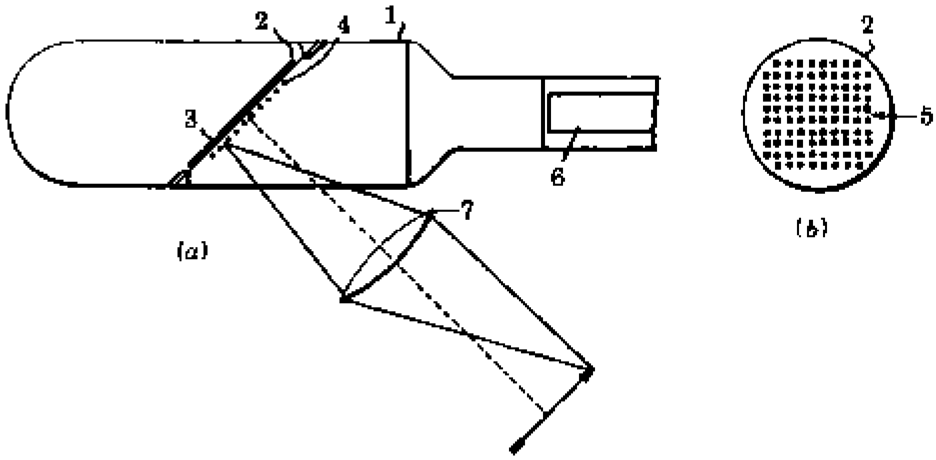


Fig 12.2 Diagram of Tedham and McGee's first television camera tube from their patent

They based their attempt on the scheme outlined in their patent application. They used the electron gun and focusing arrangements from their receiver tube work. Instead of the normal phosphor screen they made a target by evaporating a layer of silver through a stencil mesh onto an insulating aluminium oxide on an aluminium plate. This was then activated with the caesium layer. This target was set at an angle in the glass tube with connections brought out, and then the whole thing was sealed and evacuated to high vacuum.

They borrowed a signal amplifier and coupled the scanning circuits to those of a display tube on the other side of the room. After some minor adjustments the draughtboard picture that they projected on to the target appeared on the receiver screen. They were so surprised that they just stood there. James McGee was later to describe the effect as almost magical. Campbell Swinton was proved right; it was possible to build a television system with cathode ray tubes at each end.

They spent a few hours investigating the behaviour of the tube, but gradually the picture began to fade. The tube was dying as gas leached out of the electron gun system. The put the tube away in a cupboard, but though they were now sure it was possible to make a camera this way it was going to take a great deal more work to get a really satisfactory result. The tube was eventually to make its way to the Science Museum in London.

What James McGee was supposed to be doing was supporting the display tube development. On the side he was also investigating the physical phenomena surrounding 'mosaic tubes' and particularly the secondary emission from them which was poorly understood at the time and it was necessary to be able to make an effective camera tube. At the time he was finding that photoelectric emission, which was what they needed, was mixed up with the secondary emission and it was difficult to see how these could be separated.

While James McGee was struggling with this, William Tedham was investigating the chemistry of preparing the photoelectric surfaces. Clearly the strategy that Isaac Shoenberg was following was that the fundamental phenomena, concerned with how photoelectric surfaces worked, needed to be understood before trying to build a camera. It was becoming clearer that they may well need to make a camera at some point in the future.

However, James McGee and William Tedham were also spending some of their time on improvements to the display tubes that the company was developing[2]. While they had small tubes that worked, there was still room for improving the contrast in these and also working upwards towards bigger tubes.

By the spring James McGee had a scheme for a camera tube worked out where the mosaic was 'double sided'. This was the ideal arrangement as the electron gun could be on the opposite side from the optics and the image and the whole thing could be in a line. He was allowed to apply for a patent for this idea in May of 1933[3]. The problem was that so far they could not find a way of making the necessary form of the mosaic.

After Isaac Shoenberg's meeting with Noel Ashbridge, the information that they had competition got back to Baird and BTL. They reacted badly to this as they had thought that they had the field to themselves. They began a campaign to blacken EMI's name and particularly to suggest that this was just an American development from RCA. They couldn't accept that this was EMI's own work.

The campaign was fought in the newspapers and in letters to everyone they could think of such as John Reith at the BBC, the Postmaster General and even the Prince of Wales. However the BBC knew perfectly well that this was an EMI development, but BTL achieved two things. The installation of the EMI system in Broadcasting House was put on hold, and both companies were invited to give a demonstration of their systems to a larger group of interested people.

EMI's demonstration, which was largely a repeat, with some improvements, of Isaac Shoenberg's to Noel Ashbridge in November took place on 19$^{th}$ April. There were 10 people from the BBC and the Post Office. Most were from the engineering side but the interest was now wider. The general feeling among the visitors was that considerable progress had been made.

There had been some advance with the screen of the receiver which was now a little larger at 6 ½ inches by 6 ½ inches and displays with two different phosphors were shown, one giving a black and white picture and the other with a green background. The green background gave better detail and it was stated that research was continuing to get that performance with a black and white picture. Also some experiments were taking place on using magnifiers and one was shown that gave a picture 9 inches square.

The BTL demonstration on the previous day had been to the same panel, but was a very different matter. Though they had advanced from the 30 line system they had been using, the demonstration was very unprofessional. The transmitter appeared to be of a 'makeshift type' and the receiver was a tube 3 inch square, though it was also shown on a Nipkow disc device. The pictures were 'indistinct, jerky and erratic'. In addition there was no radio transmission; the signals were merely fed from one room to the other. Altogether BTL hadn't done themselves many favours.

Isaac Shoenberg was now fighting on several fronts. The obvious one was the need to direct the work on the various aspects of the project and decide the key places that needed work and which were the best people to look at these.

He also had to continue to persuade the Board to continue the work despite the delays that Baird's tactics had produced. His success in this was shown in Alfred Clark's involvement and clearance to increase the staff. This was no mean feat in getting more commitment and expenditure in a company which was only just about breaking even and hence really couldn't afford the investment.

He was also trying to keep up progress with the BBC and to a lesser extent with the Post Office. Unless they, and in particular the BBC, could be persuaded then there would be no television service and hence no market for receivers. The company badly needed to be selling sets to get some return on all the money they were spending.

Then there was the countering of the negative publicity that Baird Television was putting out about this being an American operation and really Britain should be supporting a British concern. With the known links between EMI and RCA this was quite difficult to counter. Innuendo of this sort always leads to the 'there is no smoke without fire' attitude even when it can be shown that it isn't true. Here even that was difficult. However, Alfred Clark had established a good relationship with John Reith, the Director General of the BBC and that helped considerably.

Following Alan Blumlein's patent on his 'binaural recording' system at the end of 1931 he had been needed to continue the development of the normal record cutter system which was of primary importance to the company. However, at the beginning of 1933 Isaac Shoenberg felt that there were now sufficient resources to explore this further. A group was set up under Alan Blumlein to progress this involving largely those such as Henry Clark and HE Holman who had been working on the cutters.

They started to make progress, and by July they had modified some old Western Electric record cutters to make one that recorded both channels in a single grove on the record. By August this was well into testing and in December they began cutting stereo discs. However as the work didn't seem to have a commercial outlet, Isaac Shoenberg terminated it in 1935.

However, in April 1933 Alan Blumlein was also needed to help support the television electronics effort. He needed to split his time over many projects. It was the beginning of a wider role across the whole department as his ability to make a useful contribution to almost everything was soon to be one of the assets of the whole team.

One of the advantages of the depressed times was that it was relatively easy to recruit high quality staff. The first of these was Dr Leonard F Broadway in May. He was another PhD from Cambridge and he was brought in to strengthen the team trying to improve the cathode ray tubes in the receivers. His tasks were to improve the vacuum and find materials for the electron guns which didn't absorb gas. The other area was to look at the phosphors which produced the picture on the front of the tube.

Joining him, also from Cambridge, was Dr Eric White, who had a wide background with a first class honours in physics, chemistry and mathematics. His role was to help with the electronic circuits needed to support the transmission and reception of the signals. Isaac Shoenberg was now steadily strengthening the teams involved in the television effort, because in addition to the more senior people he was bringing in more juniors, technicians, and personnel to the drawing office and workshop.

Fig 12.3 Dr Leonard Broadway

Behind the scenes at the BBC and the Post Office there was a battle going on about whether the promised EMI installation of equipment at Broadcasting House should continue or whether BTL should be given a chance to test theirs as well. Because of the publicity that had been put out by BTL the matter had become rather political and the decision was postponed again.

The delays were a mixed blessing. Though it was frustrating that the trials could not go ahead and the possibility of a television service appeared to be receding into the future, there was time to improve the equipment. Isaac Shoenberg had far more resources at his disposal than BTL and so the delay was likely to play into his hands.

Part of the problem was that Noel Ashbridge and some of the others at the BBC had a low opinion of BTL and their lack of professionalism. This was to change to some degree in early July when Adrian West reappeared as the Technical Director of BTL. There had been something of a coup with John Baird himself having been eased out and only retained as a consultant and tucked away in a laboratory to continue his researches.

Sydney A Moseley, who had been on the Board of BTL, resigned. He had links with Fleet Street and had been at the epicentre of the vicious campaign against EMI. Much of what had been put out was known to be incorrect by the BBC and was not doing BTL's reputation there any good. Sydney Moseley had understood this and was prepared to fall on his sword to give the company a better chance.

The company also moved to a leased set of premises on the ground floor and the South Tower of the Crystal Palace at Norwood. Adrian West was moving quickly to put the company on a more professional footing and was soon recruiting competent engineers to progress the work further.

In July 1933 also, Vadimir Zworykin from RCA came to London and at the Institute of Electrical Engineers gave a lecture entitled 'Television with Cathode Ray Tubes'[4]. Of course, members of the EMI team were in attendance. Isaac Shoenberg immediately sought copies of the paper that was submitted which was due to be published later in the year. It was one thing to hear a lecture but he needed the written proof to show to the Board to demonstrate that an electronic television camera was a practical proposition.

The lecture was quite informative to the lay person giving a clear indication that RCA had succeeded in making an all electronic television system. However for those who had been working in this area for some time it merely told them what they already knew. Valdimir Zworykin was very careful not to give away any of the really important details of how the pick-up or camera tube was constructed.

On the crucial matter of how the mosaic was made he started talking about a special process and described more than one method. Obviously he was not going to give away the secrets. As James McGee was to say: ‘it was quite clear that we could learn nothing from Zworykin’s paper’. It was clear, however, that they were still using the basic Cs-O-Ag photo-detector material and so were not that far ahead.

In terms of the receiving side the critical component was the phosphor, and though little was given away about this, it was clear that it was still a green colour which the EMI team had already decided was not sufficiently good for a commercial device. It looked as though EMI had made at least as much progress as RCA in this area.

For Isaac Shoenberg there were important matters in the paper. The critical one was that it could be done. An electronic cathode ray tube camera was a practical proposition. The second thing he learnt was that the work they had been doing was on the right track. The patent that Tedham and McGee had submitted the year before described something very similar to the RCA device. The third thing was that RCA had not been able to make a double sided mosaic and hence produce a camera where everything was in line.

He started to think that not only was this sort of camera possible, but it was also desirable that they should develop one themselves. The policy of only making the receivers was not sustainable. It was clear that merely producing film scanners was not going to be acceptable to the BBC and they were not going to run a service unless someone could supply studio equipment for live broadcasts. His next task was to convince the Board of this and get them to commit even more money to this project.

The wrangle about running transmission trials from the BBC’s Broadcasting House rumbled on. The Post office was taking the view that both the EMI and Baird Systems should share the transmission equipment, possibly on alternate days. As they wanted to modify the transmitter, and there were other things they wanted to keep secret, Isaac Shoenberg turned this down as impractical. He was not too concerned when the upshot of this was that BTL were to have the first run at this in a slot throughout the autumn which would be followed by EMI’s turn in the new year. It would give a chance to find out exactly how much progress BTL had made.

In September the team was extended again when Dr Gerhard Lubszyinski joined the group to help with work on cathode ray tubes. He had come from Germany after working for Siemens and Halske and then for a short period for Telefunken. He was one of a number of German refugees, in trouble with the Nazi regime, that Isaac Shoenberg helped to come to England and find employment in the company. In his case, it was a good decision as he was to make significant contributions to the development of television.

However, Isaac Shoenberg’s own contract with the company was due to expire five years after he started with Columbia and that was on the 1st September 1933. As early as February the Board had agreed to extend this for another five years[5]; they definitely didn’t want to lose him now as he was absolutely essential for the company. It was a measure of his value that his salary was set at the extraordinary sum of £4000 per annum, when some of those he employed probably earned less than £200 and even James McGee with a doctorate was on £350.

1 GB Patent 406353
2 GB Patents 415071 and 415143
3 GB patent 419452
4 Journal of the Institution of Electrical Engineers, Volume 73, Issue 442, October 1933 pp 437 - 451
5 IET archives, NAEST 62/2.6

# 13 Electronic Television

After the presentation of Vladimar Zworykin's paper Isaac Shoenberg had some important questions to answer. The first was, of course, could they make a 'pick-up tube' or camera along the lines described. It was clearly possible and he had great confidence that his team, perhaps further strengthened, could achieve something similar. He had great faith that a competent team, like the one he was assembling, suitably resourced, could achieve such an objective.

The next question was whether they should make such a device. That was more complicated. The company's policy up to this point had been only to make receivers, but the flaw in this was that if no one made the equipment to create programmes, then there would be no service, and hence no market. There was also the danger that BTL would produce something and might be able to bounce the BBC into taking it and hence set their own standards, which almost certainly would not suit other companies such as their own.

Fig 13.1 Isaac Shoenberg carefully considering his options

The matter didn't stop with the camera; it needed all the studio equipment. In addition to the cameras it would have to be control desks to switch from one to another, film scanners and then the transmission equipment. They had no knowledge of transmitters, but he had been trying for some time, without much success, to persuade the Marconi Company to enter into a joint arrangement so that everything could be provided as a package.

The whole thing was a risk, and a high stakes one at that. If it failed it would have serious consequences for the company, the team and for him personally. He had to consider the matter from every angle. There was one advantage, and that was that they could be able to sell the cameras and studio equipment at the beginning of the service and that had the potential to bring some return earlier than merely the sales of receivers could do.

After careful consideration, he decided that they should take the risk. As usual it was one of his calculated risks, but he had to come down on one side or the other. There was no fence to sit on. James McGee, who had great respect for his boss, was to say later: 'With the benefit of hindsight, it is possible to detect what I believe was the only error made by Shoenberg in his direction of our work: this was his decision to delay the beginning of serious experimental work on the television camera pick-up tube.'[1]

Had James McGee a full view of all the factors necessary to make this decision, and the risks involved? He was the man who was keen to have a go, not the one with the overview of everything. It is unlikely that this would have started more than a few months earlier as it was necessary to do the investigations into the methods of making and characteristics of the mosaics at the heart of the camera.

The next question was whether he could persuade the Board to invest even more money and resources on this television business. To do this the Zworykin paper was an enormous help; it showed that it could be done. There was also the helpful matter of wanting to beat BTL, which while more emotion than calculation, no doubt entered the equation. Arthur Clark had become heavily involved in the television endeavour so he could be convinced, while Louis Sterling would quite likely take Isaac Shoenberg's judgement in the matter after some serious questioning.

By September 1933 the decision had been made. Despite the costs probably being in the order of £100,000 per annum they decided that they would take the gamble and do it whole heartedly and not try and skimp. There was no point in trying to cut corners; that was a sure way to spend money and fail. Isaac Shoenberg was given permission to proceed, but also to recruit staff and resources to the level needed. They would have to trust him to do this at the correct level to get the job done, without wasting money.

In the middle of all this Isaac Shoenberg found the time to sit down with George Condliffe and William Tedham to come up with a new arrangement of the electrodes in an electron gun for use in a cathode ray tube. They applied for a patent for this[2]. It was a measure of his hands-on involvement that his name went on to the patent. This was not normally something he did as the boss. Usually the patents were simply in the name of the inventor or inventors.

His first act after the decision to proceed was to rearrange the department. What was needed was a group to work on the camera, another on the display and then others to work on producing a receiver, all the studio equipment and all the electronics in between. In a surprise move James McGee was put in charge of the key group to develop the camera pick-up tube.

The person who might have been expected for this was William Tedham, but all was not well with him, and no doubt there had been a serious conversation before the decision was announced. He was not a man who took pressure too well. On the other hand James McGee was a pushy young Australian with a 'can do' attitude. It was almost certainly the right choice.

The display tube work was left in the charge of William Tedham for a while until his health began to fail and he was replaced by Dr Leonard Broadway. To oversee all the electronics, and provide a coordinating function, was Alan Blumlein. Isaac Shoenberg had very carefully moved the pieces into place.

He didn't just leave it there; he needed to keep on top of the situation to steer the work in the correct direction and be sure exactly what was happening. To do this he would periodically visit all the laboratories, across the site from his office in the managerial building, and then thoroughly grill particularly these group leaders.

He would also more often summon people to his office. This was usually carefully arranged to be at 'elevenses' or 'tea' to put everyone at their ease. As James McGee later said: 'then began a really thorough grilling'. The point of this was to ensure that all matters had been thoroughly thought through. The discussions often became heated, but never acrimonious because everyone had the same objective; to produce the best possible solution to their problems. It was essential that if he was to make the correct strategic decisions that he thoroughly understood what was happening and the issues.

By the beginning of November 1933 James McGee was outlining a programme of work on Cathode-ray transmitting tubes[3]:

> In view of the fact that although we know that the Zworykin 'iconoscope' will work we do not know the details of the physical processes involved in its operation, it is proposed that two main lines of investigation should be followed namely:
> (1) The production of a tube as nearly as possible identical with the tube described by Zworykin in his paper.
> (2) The detailed investigation of each operation that occurs in the iconoscope, separated as completely as possible from the complicating influences of the other operations involved in the complete tube.

There has been considerable controversy as to whether the Emitron, as the EMI tube was eventually called, was a copy of the RCA iconoscope because superficially they looked so similar. Here lies the answer: it was so in the general principles, but as Zworykin had been very careful not to give away any of the important detail, they had otherwise to start from scratch. Of course they had undertaken a lot of preliminary work on photoelectric surfaces, and they could also lean heavily on the display tube work for the electron guns and vacuum techniques.

Because they were short of space and due to move to a new laboratory they tackled the second part first. They looked at the base material for the mosaic and rapidly settled on thin sheets of mica. To separate it into the separate 'islands' on the mosaic they explored three different methods: ruling lines, putting on the silver layer through a mesh and heat treating the silver layer so that it broke up into small blobs. They second method was soon abandoned as the meshes were not fine enough. They found that they could rule up to 300 lines/inch, but settled on 100 as being satisfactory on the 3 inch by 3 inch plate to start with. The heat treatment looked like something that would eventually produce the right answer but required a lot more investigation.

The rate of progress was phenomenal and was a measure of their initial knowledge and the amount of resources that were being employed. They were still struggling with obtaining good enough vacuums in the tubes, but with the help of Leonard Broadway were gradually mastering it.

In parallel the electronics was being designed particularly by Michael Bowman-Manifold who had already done considerable work on the sawtooth signals necessary to drive the coils on the tube so that the image was scanned. For the camera tube they had to be modified to give a keystone form to the scanning so that it was uniform on the mosaic which was set at 30 degrees so that it didn't interfere with the optical path.

BTL, having won the battle to install equipment at Broadcasting House, made little use of it. They did install some equipment in September but it never worked properly and was removed in December. However, they were concentrating all their effort at Crystal Palace and at the end of November were able to demonstrate to Colonel Anguin of the Post Office, on a cathode ray tube receiver, some films at 180 lines and 25 frames/second. It was a considerable improvement.

However, Isaac Shoenberg was carrying on a two pronged attack. Cecil Browne was still developing his mechanical film scanner and had now reached the same level of 180 line and 25 frames/second. Now that their display tubes had improved considerably in brightness, the flicker at this frame rate was starting to be very noticeable. Consideration had now to be given to the best way to overcome this without too great a penalty.

Despite this Noel Ashbridge was very impressed by a demonstration of this system in January 1934. The transmitter, on the research building roof, had been upgraded in power quite considerably to give a stronger signal. Thus it could reach the receiver, which looked like a large radiogram, installed in the Abbey Road Studios some 12 miles away. Isaac Shoenberg was keeping the BBC happy and demonstrating progress to them while they tried to make an electronic camera. While professionally he kept his feelings well under control, sometimes with those close to him his excitement was allowed to show, like when he took his daughter Elisabeth to see 'the magical moving pictures on a little screen'.

Rather like BTL he had decided there was little to be gained by installing equipment at Broadcasting House at this stage. By increasing the power of the transmitter at Hayes they could do the technical tests on how well the signal propagated in the London area. Also the BBC was not going to run a service at this stage and certainly not with just films as the source. He made it clear that the company was still mainly interested in selling receivers, without letting on what was also going on in the laboratories at Hayes.

On the 24th January 1934 James McGee's team got their tube number 6 to produce a reasonable picture. They sealed it up and left it over the weekend and on the Monday it was working, if anything, better. Isaac Shoenberg was invited to have a look and he brought Alfred Clark with him. The picture was nowhere near as good as that from the mechanical scanner but though it was described as 'fluffy' it did, for the first time, show live images of people moving about.

The poor quality of the pictures might have caused most managements to abandon the effort, but Isaac Shoenberg was more courageous and knew that this was just the beginning and that improvements would follow. The prize of a flexible mobile television camera was worth a great deal of time and effort to achieve. They had proved that they could make it work; now it needed to be better. It wasn't too difficult for him to convince Arthur Clark of this.

Fig 13.2 An early Emitron camera tube. The long stem on the right contains the electron gun with its focusing electrodes and deflection coils and the optical window is above it. Inside the sphere is the mosaic. The 'tail' on the left is where the tube was sealed.

James McGee and his team were still trying to find the optimum method of making the mosaic, but within a couple of weeks were making reasonable tubes. There was considerable pressure to produce some working tubes so that other parts of the operation could proceed. However he needed to return to the theoretical side as it was important to understand the basic physics if they were going to get the best out of the tubes.

For someone he could discuss it with, Isaac Shoenberg suggested Professor Pyotr Kapitza, yet another Russian, a physicist and engineer who was working at Cambridge. He was an obvious contact as he was David Shoenberg's supervisor for his doctorate research on the effects of magnetic fields. It was useful to have another view to try to understand exactly what was happening in the tubes.

It was somewhere around this time that Isaac Shoenberg made one of his more famous remarks on being shown a demonstration of an electronic camera system. He turned to his team and said in his usual inimitable manner: 'Well, gentlemen, you have now invented the biggest timewaster of all time. Use it well.'

Isaac Shoenberg was now ready for his next moves. The electronics team were ready to put the circuitry around the tubes and turn them into prototype cameras. The next step was then to design the studio equipment so that a demonstration studio on the ground floor of the research building could be equipped. This was to have 6 cameras, 4 as free standing or mobile units and two connected to film projectors as telecine machines. All this needed to be run from a control desk to provide the means of switching between the cameras.

Fig 13.3 Bernard Greenhead, one of the engineers, with a prototype Emitron camera

Obviously the increased tempo needed more staff and steadily the numbers were being built up. He had recognised that they, in particular, needed someone to thoroughly investigate the photoelectric materials. Dr Leonard Klatzow was recruited for this. He had originally come from South Africa as a Rhodes Scholar and so it was via Oxford, rather than Cambridge, university this time.

With the camera tubes showing promise there was a need to give a name to their own development, partly to distinguish it from the RCA device. Isaac Shoenberg pondered this for a while before come up with the name 'Emitron' for the camera. It had the right ring of sounding like electron or electronic while neatly incorporating the company name.

Isaac Shoenberg had another trick up his sleeve. His long campaign to get a link up with Marconi's Wireless Telegraph Company, to provide the transmitters that they were missing, was now coming to fruition. It was helped that Frederick Kellaway, with whom Isaac Shoenberg had a cool relationship, had died the previous year and H A White was now the managing director. In March White was to inform the BBC that agreement had been reached to form a joint company to exploit their common interests in television.

Though Isaac Shoenberg might not have known that BTL demonstrated their system to the Prime Minister as well as representatives from the Post Office and BBC in March; he did know he was in a race. BTL included some 'live' scenes, but it was noticeable that these only included the head and shoulders of the person, while the rest of the demonstration was from film. There were also other companies that were working on television systems.

In the meanwhile, Leonard Klatzow had been working on the heat treatment method for creating the islands on the mosaic to a point where it could be used. It was incorporated into tube number 12 and onwards. By the 5th April 1934, James McGee's team had mastered the process and produced tube number 14 which was much better in sensitivity and picture quality. They were able to direct the camera out of the window of the laboratory and get the first outside daylight pictures. This was a considerable milestone and was showing that Isaac Shoenberg's faith in the team was not misplaced.

Another big step was that cables of 60 feet long were produced so that the cameras could be moved about quite freely. This was a vital step in making television cameras as flexible as film ones. Later the cable lengths were increased to 200 and then 1000 feet. It meant that the camera could be taken outside and down to the canal to watch the boats going past. Outside broadcasts, a key requirement of the BBC, were now a possibility.

It was now time for more demonstrations and an important one was to Douglas C Birkinshaw who had been running the BBC's 30 line service using Baird equipment. This took place on the 18th April, and he was most impressed. He saw immediately the significance of the enormous difference between the EMI and BTL systems. He reported: 'A picture not produced by mechanical means. No whizzing discs, no mirror drums, silence, lightness, portability. It showed the way things were going.' He claimed that he could see even then that Baird system wouldn't lead anywhere as they were unlikely to ever be able to do an outside broadcast.

It was not all plain sailing for the team. One of the problems of the camera tubes was that they generated secondary electrons, as the beam from the electron gun hit the mosaic, which had nothing to do with the primary ones that formed the image, and hence the image became distorted. The effect was for the picture to be darker on the left and top and lighter on the right and bottom. Time was spent trying to understand the phenomenon, but though it could be reduced to a degree, it could not be removed.

Maybe this was the point where Isaac Shoenberg uttered one of his famous sayings: 'Well gentlemen, we are afloat on an uncharted ocean and God alone knows if we will ever reach port.' It might have seen a low point, but the electronics team of Alan Blumlein, Cecil Browne and Eric White started to work on an electronic solution to the problem. The idea was to inject signal to cancel out the unwanted ones, but this wasn't simple as these varied to some extent with the nature of the picture being viewed.

The BBC and the Post Office also had a problem. BTL had set up a transmitter at Crystal Palace and were campaigning to be allowed to run a television service themselves. EMI, on the other hand, wanted a service, but run by the BBC with them supplying the equipment. It was for these reasons, as well as others, that the BBC favoured the EMI approach. They were well aware that BTL was owned by a film company and could transmit films. This would shut out the BBC, which they definitely didn't want.

To try to untangle this, John Reith of the BBC suggested to the Postmaster General that people from each of their organisations should meet to try to find a way forward. Representatives from both organisations met and they soon agreed that a formal committee should be set up to advise the Postmaster General on television matters. The BBC were keen that this should be as rapidly as possible as there were many contentious matters that needed to be resolved. A committee would have the authority to make recommendations and basically the BBC and the Post Office could hide behind them.

The Postmaster General agreed and a committee was set up. However things were not standing still. EMI were progressing rapidly though they still had many problems to solve. With the resources that Isaac Shoenberg was throwing at the problem it seemed reasonable that they would soon have a practical system. BTL were also progressing with two different methods of producing 'live' pictures. The race was on.

On 22nd May 1934 the joint company Marconi-EMI was formed. Isaac Shoenberg had at last put the whole package together, just in time, and was now in a position potentially to offer a complete studio and transmission solution to the BBC. His reward was that he was named one of the directors of this new company, the others all being senior board members from the two parent companies.

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1 McGee J D, The Life and Work of Sir Isaac Shoenberg 1880 – 1963, The Royal Television Society First Shoenberg Memorial Lecture 1971

2 UK patent 431327

3 IET Archives, NAEST 148/10.32. Notes for what appear to be reports to the management. Unfortunately they end at the beginning of February.

# 14 The Selsdon Committee

On 14th May 1934 the Postmaster General's Television Committee was set up. As it was under the chairmanship of Lord Selsdon, it became known as the Selsdon Committee. Its terms of reference were: 'To consider the development of Television and to advise the Postmaster General on the relative merits of the several systems and on the conditions under which any public service of Television should be provided.' The other members where an indenpendant vice chairman, two members each from the Post Office and the BBC, and one from the Department of Scientific and Industrial Research, and a secretary also from the Post Office.

On the 29th the committee met and issued a request asking for any society, firm or individual wishing to submit written or oral evidence to the committee to communicate with the secretary. Isaac Shoenberg contacted them straight away and invited the committee to a demonstration which took place on the 1st June. He understood immediately the need to impress the committee.

The demonstration was followed up at a meeting on the 8th June when he led a delegation of 6 to give evidence. With him were George Condliffe the manager, Alan Blumlein overseeing the electronics, C S Agate who was responsible for the receivers, Cecil Browne with the background in the mechanical film scanners, and N E Davis the Marconi transmitter expert. It was a very strong team and again showed the importance that the company attached to this endeavour.

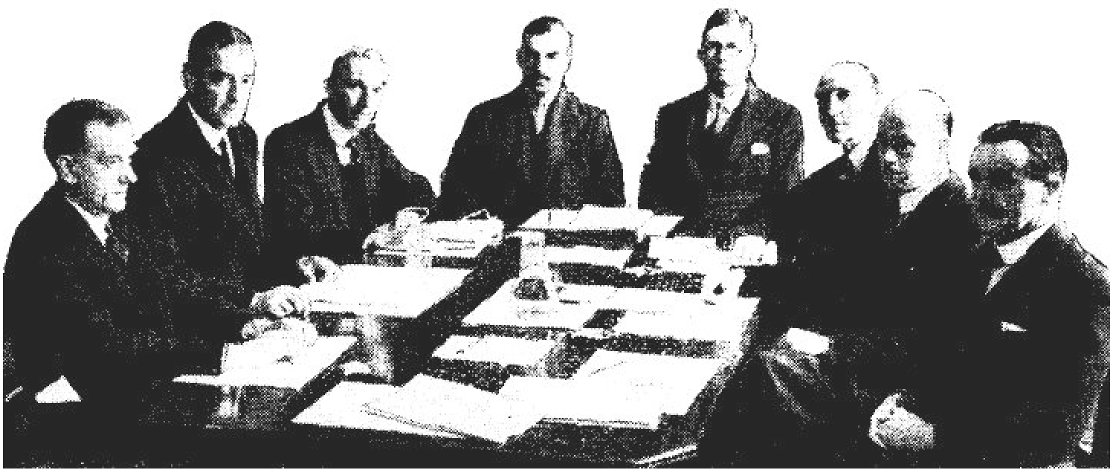

Fig 14.1 The Selsdon Committee. From left: Sir John Cadiman, Lord Selsdon (chairman), Mr. F. W. Phillips, Mr. J Varley Roberts, Mr. O. F. Brown, Vice-Admiral Sir Charles Carpendale, Mr. Noel Ashbridge, and Col. A. S. Angwin.

The potential competition now started to come out of the woodwork. In addition to BTL, Cossor, Ferranti, GEC, Plew, and Scophony all wanted to give evidence though it was unclear at this stage how many of these actually were in a position to offer practical systems. It was also noticable that none of them, including BTL, took more than three people to the committee. The effort that EMI, or now Marconi-EMI, was putting it was markedly greater.

On the 11th Arthur Clark accompanied one member of the committee to a further demonstration, and then two days later the whole committee came again. On 27th June Arthur Clark and Isaac Shoenberg were back giving further evidence to the committee. At some stage Stanley Preston, who dealt with patents at EMI, also gave evidence as the committee had some concerns about the patent position. It was an extraordinary effort ensuring that no stone was left unturned and nothing was left to chance. It was too important for the company. They were determined to win this race.

With all the work going on and the numbers of people that were being added to the EMI team, the research building was being extended with another wing. Louis Sterling was working hard rationalising the company to make cost savings which would free up money to support all this effort.

Isaac Shoenberg hadn't entirely put all his eggs in one basket as regards the camera tube. Gerhard Lubinski and Sydney Rodda were investigating ways to increase the sensitivity of the tubes by using an electron multiplier technique, but this was going to take more time to produce results. Also James McGee and Alan Blumlein had had a brainstorming session and come up with a scheme of Cathode Potential Stabilisation (CPS) that would overcome the secondary emission problems that were bedevilling the Emitron tubes. These ideas were all patented, but Isaac Shoenberg had to decide which should be progressed now and which held for later.[1]

It was clear to him that they must put maximum effort into the basic Emitron tube as that was the furthest down the line, and despite its problems, was known to work. He decided to continue with investigations on the possible increase in sensitivity as that seemed something that could produce results in the not too distant future, but the CPS idea would require a great deal of work and so was put into abeyance.

Fig 14.2 An uncorrected Emitron image showing the secondary electron shading.

The immediate problem to solve was the shading of the pictures due to the secondary electrons in the Emitron tubes. The electronics team under Alan Blumlein found a solution. Unfortunately the change from one side of the screen to the other wasn't a simple straight line, there was also a curve to it and so it was necessary to add two corrections which became known as 'tilt' and 'bend'.

This was needed across the screen on each line and also down the screen on each frame, meaning that there were 4 adjustments necessary. Also the sensitivity of the tubes varied, and so there was also an adjustment to standardise the brightness. It was brilliant work by the electronics team, but it meant that someone had to keep adjusting these controls as the scene changed and this required a considerable degree of skill. Nevertheless it was a solution to one of the most pressing problems.

Another problem which exercised the electronics team a great deal was the amplification of the transmitted waveform and whether this should just be the varying or ac waveform or include the fixed level or dc component. The consensus was that this latter should be included, but the method of achieving this was in dispute. The two ways were to amplify the whole signal together, or to only amplify the ac signal which was easier, and then restore the dc back in. The technique had been devised by William Willans, who had originally been part of the Columbia team, and was patented by him[2].

In the end Isaac Shoenberg had to intervene. As he was to say later: 'It seems strange now that this matter should ever have been one for controversy, but at the time there were cogent arguments on both sides and in the end I made the decision in favour of restoration.' Strategic matters always ultimately came back to him. The more tactical items he left to his teams.

It was a good decision to include the dc component. It turned out later that the Americans had decided not to include it and the brightness of their pictures varied as a result. It was one of the points in which EMI and RCA methods diverged, clearly showing the independence of the developments. Decisions like this were all part of Isaac Shoenberg's strategy which was to produce as good as system as could be sensibly achieved with the technology available at the time. This was an approach thoroughly understood by his teams.

Leonard Klatzow had moved on to trying to improve the sensitivity and the colour response of the photosensitive material. The Ag – O – Cs system they were using was sensitive in the infra-red region. This was undesirable as images and particularly faces look different in infra-red light and as a result it was necessary to use some very strange makeup to make things look normal. It had been noticeable that Valdimir Zworykin's tube was also sensitive in this region, so RCA had not solved this problem.

James McGee later explained how this problem was solved by Leonard Klatzow and a piece of serendipity:

> He had left a young technician, Hodgson, to prepare an experimental photocathode while he was away for a short holiday. When he returned he found Hodgson very apologetic because he had bungled the experiment. However, on examining the failed tube Klatzow found to his astonishment that a silver-silver oxide-caesium cathode had been formed which had a good visual sensitivity but very low infrared response. It took Klatzow quite a long time to find just what had been done by accident and repeat it in a real tube.

It was extraordinarily lucky as this was a considerable problem. It was possible to use the strange makeup, but if the television system was going to really be satisfactory in practice, it was a problem that needed to be solved.

The flicker on the display screens was the next problem to be resolved. What it really needed was an increased number of frames per second, but the implications of this was a doubling of the speed of everything and also the bandwidth of the transmitted signal. The search was on for a better way. In 1932 R C Ballard of RCA had applied for a patent for what he called intermeshed lines on a cathode ray tube.[3] The idea was to scan every odd line and then every even line. The effect was to double the screen rate as far as the flicker was concerned without increasing the bandwidth of the transmitted signal. It did appear to be getting something for nothing at the cost of some circuit complexity.

In 1933 a British version of this patent had been taken out in the name of Marconi's Wireless Telegraph Co as an example of the complex linkages between the various companies. Because EMI was now linked with this company in the Marconi-EMI company they had the right to use it. Thus there was no need to contest it, as the idea went back some way and even John Baird had patented something not very dissimilar and so there was some doubt whether it was valid.

After some discussion, Isaac Shoenberg agreed that this was the way forward. However, there was a need to change the number of lines in the picture. For this scheme to work there needed to be an odd number of lines. It is an odd quirk of numbers that to get an odd number by multiplying others, they all have to be odd. After some fiddling with numbers they chose 3x3x3x3x3 which is 243 as the division ratio between the line and frame, hence producing the 243 lines. This was some increase from the 180 lines they had been using, but now with electronic tubes at both ends the mechanical limitations no longer applied.

The scheme they implemented now effectively gave the performance of 50 frames a second though only 25 pictures a second were transmitted. Also with 243 lines, and no flicker, it was now a very satisfactory picture. It did need some upgrading of the electronics, and the additional complications of the interlacing as the technique is more commonly called.

Fig 14.3 Alan D Blumlein – the heart of the electronics effort at EMI

There had been a tremendous amount of work by Alan Blumlein and the electronics team to define the characteristics of the whole system. The inclusion of the dc component in the transmitted signal had been decided, but there were many other issues to be settled in the exact form of the transmission waveform. There were decisions about which way up the signal should be; should white be a maximum signal or should black.

How should the synchronising arrangements be made and what form should they take in the transmission? Alan Blumlein worked his way through the issues and eventually came up with a set of standards that formed a robust arrangement. More white should increase the signal and black would be an intermediate value of 30% with the pulses that determined the synchronisation of the lines and the frame being ‘blacker than black’. It was a very effective arrangement and robust in use.

In addition to the work on defining the system, Alan Blumlein had to lead the electronics team and could go anywhere and assist. He had an uncanny knack of looking at other people's problems that they were struggling with, and rapidly come up with a solution. This didn't always endear him to the recipients, but all the engineers soon began to appreciate that he was trying to help and he had a mild manner and would apologise immediately if he thought he had caused offence.

His contribution to the operation was immense, and some have described him as a genius. He was the one with a roving brief to bring all the work together. With a system that spanned all the way from the camera through transmission to reception, it needed someone to take an overall view. While Isaac Shoenberg dealt with the strategic matters it was Alan Blumlein that ensured that all the detail was correct. Isaac Shoenberg was so pleased with him that he presented him with a gold pocket watch in November 1934.

Once the 243 line, interlaced, standard was implemented it was time for more demonstrations. These included Sir Stafford Cripps, representing the government, and even the Prince of Wales. Valdimir Zworykin of RCA also visited, but it is doubtful that they told him any more than he had been telling them. By December the Selsdon Committee made another visit to see the progress. EMI now had a reasonably satisfactory system and were proud to show it off. One demonstration was even to the staff of the head office.

Lord Selsdon and his committee set about their task very thoroughly. They ended up examining 38 witnesses as well as consulting various government departments and received many written statements. Any relevant demonstrations that were offered to them, they attended. They also contacted the telegraph administrations in France, Germany and Italy as well as the Federal Radio Commission in the USA to discover what they could about those country's television schemes.

In addition they sent a delegation to America where they visited most of the important organisations involved in television research, as well as the Authorities involved with broadcasting including with the Federal Communications Commission. A second delegation visited Germany to look at the experimental installations of the Reichspost and of several companies in Berlin.

They were being very thorough so that their advice to the Postmaster General would represent a rounded view of the whole subject and not just what was happening in Britain. In view of the battle between BTL and Marconi-EMI this was very wise. It was very important that they didn't just get sucked into only considering the merits, or otherwise, of these and any other British offerings, but took a longer view of where the whole industry was heading.

This must have been a very worrying time for Isaac Shoenberg. Had they done enough to convince the committee? When it came to the engineering matters he had confidence in his team, but this was something largely out of his control and the whole business hinged on this. First would they recommend that a television service went ahead? If not, then this whole effort would have been wasted.

Even if they did recommend a service would that give them the opportunity to exploit their system? The committee had been tight lipped about the information that each company had provided on the grounds that it was commercially confidential. Thus the precise position of all the other companies wasn't known. It didn't seem likely, but had someone such as BTL come up with a better system?

The committee had hoped to have their report ready before Christmas, but some delays, including problems with getting to talk to John Reith the Director General of the BBC, meant that the report didn't appear until the 31st January 1935, when it was presented by the Postmaster General to Parliament.[4] What might have not been too obvious at the time was the importance they placed on consideration of the future of the existing 30 line television service. What would be its future if a high definition service became available? There was a considerable body of amateurs, and some magazines that supported them such as Television and Shortwave World, that wanted the 30 line system to continue.

When the report came out the committee had ducked this problem. They recommended that their committee should be succeeded by a Television Advisory Committee (TAC) and that this service should continue for the moment. The TAC should then advise on when it should finish. The general idea was that it should continue until at least one high definition television station was operational.

What was a considerable relief was that they thought that the state of the art had reached a level where a high definition service was practical. Obviously with the limited range of the high frequency transmitters needed to carry the signal, a number of stations would be needed. The service would start with one station, and that, of course, would be in London.

Seeing the committee contained representatives of the BBC, it was hardly surprising that it was recommended that the BBC should run this new service. They also recommended a minimum standard for this service as 240 lines at 25 frames per second, though a higher one would be acceptable. This was a relief to Isaac Shoenberg, and showed that no one had produced something superior to their system.

The bulk of the report dealt with many of the matters of importance to the BBC, such as how the service was to be financed. They were also concerned with the relation of vision broadcasting to that of sound only. They also recommended that the vision pictures should be accompanied by sound, as if anyone had considered not doing so, but as it required an additional frequency to broadcast it, they wanted to be sure no one tried to cut a corner.

Eventually, buried in the heart of the report was the recommendation that the systems from two companies appeared to reach the required standard. These two companies BTL and Marconi-EMI should be invited to tender and that the intention was that both systems should operate side by side in a new station which would cover the London area.

While this was a matter of relief for Marconi-EMI that their system was included, there was the feeling that the committee again had ducked from making a firm recommendation. What might not have been too obvious was that there would have been political problems if BTL had not been given a chance. They were the ones that had the profile in the public imagination due to their long courting of the press. They also had friends in high places. Nevertheless the shares of both companies rose on the stock exchange with the news.

The report was greeted with incredulity in America. They could not believe that Britain was ready to launch a high definition television service, particularly at the level that was being suggested. They had thought that they were well ahead, and this came as a nasty shock to them that progress in Britain was much more advanced than they thought. Some suggested that it simply wasn't true, while an opinion was expressed that they had been misled by the Television Committee representatives when they visited America a few months before.

The company suddenly issued Isaac Shoenberg with a new contract to run from the 1st January 1935[5]. Basically it was the same as the previous one, with a single significant change. His salary was raised from the already impressive sum of £4000 per year to the even more extraordinary sum of £5000. It was clear that they were very happy with what he had been achieving with the team he had built up, despite the risks involved.

Isaac Shoenberg, however, now had a good idea of where they stood. He could be reasonably confident that BTL were still using mechanical methods for their 'cameras' and knew the limitations of these. They would need huge amounts of light to get a reasonable picture, and would not be very flexible in use. He knew from discussions with the BBC people that the ability to move the cameras about was considered to be very important. The electronic cameras scored well on this point.

The other requirement, as he knew well was to be able to televise sporting fixtures and other out of doors events. Having an outside broadcast facility was the way the service had to go and the Emitron cameras were just about good enough to provide this. Also he had Gerhard Lubszynski and Sidney Rodda working on a project which should lead to a more sensitive camera in the future. He had that covered.

What nobody outside the company knew was that he had another trick up his sleeve which was likely to change the rules of the game. It was now time to play that card.

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1 GB patents 442666 and 446661
2 GB Patent 422906
3 US patent 2152234A
4 The Selsdon Committee's report (Cmnd. 4793)
5 IET Archives, NAEST 62/2.7

# 15 Preparations for a television service

The Television Advisory Committee was remarkably quick off the mark as its first meeting was on the 5th February 1935 only days after the publication of the Selsdon Committee report. Clearly the arrangements of the committee had all been resolved before the report appeared. It was helped by the fact that most of the committee was the same, with two people dropping out to be replaced by another from the Department of Scientific and Industrial Research. The BBC and the Post Office retained their representation.

Fig 15.1 The television advisory Committee, TAC. From left to right, are: Mr. Noel Ashbridge, Mr O F Brown, Sir Frank Smith, Lord Selsdon (chairman), Mr F W Phillips, Col A S Angwin, and Mr J Varley Roberts.

They had a number of matters to resolve: the specification of the equipment from the two companies, the location for a London station, and the form of a set manufactures licence to deal with all the patent issues. They were particularly concerned about this as they remembered the situation when radio was first introduced and the Marconi Company held the relevant patents and was persuaded to offer a general licence to bona fide set manufacturers which covered all the relevant patents.

Their caution was undoubtedly because the Marconi Company was involved again, as was the person who had been in charge of those patents, namely one Isaac Shoenberg. This time he was in a different position, but he still controlled many of the key patents. The television situation was also more complicated as some of them were in the hands of other organisations and only licensed to Marconi or EMI.

For Isaac Shoenberg, the nature of the competition from BTL was beginning to become a bit clearer. They were offering four different systems to cover the requirements for the new service, all at 240 lines and 25 frames per second. The first was a telecine machine for transmitting films. This was still using a mechanical method using a Nipkow disc. This was using a technology the BTL had been working on for some time and had now increased the number of lines. It was likely to be reasonably satisfactory.

The second was the Spotlight Scanner which was an updated version of the early Baird system, but at this number of lines it would need a very bright light and could only show head and shoulders of someone who was in the dark. It wasn’t likely to be very satisfactory. What he probably didn’t know was that BTL had not solved the problem of the photocells being responsive to infra-red light and so the strange yellow makeup and blue lipstick was needed.

The third was what was known as the Intermediate Film system. They had even considered it themselves at one point, but had decided it was impractical. It started with a film camera taking pictures of the scene. The film came straight out of the camera and was processed as fast as possible and then transmitted by being read by what was basically a telecine machine. Effectively this ‘stored’ the image and so didn’t need excessive amounts of lighting, but the complexity and inflexibility scored heavily against it.

The fourth was an electronic camera. It was soon apparent that this was not BTL’s work, but buying in the device produced by Philo T Farnsworth in America. The information available made it clear that it did not have the essential ‘storage’ and hence would need huge amounts of lighting at this number of lines. Also the buzz around the industry was that the development hadn’t progressed that far. Altogether there wasn’t too much to worry about.

The Television Advisory Committee (TAC) decided to set up a Technical Sub-committee and on 15th February the companies were invited to come and explain the specification of their systems. It was here that Isaac Shoenberg, accompanied by George Condliffe and Alan Blumlein, produced his new card. He said that the offer would be as previously stated to the Selsdon Committee, but with one important change. He was now offering pictures at 405 lines instead of 243. It was a very considerable uplift and a huge surprise.

Towards the end of 1933 there had been two technical papers published in America investigating the satisfactory number of lines needed for a satisfactory television picture[1]. It depended on whether the scene was a close-up or a more complex view of say a football match. The articles agreed that for a satisfactory picture under all conditions the number of lines needed to be 360 or more like 400. Going much beyond that wasn’t necessary.

In the autumn of 1934, with a satisfactory 243 line system, Isaac Shoenberg and the team had asked themselves what was the practical limit for the number of lines. With the absence of mechanical parts, the issues were about spot sizes in the camera and receiver display, and then the performance of the electronic systems, particularly the bandwidth.

One Sunday afternoon, in November 1934, Alan Blumlein had held a brainstorming meeting at his home with a group of his electronics engineers including Eric White, Edward Cork, Michael Bowman-Manifold and William Percival. They were looking for a simple way of converting the 243 line system to run at a higher number of lines. The solution was to convert one of the dividers from 3 to 5 and this meant that the number of lines was now 3x3x3x3x5 which is 405.

They considered the other changes necessary and over the next couple of months a modified system to run at this new rate was constructed. This was not a fully worked out system with all the advantage taken of the potential, but one that demonstrated that all the parts could be run at this number of lines. It was shown to Isaac Shoenberg shortly before he had to disclose his preferred basic specification to the TAC.

Later, James McGee was to say, regarding Isaac Shoenberg’s opting for 405 lines[2]:

> I consider it the most courageous decision in the whole of his career… Remember that this meant a 65% increase in scanning rate and a corresponding decrease in scanning beam diameter in the cathode-ray tube and nearly threefold increase in the picture signal bandwidth and worst of all a fivefold decrease in the signal/noise ratio of the signal amplifiers. And this lists only a few of the resulting problems!
>
> The cynic may say that this was a piece of gamesmanship planned to overwhelm our competitors. But no one who knew Shoenberg or was aware of the real state of technical

development at the time would give this idea a moment's credence. No! – it was the decision of a man who, having taken the best advice he could find, and thinking not merely in terms of immediate success, but rather of lasting, long term service, decides to take a calculated risk to provide a service that would last.

Clearly James McGee, who of course was there at the time, was very impressed with this. However, most of the problems fell into the electronics area and no doubt all of this was thoroughly discussed with Alan Blumlein and the team before making the decision. It might not have been quite a risky as James McGee was suggesting, because they had already shown that the parts could work at the increased rate. In addition, he had already asked N E Davis, the Marconi transmitter expert, what he thought he could achieve.

Isaac Shoenberg also knew that if the increases in bandwidth couldn't be achieved all that would happen was that the picture wouldn't be quite as sharp as it could be theoretically. It was likely that initially the receivers couldn't deal with the full bandwidth required for the 405 lines, but it was better to have a standard that meant that as they improved it would not be necessary to make any changes in the transmission.

It was another example of Isaac Shoenberg's ability to carefully calculate a risk and then take it. He didn't need to do this as the 243 lines and 25 frames per second interlaced already met or exceeded the required minimum specification. However, he was thinking of a standard that would last, as operating at 240 lines was not fully satisfactory and was bound to be superseded in the not too distant future. Perhaps in the back of his mind was also the thought that some of the competition had been eliminated because they couldn't meet the 240 line standard, and this might happen again.

However C S Agate, in charge of the receivers, was a little concerned that they might not be as reliable at the higher rate as at 243 lines. Also, as Isaac Shoenberg was to say later: 'I was warned by a well-meaning and very influential friend that my crazy choice of 405 lines instead of the safe and perfectly sufficient 240 lines, apart from ruining the company, would probably also break my neck.'[3] Despite this warning, probably from Louis Sterling, having calculated his risk, he stuck to his decision; to the admiration of his team who felt that this new specification was just another interesting challenge.

A few days after the meeting with the TAC, they were giving a demonstration to Lord Selsdon and then to other members of the committee. Presumably this would have been of the 405 line system. The committee didn't seem concerned about whether this number of lines was achievable; they were more bothered to try to establish whether equipment could be shared between the two systems.

It soon became apparent that only the sound system and the aerials would be common as neither company wanted to share vision transmitters. Isaac Shoenberg was very keen that the secrets of their system, including such things as the modulator for the transmitter, should not leak out to the competition. Fortunately, though, there was general agreement on the approximate frequency of the transmission. With such different methods for generating the signals and a different transmission standard the committee had to accept that little could be saved by using common equipment. The BBC was faced with largely buying two sets of equipment.

The committee was also busy examining sites for the London television station. It had already been decided that none of the existing BBC sites was suitable. What was required was somewhere on the highest hill possible with a clear view over most of

London. There also needed to be some buildings to accommodate the studios and equipment.

They came to a list of four possible sites; Crystal Palace, Tudor House and Heath House both in the area of Hampstead Heath, and Alexandra Palace. Crystal Palace was already occupied by BTL and they didn't want to be tied to them and also it was in south London when it was likely that the bulk of their potential 'lookers', as they were known at the time, were likely to be in north London.

The two sites around Hampstead Heath were promising but the possible installation of a high transmitting mast was likely to bring considerable opposition from vocal people in the area. The committee shied away from this and so the choice settled on Alexandra Palace, despite it not being quite as high as the others. This could be overcome with a taller mast, which would be acceptable as it was in a park and away from other buildings.

The place was unused and so it was possible to lease a wing and refurbish it for the studio and equipment requirements. Also there was a tower at the end which, with some reinforcement, could be used for the base of the aerial mast. It had no near neighbours and was easily reachable from existing BBC sites and central London. Thus the choice fell on Alexandra Palace.

Fig 15.2 Alexandra Palace, with the wing being used for the television station, and the aerial mast with a total height of 300 feet.

By March the committee had come to a conclusion on this and they submitted their recommendations to the Postmaster General in early April. However, this wasn't publicised in the Press until early June, though the choice had leaked out earlier from the Trustees of Alexandra Palace who were very keen to put part of the building to use. That was another advantage, as the Trustees were, understandably, very helpful.

While this was in chain the two companies had been sent a questionnaire by the committee to lay out exactly what precise standard they were offering. BTL tried to argue that the interlacing was not proved to remove the flicker, even though the committee members had been shown demonstrations by EMI which proved the contrary. Also Engstrom of RCA published an article where he showed the improvement that could be obtained from interlacing, and also determined the minimum rate to avoid flicker[4]. It was higher than the 25 frames that BTL were using and lower than the effective 50 of the EMI system.

Also BTL were keen to stick to 240 lines as their mechanical systems couldn't go much further. They thought it would last for three years. BTL's view was not that higher numbers of lines were impossible, just undesirable. The wisdom of Isaac Shoenberg's view that a higher standard would have a longer life was apparent from this. Clearly BTL were on the back foot, but the Selsdon committee had set a minimum standard and as they met it, there was little the TAC could do but accept it.

However, they did attempt again to see if a common standard could be achieved. There was further wrangling and suggestions of an intermediate number of lines, but this was not acceptable. Isaac Shoenberg stuck to his guns and said that he thought each company should be free to give the best service that they could during the experimental period. This opinion eventually prevailed, and the two standard system was announced to the press in early June at the same time as the choice of Alexandra Palace as the venue.

Immediately the two companies were invited to tender for the supply of equipment for the new station. They were only given less than a month to do this as these had to be submitted by 4th July. This was a stressful time for Isaac Shoenberg and his team. They had absolutely no previous experience to go on, but they had to quote for the whole systems and get the figures right. This meant that they had to have a reasonable return, but the price should not be too high and annoy the committee.

They submitted on time with an offer of 6 cameras, two for telecine work, and four for use in the studio. The price was £15657 for the vision transmitter, and £24530 for the studio equipment. They had pitched it about right as the committee didn't want to quibble with their figures. Unknown to them, BTL had come in with considerably higher numbers and were pressured into reducing some of them, though they still ended up higher that EMI's. They had included the Farnsworth electronic camera, but the committee refused to include this as they had not seen a working demonstration.

The issues for Isaac Shoenberg were about the running costs, which he was forced to reduce, and the old chestnut of the licence of all the patents to allow other companies to manufacture the receivers. This was reasonably straightforward as it only required giving an undertaking that this would be forthcoming.

In August, it seemed a reasonable time for Isaac Shoenberg to go on holiday and they went to Austria. As a Jew he was still safe there at this time, but it was unwise to go to Germany. He was a great believer in his staff taking proper holidays because they would work much better if they were refreshed by a proper break. However, just as he was taking his break, a crisis blew up with the committee and he was forced to try to negotiate remotely.

One matter that was applying pressure to the committee, which inevitably spilled over to the companies, was that the BBC 30 line transmissions, using the Baird equipment, were to be shut down on the 15th September. There had been many who were unhappy about this and so, as the decision basically came from the committee, they were the ones being criticised for the absence of a television service. They were thus in a hurry to get the new high definition service operating as soon as possible.

However, protracted negotiations with the two companies, and the need to come up with a common set of conditions delayed the placing of the contract until October. BTL were still not happy and went on arguing until January, when they finally accepted them. All this was eating into the time needed to produce the equipment, though it was obviously possible to do some of the work beforehand as there was little doubt that it would appear soon.

With the contact finally placed it was time to actually do it. They really were going to equip a television station. All the experimental and prototype items had to be turned into proper production units. However, the committee were soon back asking if either company could supply portable outside broadcast equipment. Isaac Shoenberg politely answered that the necessary development work couldn't be undertaken until the London Station was nearing completion.

With the supply and installation of all the equipment at Alexandra Palace due at the end of February 1936, the timescale was already very tight. He knew it would be madness to divert resources on to this when everything was needed to get the station ready. Besides BTL were unlikely to be able to offer anything.

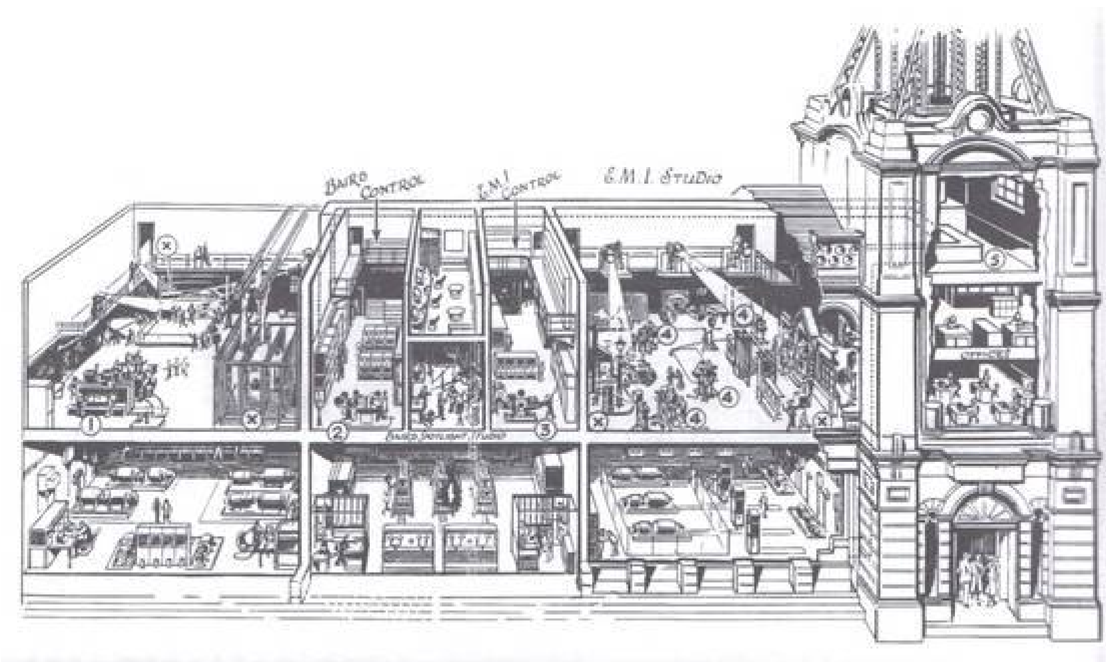


Fig 15.3 Cutaway showing how the studios and equipment rooms fitted into the wing of Alexandra Palace.

Though the mast was scheduled to be finished by mid March, delays soon began to creep in. This gave cover for delays in the installation of the equipment and in reality it was looking more like the end of April when everything would be installed with testing and inspection by the committee still taking place, and even this started to slide. In the end it took until July before the mast was complete. Needless to say the committee was not happy with the progress.

The teams were working anything up to 15 hour days. No one had done anything like this before and so trying to estimate how long it would take was very inaccurate. Any small problem often had knock on effects elsewhere and could cause delays out of all proportion to the problem. It was clear that BTL were having just as many problems, if not more, and were also struggling to complete their installation.

What was concerning the committee was that there was going to be the Radio Exhibition at Olympia which was due to start with a Press view on the 23rd August. The committee were being criticised for the delays, though of course it really wasn't their fault, so for them it was vital that demonstration transmissions should take place then. To add more pressure to the companies they made it clear to each of them, that if their equipment wasn't ready they wouldn't be included in the transmissions.

The pressure on the teams was immense. Alan Blumlein, supervising work on the transmitter one evening at Alexandra Palace, was so tired that he keeled over and cut his head quite badly. Everyone was under the cosh as failure to deliver the system in time for the exhibition was bound to bring bad publicity and put the whole project in jeopardy. Isaac Shoenberg himself was under great pressure, but he managed to hide this from the teams. They had enough to deal with.

In the midst of all this another problem arose. Isaac Shoenberg was to describe it later[5]:

> …a few weeks before the Alexandra Palace transmitting station was due to open, we seemed to have lost the art of making first class Emitrons. Naturally when things like that happened they caused great anxiety, but I must confess to you that fundamentally it did not disturb me too much, for if there is any lesson any research worker learns—sometimes rather painfully—it is that the course of true research never did run smooth. With such a wonderful team as mine I should not have done my duty if I had not followed the rough and uncertain path which was, perhaps, the only one which could lead to considerable achievement.

Nerves of steel! With all this going on and the management behind him nervously waiting for the company to come out the other end and start getting some return on all the effort and expenditure; he remained calm. He knew he had to sit on his hands and let them get on with it; there was nothing he could usefully do.

Perhaps his confidence wasn't misplaced. He had built up an exceptional team which totalled 114 people. There were 32 graduates of whom nine had PhDs, which were rare at the time, 32 laboratory assistants, four glass blowers, four female pump operators, one coil winder, three mechanics, 25 instrument and tool makers, five girl assistants, seven draughtsmen designers and one designer draughtsman.

In the end both companies made it. EMI had two days to spare and BTL only managed it at the very last moment, but in principle they were ready and demonstration programmes went out for the exhibition. The Press were quite impressed on their preview day and gave good reports. For the actual exhibition, the interest was such that the visitors only had a short time in front of the receiving sets so that others could get a glimpse.

The Baird transmissions used the spotlight scanner for announcements and then film as their intermediate film system wasn't yet commissioned. However, the EMI transmissions had scenes from the studio and even outside in the park, as well as film. Though both companies suffered breakdowns, the difference between them was beginning to show.

The BBC were gathering a great deal of information from the public and it rapidly became apparent that just showing films didn't go down very well. This was playing into EMI's hands as it was in the live programmes where their strength lay, whereas Baird's was in their telecine. Cossor, one of the receiver manufacturers, wrote a report on their view of the transmissions. They had a few minor comments about the EMI system but on the whole were complimentary. However the BTL transmissions, they said, didn't conform to the stated specification and they didn't like the rigidity of the spotlight scanner.

The opening of the television service was now set for the 2nd November, but the committee had grave doubts about the Baird system as their intermediate film machine had not yet run reliably. Though BTL had won the toss to go first on the opening ceremony, the committee decided that if the intermediate film system didn't pass a test a few days before, they would change to the EMI system. In the end they decided to run the opening ceremony twice, a few minutes apart. Just in case.

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[1] Wenstrom W H, 'Notes on television definition', *Proc. IRE,* 1933,21, No. 9, September, pp.1317-1327; Engstrom E W, 'A study of television image characteristics', *Proc. IRE,* 1933, 21, No. 12, December, pp. 1631-1651

[2] McGee J D, The life and work of Sir Isaac Shoenberg 1880 – 1963, 1971 Shoenberg Memorial Lecture, The Royal Television Society Journal, Vol 13, No 9, May/June 1971

[3] Shoenberg I, Notes for a talk, IET Archives NAEST 62/3.9

[4] Engstrom E W, 'Determination of frame frequency for television in terms of flicker characteristics', *Proc. IRE,* 1935, 24, No. 4, April, pp. 295-310.

[5] Shoenberg I, Response to the award of the Faraday Medal, Proc IEE, Volume 101, Issue 130, July 1954, p. 249 – 254

# 16 The London Television Station

It might be thought that with the opening of the television service at Alexandra Palace, the pressure would be off Isaac Shoenberg and his team; but it wasn't so. First of all they were still in a trial of the two systems, and clearly the BBC and the Television Advisory Committee (TAC) didn't want this to continue so there was only going to be one winner. Isaac Shoenberg was very determined that it was going to be their system that came out on top.

It was thus imperative to ensure that the system worked as well as possible at all times. One particular problem was that the lifetime of the Emitron tubes was not very long and varied from some 200 running hours down to poor ones which perhaps only lasted 10 hours. It was thus necessary to keep up a constant supply of new or refurbished tubes so that the cameras were maintained in operation.

The opening ceremony, which he attended, was an opportunity to see the Baird equipment in operation. The intermediate film system, stuck behind its glass window because of the noise it made, was very inconvenient for the BBC because of its inflexibility and that transferred to rather rigid and hence less interesting pictures. The comparison with the use of the Emitron cameras was very marked. They had already seen the transmitted pictures from the spotlight scanner, and they were pretty bad.

A pointer to the likely outcome was that Isaac Shoenberg had eventually quoted for an outside broadcast unit, and before the decision on which system would finally be used, an order was forthcoming. Clearly BTL were unable to quote for this, but it was still a surprise that the committee and the BBC should want to progress this before the decision.

Fig 16.1 Elizabeth Cowell, one of the first presenters, faces an early Emitron camera which still had the unsatisfactory crude viewfinder.

A system of three Emitron cameras and more or less a copy of the studio equipment was housed in a truck and provided a suitable outside broadcast unit. However there were a couple of problems; it was not always possible to obtain power at every location and so a second vehicle with a generating station was also provided. The other problem was to find a way to transfer the signal from the unit back to Alexandra Palace for transmission. The committee were considering both cables and radio transmission but were unsure about either.

As usual Isaac Shoenberg was well ahead of them and had already set in chain some research work to produce suitable cable. Their clever design of balanced pair cable had been manufactured and a demonstration was arranged for the committee at Hayes. The signal was fed through the cable on huge drums in the works which showed no appreciable change in the picture with or without it. It could work for up to 8 miles without a repeater which was convenient as Broadcasting House was on 7.25 miles from Alexandra palace and could house the repeaters.

The cable was pulled into ducts by the Post Office, and connected to a number of convenient points. This would give reasonable access to most of central London. It certainly would enable some coverage of the forthcoming coronation to take place. At the same time, after some discussion over price, another truck with a radio transmitter to send signals from the outside broadcast unit to Alexandra Palace was also manufactured. There were thus three trucks which used together could provide outside coverage of most of the London area.

It became clear that BTL were struggling with their equipment. They kept modifying it to try to make improvements but they suffered numerous breakdowns and distortions as dirt got into the holes in the Nipkow discs. These had also not been manufactured as accurately as they really needed to be and this showed up as bends in the pictures. One of their own engineers, Jim Percy, didn't have a good opinion of the intermediate film process, and later said:[1]

> We knew how to transmit film so why not take a film of the studio action and then process it quickly. Maddest idea I ever heard of. Absolutely crackers. I can still get hysterical over it. It was another German idea and they had, of course, in their typical efficient way, got it working quite well, but we never did.

Some of this information must have leaked back to EMI, and hence it would have been apparent to Isaac Shoenberg that the cards were falling in their favour. BTL had been experimenting at Alexandra Palace with the Farnsworth electronic camera, but it was still not in a satisfactory state. The images were distorted, and it required formidable amounts of light to get reasonable pictures. It showed BTL's desperation, but it was no match for the Emitrons.

Then came an event that signed the death knell for all Baird's efforts. In the evening of the 30th November 1936 a small fire started in the Crystal Palace building. Despite efforts to put it out, it quickly spread and by the time the fire brigade was called it was totally out of control. As a result the whole building, apart from the north and south towers, was destroyed. All BTL's offices, workshop, equipment and spare parts, were lost and so there was no chance of them being able to improve their equipment at Alexandra palace.

What Isaac Shoenberg probably didn't know at the time, was that Gerald Cock, the BBC's Director of Television, after little more than a month's experience, had written a report. While it was generally complimentary about the Marconi-EMI system, its comments on the Baird system were very damaging. Apart from the telecine, which except for the flicker, was satisfactory, the rest of the system was not suitable for a television service.

As a result the advisory committee decided to recommend that future transmissions should be at 405 lines and with the interlacing to avoid the flicker. This was put to the Baird Television Company who only gave a mild reply. Probably they had been expecting this and they were in some ways relieved to get rid of the costly transmission side of the business and concentrate on selling receivers.


Fig 16.2 The outside broadcast unit with its three cameras that could operate up to 1000 ft from the truck

They did raise one matter, and that was something also of concern to the committee. The new standard involved the use of interlacing and that was covered by the RCA 'Ballard' patent. They didn't want this to be used to make an effective monopoly of either the transmitting or of the receiving equipment. The TAC had already questioned Isaac Shoenberg about the receiver side and he had given some assurance on that. They had also asked him whether there was any way to avoid the patent, to which his response had been: 'This is the only way I know of, and if I knew of any other I would have patented it.'

Clearly they were in a similar position to the early radio business in that one organisation held all the patent cards. Worse still, the same person was in charge of all those patents and he had proved adept at exploiting the strength of the position last time, and could be expected to do so again. The intention had been to shut down the Baird system in early January, but they held off from that to apply some pressure while they negotiated over the patent position.

It was also clear that EMI in particular had spent a great deal of money in developing their system and wanted to get as much return as possible without 'standing in the way of progress'. It was thus a difficult circle to square, and discussions went on throughout January of 1937. While Isaac Shoenberg, and the companies, were prepared to concede the point as regards the receivers, they wanted to protect their position on the transmitting side where possible.

In the end Lord Selsdon and Isaac Shoenberg met to thrash out mutually agreeable wording of a draft agreement on the 25th January. A few days later this was confirmed by Marconi-EMI and the matter was finally resolved. The committee notified the Postmaster General, and on 5th February the decision to only have one system was announced, and that was to be Marconi-EMI. As that was during a week when the programmes were being transmitted on that system, the Baird equipment was not used again.

While BTL were not too distressed, John Baird was not happy with the decision. He could not accept that he had made a mistake in carrying on with mechanical systems for too long. He also could not appreciate that EMI had almost completely developed the system on their own. He kept to the line that this was an American system from RCA and hence unfair competition. He went off to try to tinker with receivers suitable for showing television pictures in cinemas. He was happiest while still inventing. He had no understanding of the professionalism and carefully constructed teams that Isaac Shoenberg had built to solve all the myriad problems to produce a really satisfactory system.

On the other hand it must have been a relief to Isaac Shoenberg to finally have the matter settled. While the pointers had been in this direction for some time, there had always been a measure of doubt. The commitment had not only been in money by the company, but also personally by all those involved in the development. This was particularly true of Isaac Shoenberg whose neck was definitely on the block had this huge gamble not succeeded.

Once again it would have been easy to relax and celebrate that it was all over. Isaac Shoenberg knew that there was still work to do. They needed to support the BBC to ensure that the system performed as well as possible for real programmes. There was a need to keep improving. Sometimes it was small things like the need for a proper viewfinder on the cameras. It was only when the cameras were used in real studio situations that this became apparent and a suitable device had to be designed and fitted.

At Alexandra Palace the BBC had taken advantage of the long cables available for the Emitron cameras and had used the space outside the building for outside broadcasts. These included gardening, archery, firefighting demonstrations, and dog shows among other things. The BBC had already seen the need to go further afield and so had ordered the mobile unit long before the matter of the transmission standard had been resolved.

This was just as well as there was a coronation in the offing and they were keen to be there if possible. This had been planned for Edward VIII and was to take place on 12th May 1937. However, on 11th December 1936, he abdicated as he preferred marriage to Mrs Simpson to being the King. He was succeeded by his brother as George VI and it was decided to retain the coronation date, only with a different monarch.

They were not permitted to place cameras inside Westminster Abbey, but there was no objection to them capturing the procession. After surveying the route the best position appeared to be at Marble Arch, and with the outside broadcast trucks being delivered with only a couple of days to spare, after another rush to get everything ready, they were positioned there just out of the way. Despite the signal disappearing just before they were due to go on air, which was solved with a bang on the racks of equipment, the broadcast was a great success. Though there were a relatively small number of receivers, it was estimated to have been seen by 50,000 people and received up to 63 miles away.

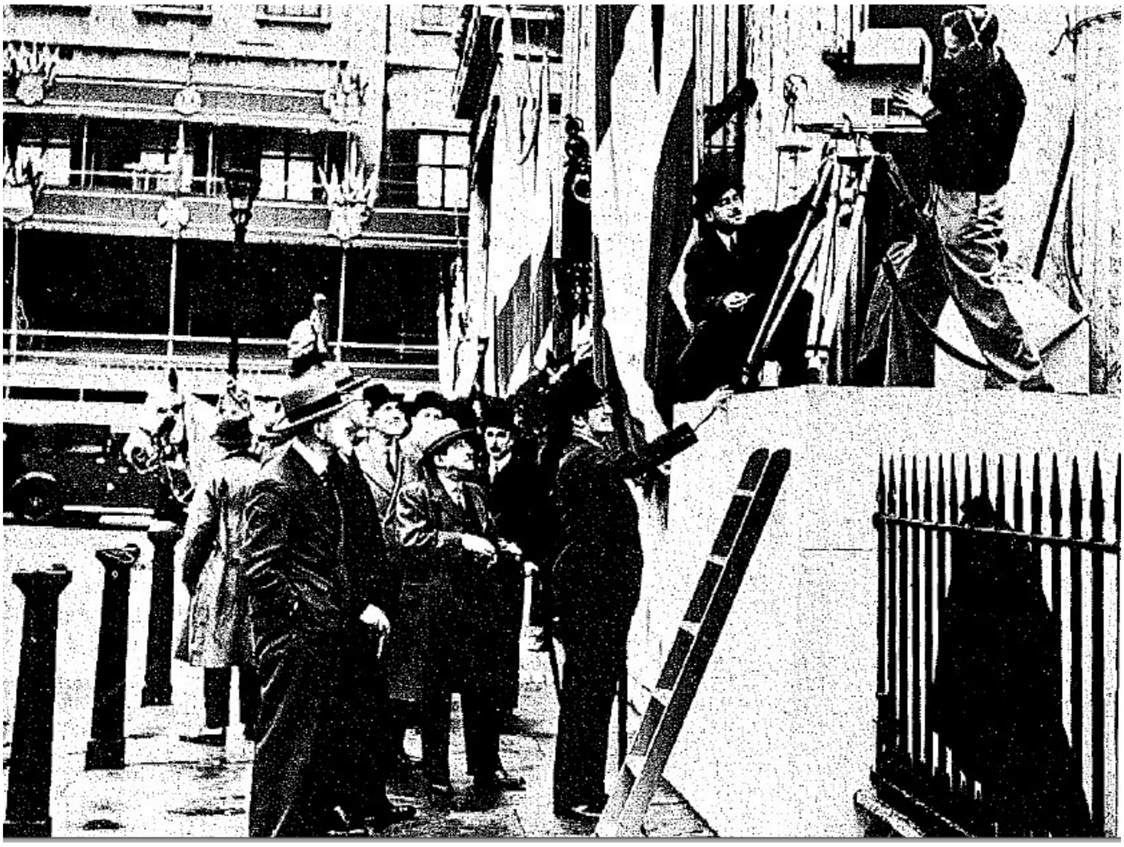

Fig 16.3 Isaac Shoenberg and the Television Advisory Committee examining the camera setup at Marble Arch before the coronation procession. Sir Noel Ashbridge is on the plinth, by the camera and cameraman, with Lord Selsdon below him. Isaac Shoenberg is the small man in the centre of the group.

This gave the BBC confidence in outside broadcasts and they fitted many into the schedules, such as tennis at Wimbledon and the London Lord Mayor's show. It all helped to raise the interest in the new television service. No other media could bring live pictures of an event. In cinemas the pictures could be shown, but well after the event, while sound radio, of course, had no pictures. They were so pleased with the outside broadcasts that it wasn't long before they were ordering another set of equipment. This was all good business for EMI, and provided another opportunity to recover some of the development costs.

Isaac Shoenberg sometimes invited guests from his teams to his home in Willesden and on one occasion Dr Ralph Beal his opposite number from RCA was also present. James McGee was one of those present and he described what happened:[2]

> 'When the time came for the short evening TV broadcast, Shoenberg quite casually switched on the receiver in his lounge and we all settled down to watch the programme – though of course everyone was much more interested in the technical quality than the actual programme content, and on tenterhooks lest there might be a technical hitch. You can imagine our pleasure when, as soon as the programme ended, Dr Beal turned to Shoenberg and said: 'Well, Mr Shoenberg, I congratulate you. That is the sort of television broadcast I have dreamed about but have only this evening seen for the first time.' It was a generous acknowledgement appreciated by us all.'

It was an indication of what they had achieved. In 1933 when Vladimir Zworykin gave his lecture, RCA was well ahead, but now the tables were turned. Clearly the

EMI team was ahead. They had a working system providing a live television service. This had all been achieved in less than four years from largely a standing start. Dr Ralph Beal was in a position to know just how far they had come and what help, or otherwise, had been provided by RCA.

This was pointed up again, a little later, when Vladimir Zworykin also paid a visit. He took the opportunity to go and have a look at the outside broadcast vans in operation. By now the engineers, operating the 'racks' to correct for tilt and bend, had become expert. One of them, Alan Bray, was to describe what happened when Vladimir Zworykin appeared:[3]

> 'We all stood to attention because he was such a great man and he went up to the picture in the van and said, 'I don't believe it! How do you get pictures like this?' We'd become so skilled turning our knobs that we'd got a jolly good picture and he said he had never seen anything like it.'

This was from the man who had been working on this type of camera for around ten years. EMI, under the pressure of needing to have a system into service, had solved the practical problems, some of which, despite all the progress they had made, were still unsolved by RCA. After the visit of Dr Ralph Beal, RCA and EMI settled on an agreement to exchange information. But as James McGee said later, 'I think they learned more from us than we did from them.'

The American Radio Manufacturers Association was very interested in the progress of television in the UK. During the summer of 1937, two engineers from the Hazeltine Service Corporation had set up a temporary laboratory to study the British system. They looked at receivers, visited Alexandra Palace, talked to people in the industry and studied the waveforms and the performance of the system. They were interested particularly in the polarity of the transmission, the transmission of the dc or background components, and the shape, amplitude and duration of the synchronising pulses. In the article they wrote they said:[4]

> This article aims to describe cathode ray television as it exists in England, where the standards of operation on these three items in question are the exact reverse of United States practice. The picture of British television, here presented as it appears to American engineers, is that of an operative system giving good stable pictures of acceptable detail, brilliance and interest…That these British standards constitute a major improvement over present American practices is an inescapable conclusion, because television is technically successful and an accomplished fact in England.

Generally they were very impressed with the detail of the transmitted signal. Isaac Shoenberg and Alan Blumlein had done their work well. As they had said to the Television Committee the whole arrangement was the most clear and logical that they could envisage. The Americans went on to incorporate some of the arrangements into their standards before the public service started in 1939, and the ideas rippled into other country's systems. It was quite an accolade.

The sales of the television receivers had started out rather slowly. A number of reasons had been identified for this. The programmes were only transmitted for two hours a day, and some of the material was not yet particularly good. Potential buyers were put off because there was no guarantee that the standards wouldn't change again. However, the most important was the high price of sets. EMI tackled this by a sudden reduction in what they charged once the Baird system was dropped. Gradually, as things improved, numbers started to rise.

Amongst the improvements to the system was a major one that had been in research for some time. This was the different approach to the camera that had been developed by Gerhard Lubzynski and Sidney Rodda. By the autumn of 1937 this work had come to fruition and was known as the Super Emitron. It had two advantages over the original Emitron in that it was 10 times as sensitive and so could work at lower light levels, and also it used smaller lenses and so standard zoom lenses could be fitted.

It was thus very suitable for outside broadcast work where its one drawback in the early devices didn't show up. There was a certain amount of twisting of the picture and straight lines didn't quite show up as such. Outside this rarely mattered, but in the studio it was rather noticeable. The solution was to keep these new cameras for outside work and use the original Emitrons in the studio.

The first use of the Super Emitrons was at the Cenotaph ceremony on 11th November 1937 where they were used to show close-up images of some of the participants despite the cameras being sited some distance away. It meant that the outside broadcast teams now had the tools to televise many sporting events, such as the Boat Race and football matches.

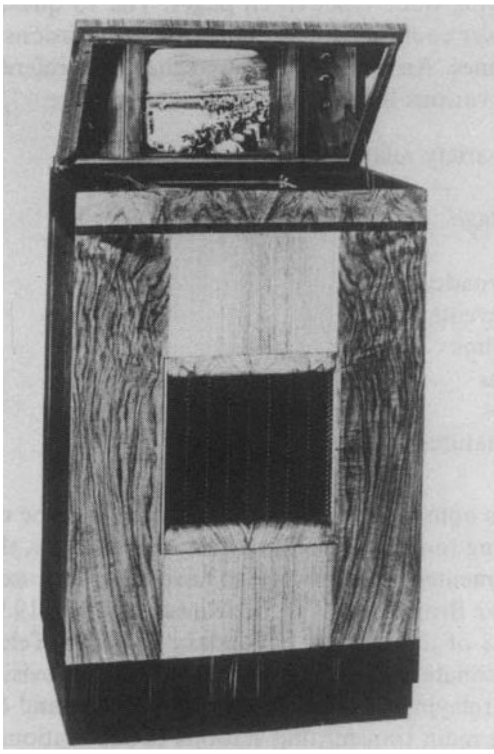

Fig 16.4 An early EMI receiver under the HMV brand name. The display tube was huge and so mounted vertically and viewed via a mirror at 45 degrees at the top.

After the shut down of the Baird system, the BBC used that studio for rehearsals, but really the fledgling TV service could do with more space. However, it wasn't until 1938 that the Baird equipment was stripped out and EMI got another order for a further set of equipment to convert that studio to the Marconi EMI system. It was yet another piece of income earned to pay back some of the costs of developing the system.

Having achieved a reasonable satisfactory television broadcast system at Alexandra palace, Isaac Shoenberg was looking around for other uses for the technology to try to get more return on all the effort that they had put in. As early as the beginning of 1936 he had discussed the possibility of putting a television system onto a plane with Sir Frank Smith of the Dept of Industrial and scientific research, who was also a member of the TAC.

This work did proceed and a trial was undertaken to try to get the military involved. Eventually systems were supplied to both the French and British forces. This allowed a television system in an aircraft to transmit the pictures to a receiving station on the ground or on a ship. However, they didn't find it particularly useful, and this idea didn't lead anywhere.

Meanwhile the work at Alexandra Palace continued. The BBC team were steadily learning the new art of television presentation, and Isaac Shoenberg's team were step by step improving the technical system. This together with a larger array of available receivers, gradually increased the numbers. Some much cheaper sets started to appear though the drawback was the small size of the screen.

One of the great coups of the fledgling television service was that they were able to get cameras to Heston aerodrome in 1938 when Chamberlain returned from seeing Hitler waving his 'piece of paper' and claiming 'peace in our time'. Thus when he stepped from his plane to greet the waiting crowd, it was all caught on live television. It was a first, but it pointed the way to the future.

At some point when the Emitron system was in devlopment, but showing promise, Isaac Shoenberg had made another of his famous remarks: 'We are lighting a candle, gentlemen, which will not easily be put out. Unfortunately on 1st September 1939, with the war imminent the Alexandra Palace transmitter was shut down on the grounds that it could form a homing beacon for the enemy. The 19,000 receivers went blank.

Though the candle was doused for now, and was to remain so for nearly seven years, it had a great future in front of it. The work that Isaac Shoenberg and his team had put in and the crucial decisions they had made, like the move to 405 lines, stood the test of time. Unfortunately that lead they had established was lost, but for now there were more important things to do.

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1 Norman B, Here's Looking at You, The Story of British Television 1908-39, p 106

2 McGee J D, The Life and Work of Sir Isaac Shoenberg 1880 – 1963, The Royal Television Society First Shoenberg Memorial Lecture 1971

3 Norman B, Here's Looking at You, The Story of British Television 1908-39, p 200

4 Lewis H M, and Loughren AV, Television in Great Britain, *Electronics*, October 1937, pp. 32–35, 60, 62

# 17 Night Defence

With his background it was hardly surprising that Isaac Shoenberg would take a close interest in what was happening in Germany after 1933. This extended to assisting people who had fallen foul of the Nazi regime and needed to leave the country. If they had some aptitude in the electrical field, he would find work for them within the company. In some cases he was helped in this by Professor Fritz Schröter who was the Director of Television Research for the Telefunken Company.

Among those he found work for was Dr Gerhard Lubszynski who was to make very considerable contributions to the design of television camera tubes. Assisting him was Heinz Kallmann another physicist who had worked as a research engineer for C. Lorenz in Berlin, who also produced a number of patents while at EMI. Later a young man called Hans Hirsch was found a post in the laboratories. He was studying at the same time and later, with a name change to John Hirsch, gained a doctorate and became a Reader at Birkbeck College. He was the grandfather of the journalist Afua Hirsch.

As the pressure of the television work began to decrease, after the launch of the service, Isaac Shoenberg could see what was coming and was keen that EMI, and particularly his research department, was used to make a contribution to the defence of the country. Despite his approaches to the Air Ministry, this didn't lead to anything. There seemed to be a preference of those companies that were already approved military suppliers, and EMI was not one of them.

Ever since the First World War, sound locators had been used to detect aircraft. There were two types: large 'sound mirrors' built of concrete in fixed position near the coast, and smaller mobile units with usually four horns that could be rotated to try to pinpoint the source of sound and hence the position of the approaching aircraft. As the 1930s progressed, these were still the main equipment used to help align gun batteries and searchlights to pinpoint enemy aircraft.

By 1938, after the German Anschluss with Austria, it was becoming increasingly obvious, to those who were closely watching the situation, that war was going to be inevitable in the not too distant future. At EMI, Isaac Shoenberg and his team were looking for a way to break into the military equipment market. In June, George Condliffe suggested using the basic scheme of Alan Blumlein's binaural or stereo system to indicate the direction of a sound source, with possible application to aircraft sound locators.

This seemed like an opportunity and some work was immediately undertaken at top priority to see if this worked. This soon looked promising. The arrangement used a pair of microphones and then took the sum and difference signal from them. It was much easier to align the detector using this difference signal than just trying to compare the difference of the normal signals arriving at a persons two ears.

At the end of September there was the Munich agreement and the humiliating arrangement for the Czechoslovaks to give up a whole chunk of their territory to the Germans. It only took a few days into October 1938 for the German forces to move in and occupy the whole of the Sudetenland. Despite Hitler saying that this was his last territorial demand, it was difficult to believe him. War began to look even more certain.

The same month Isaac Shoenberg invited a group from the Air Ministry to a demonstration of their enhanced sound locator system. The demonstration went well and led to a contract to manufacture some units as an add-on to existing sound locators. At last they were starting to make a contribution, if in only a small way.

Alan Blumlein then made the suggestion that this could be extended further by having a visual display. This was to lead to the Visual Indicating Equipment (VIE) system. One of the great advantages of this was that the angle of view could be change from wide to narrow, making tracking of the aircraft much easier. With the conventional sound locator the angle where the sound could be pinpointed was determined by the distance between the listening horns. The wider apart they were the narrower the angle they 'viewed'.

With a narrow detection angle it was difficult to find the contact in the first place, but once found its direction could be reasonably accurately determined. The VIE system could be switched so that the wide angle could be used to find the initial contact and then the narrow angle selected for greater accuracy. Viewing this on a visual display was much easier than constantly listening for the small changes.

The system was just being tested when war was declared in September 1939 and by December six prototypes were available. To the surprise of the Air Ministry the sound locators with their VIE units were available on schedule in mid January 1940. These rapidly proved their worth and by the end of the year 400 sets had been manufactured.

Fig 17.1 A team operating a sound locator

There was a fundamental problem with even the best of the sound locators. The speed of sound is relatively low and by the time it reaches the sound locator the aircraft is somewhere else. With the slow speed of aircraft in the First World War this worked well, but by the second the speeds were so great that it was difficult to try to work out where the aircraft actually was. There was a need for something better, ideally working at the speed of light.

Alan Blumlein then took the idea of the VIE further: why not use radio beams for the same type of system. They knew, from the television work, that radio beams bounced off objects, so by sending out a radio beam the returning echo from an aircraft could be detected by a very similar arrangement with radio receivers substituted for the sound systems. Again the result would be displayed on a cathode ray tube. There was an additional advantage that the range could also easily be measured by the time taken for the signal to be sent to the plane and back.

By June of 1939 they had found time to work out the details of the system well enough for Alan Blumlein and Eric White to apply for a patent on the method[1]. This was followed, after further work, by an additional application a month later[2]. The looming international situation was concentrating minds on the defence of the nation.

The ‘60 MHz job’, as this scheme was known, was what was called at the time a Radio Direction Finding (RDF) device, which would later be called radar. What is now unclear is how much they knew about the subject or was it just invented without any background knowledge of what was going on elsewhere. Though it might have been new to them, the basic idea went much further back. Unknown to them, though they might have had their suspicions, in great secrecy the country was building a chain of radar stations to warn of approaching enemy aircraft.

The knowledge that radio waves were reflected by objects, particularly metal ones, went right back to Heinrich Herz’s original experiments. Marconi had also suggested that it might be used to detect ships, and there had even been some attempts to build such systems. However in Britain the first serious approach was made by Robert Watson-Watt who was the head of the National Physical laboratory’s Radio Research Department.

He had been approached to see if a ‘death ray’ as a defence against aircraft was practicable. He soon proved that it wasn’t, but suggested that detection of aircraft by radio was a much more promising option. The teams of physicists, that were secretly built up, managed to produce a system working at quite a low frequency, but it was capable of detecting aircraft at distances of 100 miles or so.

As television systems and radar share many features it was extraordinary that the expertise of Isaac Shoenberg’s superb team was not used for this purpose. The overriding secrecy meant that no commercial company was trusted with the knowledge of the whole system and even when they were called upon to manufacture equipment any one company was only given a small part of the jigsaw so that they wouldn’t understand the whole. As EMI was not a military contractor they were not asked to be involved.

Fig 17.2 Some members of Isaac Shoenberg’s family in 1940. Left to Right Esther, Marguerite Berline - son David’s mother-in- law, son Alexander, sister Zlata, son Mark and brother David.

The first step that pointed to war being imminent was on the 23rd August when Nazi Germany and Soviet Russia signed a non-aggression pact. It was rapidly followed on the 1st September by the Germans invading Poland. This time there was no chance of the Western Allies tolerating this – they had learnt their lesson after Munich – and ultimatums to withdraw were issued. The deadlines of these passed and hence the Prime Minister Chamberlain was forced to announce that the country was now at war.

This must have led Isaac Shoenberg to worry about his sister Genia, and disabled brother Aaron, back in Pinsk which was still then part of Poland. A couple of weeks later on the 17th September 1939 the Soviets moved to invade Poland from the east. Clearly there was some collusion to destroy Poland. As it was close to the Russian border, one of the first places to be overrun was Pinsk. Now there was no hope of communicating with them and providing additional funds to help them.

When war had been imminent there was a strong feeling that the bombing of London would start almost immediately. There was a huge operation to evacuate large numbers of children and spread them around safer parts of the country. Many adults, when they could, also decided to leave. Among them were Isaac Shoenberg and his family. He and Esther, accompanied by son Alexander and their cook Olga Muller, who sounds like another refugee, went to Amersham[3]. Zlata and daughter Elisabeth went to their cottage at Friston. How long they remained out of London isn't clear but they still seemed to be associated with the Willesden Lane address.

At work the first action was to rapidly get a partial demonstrator of the '60MHz job' put together. The frequency chosen was that used for the radio link for the external broadcasts and hence much of the equipment they already had could be used and any extra parts hastily designed. The aerials consisted of a transmitter and three receiving towers at the corners of an equilateral triangle of 70 m each side. This was set up on Lake Farm an open area next to the research laboratories.

Fig 17.3 Isaac Shoenberg greets the Queen and King on a visit to EMI at Hayes in 1940

By early December Isaac Shoenberg was able to invite scientists from the government and the Air Ministry Research Establishment (AMRE) who were the successors to the people who had built the first radar stations. While they were impressed they could see that it had shortcomings for its primary purpose which was similar to the sound locator for identifying aircraft for anti-aircraft guns, which was known as Gun Laying (GL). The main problem being that the large distances between the aerials, and need for fixed positions, meant that it was impractical when movable devices were required.

However, there was a strong feeling that a number of items of the technology involved could be useful in other AMRE radar systems. At last Isaac Shoenberg and the team were aware of the radar work going on, and it was accepted that they could make a contribution. It is here that the precise timings and sequence of events becomes rather confused with different sources having somewhat different versions.

What is clear is that AMRE had a problem with their airborne radar which was known as the Air Interceptor or AI. This was to guide fighters, particularly at night, onto enemy aircraft. The system functioned, but they had been unable to get it to work closer than about 1000 feet from the target. As this was beyond the range of the guns, and further than a visible range at night; it was unsatisfactory in practice.

EMI was asked to help with this problem. In January, or possibly April, 1940 Alan Blumlein and Eric White travelled to Dundee where AMRE was based at that moment[4]. (They were to move several times). There they inspected a Mark III, the current version of the AI radar, and brought it back with them. They housed it with them in the first class sleeper compartment as they couldn't place highly secret equipment in the guards van.

With the work they had already done on the '60 MHz job' they soon had a solution. It was back to their old subject of the modulator. The problem was that the pulse from the transmitter didn't end sharply enough and so it prevented the receiver from seeing the return echo for too long. They applied their own approach to the modulator and switched off the transmitter sharply hence reducing the minimum operating distance.

However, petty politics crept in and it wasn't accepted that these rank outsiders could quickly solve a problem that AMRE had been struggling with for some time. Isaac Shoenberg suggested to the Air Ministry a comparison test be carried out to resolve the situation, but without a result. Eventually Air Marshall Dowding, who was head of Fighter Command intervened and a test with the EMI system and the latest improvement from AMRE was undertaken with both systems fitted in Bristol Blenheim twin-engined aircraft used as a night fighter.

The result was that the EMI system reduced the minimum operating distance to 400 feet, close to the theoretical value, while AMRE's version was still at something like 800 feet. This led to the modulator being included in the AI radar together with some other small modifications and this became the Mark IV version which was available by May and flight tested in June. EMI received an order for modulator units to be integrated with the other units manufactured by other companies.

As if they weren't busy enough there was another project running to use Alan Blumlein's method of a transformer bridge to measure tiny capacitances. Two plates were mounted under the wings of an aircraft and, by careful arrangement of the measuring system, the capacitance between these and the ground could be measured. As capacitance is inversely proportional to the distance, the height of the aircraft above the ground could be measured.

This only worked at low levels, but unlike other height measuring systems, its accuracy improved as the aircraft got closer to the ground. This was very useful when landing in difficult conditions or where it was necessary to fly at very low levels. It became operational later in the year and production ramped up during 1941 and 1942. The system was used extensively in many fields throughout the war such as for low-level bombing and torpedo releases, mine laying and parachute dropping.

In the first few months of the war there was little action and this period was known as the 'Phoney War'. All this changed on the 10$^{th}$ May 1940 when the Germans invaded Holland, Belgium and France. Churchill became the Prime Minister after Chamberlain, and British forces were committed to help the French.

Unexpectedly the Germans attacked through the Ardennes Forest and split the defending forces into two. To the north of their thrust were the British and some of the French army who were driven back to Dunkirk. Towards the end of May and into early June a miraculous naval rescue operation managed to extract 338,000 British and French soldiers. However, almost all the weaponry had to be left behind and Britain was left in a perilous position.

On the 22 June the French had had enough and signed an armistice, humiliatingly in the same train where the armistice at the end of the First World War had been signed. It was clear that it would be Britain's turn next. Air attacks began on shipping in the channel and then in August the concentration fell on the air bases in the southwest of England. Fortunately for the RAF they didn't pursue this to the end and on the 7th September switched to attacking other targets such as the London docks. It was clear that if the RAF could be destroyed the way would be open to an invasion.

In August production started on the Mark IV units and these were rapidly installed into the twin-engined night fighters. The Bristol Blenheim had been found to be too slow to catch up with the bombers and by September more modern aircraft such as the Beaufighter came into service and were fitted with the Mark IV system. By November the contract had been completed and such was the surprise in official circles that the Minister of Aircraft Production sent Isaac Shoenberg a letter congratulating him and the staff for delivering all of the 900 Modulator units by the original date he had forecast.

What this meant was that the company was finally in the radar business. The Mark IV radar was to be the mainstay of night fighters throughout the war. The initial doubts of the various organisations had been overcome, and it was realised that EMI had something to offer both in the design of equipment and in the manufacture. It was Isaac Shoenberg and his team, by applying their skills in this field, who were bringing the work to the company.

The Mark IV AI was only suitable for twin-engined fighters as it required the navigator to operate it while the pilot flew the plane. However, with the front line machines now being mainly single-engined such as Hurricanes and Spitfires there was a need for a version that was largely automatic. This presented many problems such as where to put the aerials which for the Mark IV were on the nose of the plane. Obviously this was not possible for the single-engined types as this was where the propeller was mounted.

On the 20th July 1940 Isaac Shoenberg and his team were invited to a meeting to start work on this problem with the intention of creating a Mark VI version for single-seaters. In October this was converted to an order for the development work which led to a couple of months of furious work on this with endless meetings with the Royal Aircraft Establishment (RAE) and AMRE, who in the middle of this were renamed the Telecommunications Research Establishment (TRE).

By the 27th of November they were able to demonstrate a basic unit which was flight tested three weeks later. It took until April 1941 for all the issues with the units to be ironed out and them to be regarded as fully successful. However, in reality, the work had come too late. It was one of the many examples of changing requirements as the war situation altered almost from day to day.

As the daytime losses had been too great, the Germans had switched to night bombing and in the autumn of 1940 the defences had not been successful against them. Fortunately the weather in the winter had not been suitable for operations which had given the defences time to adapt. In addition to many night fighters now fitted with Mark IV AI radars there was also now a ground control system which could guide the defender to the attacker.

When the Germans resumed their attacks, their losses started to rise rapidly. They were significant in March, greater in April and by May were at unacceptable levels. The night attacks largely ceased. In addition many units were moved east ready for the attack on Russia. Thus the Mark VI AI radars were now not really required though at the end of 1941 EMI received an order to manufacture more than 1000 of them.

Surprisingly the order still continued despite the fact that only a few were ever installed in single-engined fighters. The Beaufighters with their Mark IV sets had proved satisfactory for the night fighting duty and they were soon joined by Mosquitos. However the Mark VI units took on a new lease of life when they were modified and installed in heavy bombers to provide a tail-warning radar code named 'Monica' to guard against attacks from the rear.

For a time they were satisfactory in this role, but when the Germans developed a radar receiver which could detect it, it became a liability as they could home onto the bomber. When this was realised the units were quickly removed. So ended the use of what had seemed a useful device, but the techniques that had been developed by the EMI team were to live on to be reused in many other projects.

A measure of the involvement of the company at this time in all the radar work was outlined in the letter that Isaac Shoenberg received, dated 15th June 1941, from The Director of Radio production which was presumably to enable him to demonstrate to others that they were involved in important war work. It said:

> Mr I Shoenberg, Director of Electrical and Musical Industries Ltd, Hayes, is responsible for the experimental development of a series of the most vital equipments used in connection with 'night defence' against enemy aircraft, and practically the whole of the resources of his large establishment are devoted to this work of first importance in connection with the munitions programme.

It demonstrated what he and his team had achieved in converting their focus from television to vital military equipment.

A few days later on 22nd June the Germans launched their Operation Barbarossa, the attack on the Russians. While this was a relief to many in Britain as it brought another ally, it must have worried Isaac Shoenberg. Pinsk, where his brother and sister and members of Esther's family still lived, was right in the path of the assault and on the 4th July the Germans occupied the town.

Fortunately it is very unlikely that Isaac Shoenberg, busy in England, knew what subsequently happened in Pinsk, and though he probably knew they hadn't survived after the war, hopefully he never knew the full horror of it. Himmler, the head of the SS, ordered all the Jews to be killed with the women pushed into the swamps. The local commander thought this impractical, but rounded up most of the men and on the 5th August marched them out into the forest where they were shot. Aaron Shoenberg was among them.

The remaining Jews were not immediately murdered, as the SS unit involved was ordered to move on as the army advanced. This gave a breathing space which lasted until May of 1942 when the remaining people were forced into a Ghetto where some 20,000 people were accommodated in only 240 houses. The occupants were given little food and forced to work, but as all the Jews in the surrounding areas were killed, it didn't seem likely that the situation would last long. In late October Himmler ordered that the ghetto be 'cleared'. The remaining occupants were taken out and murdered.

However Genia, who carried on her work as a dentist in the ghetto, was saved this fate as she had died two months earlier in August, supposedly of colitis, but more probably of hunger and the dreadful conditions in the ghetto. Fortunately one of Esther's sisters had come to England and married an Englishman, but though another had moved to Kovno in Lithuania, none of the rest of her family survived the murderous purges of 1941.

In the meanwhile on 7th December 1941 the Japanese had attacked the American Naval base at Pearl Harbour in Hawaii and Hitler had then declared war on the Americans as well. Now Britain had another powerful ally in the Americans, but they had also gained another enemy in the Far East – Japan.

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[1] British Patent 543602

[2] British Patent 581920 There were subsequently a number of further patents generated over the next 6 months.

[3] Census Register 29th September 1939

[4] The January date is more likely as Alan Blumlein and Eric White applied for a patent for the modulator circuit on 27th January 1940 – British patent 579725

# 18 Centimetric Radar

There was another, almost separate strand to Isaac Shoenberg and EMI's involvement in war work. Back in 1919, when he had been with the Marconi Company, they had joined forces with the English GEC and set up the MO Valve Company to manufacture their requirements and sell them generally. It had been the sale of Marconi's interest to The Gramophone Company (HMV) in 1929 which had caused his rift with the Marconi Company.

Of course, only a couple of years later Columbia, for whom he was working, and HMV merged to create EMI. Once again he became involved with the valve business as the research labs of EMI and GEC provided the research arm for the MO Valve Co. He became an important influence on the MO Valve company and was the prime mover for many of their innovations.

He employed Dr Cabot Bull as his main expert on valves who was also the liaison with the valve manufacturers. In 1933 he raised one particular problem to Cabot Bull to solve and that was a way of getting around the patent that Philips had on the pentode valve. Originally valves had just three electrodes: the cathode as the source of electrons, the anode to collect them and the grid to control the flow. Another grid had been added to improve the characteristics but it also introduced a 'kink' in these. Philips's solution was yet another grid hence becoming a pentode.

Cabot Bull came up with an answer for what became the beam tetrode which was to have an important future as power amplifier devices. The idea was patented, but it doesn't just bear Bull's name but also that of Sidney Rodda and Isaac Shoenberg[1]. Knowing his attitude to the names put onto patents it would suggest that he was more active in the invention than merely setting Bull the problem. It was probably a case of an initial idea batted around between the three men until a final form was achieved.

As the decade progressed the demand was for valves that could work at higher and higher frequencies. The television transmissions had been at 45 MHz (6.7 metres) the first generation of radar in the Chain Home stations was lower than this. However the next generation used in the AI sets and also for the Chain Home Low stations, that could scan an area closer to the sea, was at 200 MHz (1.5 metres). With the demand for these from AMRE and their contractors it is quite possible the Isaac Shoenberg had a fairly shrewd idea what they were being used for, long before he became involved.

In the government scientific circles there had, for some time, been a feeling that the radar systems should move to even higher frequencies. The size of the aerial for efficient operation is very dependant on the frequency being used. For use on some ships and also ideally for AI systems on single-seater fighters there was a need to move from the metric wavelengths, such as 1.5 metres, to something like 10cm (3000 MHz).

The oversight of this area was brought under the Components Valves and Devices Committee (CVD). In a far sighted move, work was put in hand to try to develop valves or other devices to work at these frequencies. With the war underway, in the autumn of 1939 contracts were placed with the Universities of Birmingham, Oxford and Bristol for receiving and transmitting valves to work at 10cm.

By the end of the year the GEC Hirst Research Centre (HRC) at Wembley became involved as they had already undertaken some work at high frequencies. The first objective was to be able to work at wavelengths of 20 to 30 cm and they were given a contract for this right at the end of the year. EMI were also asked to collaborate on this. It seems likely that this stemmed from EMI's involvement in the valve work, rather than the '60 MHz job' radar which was only being demonstrated around this time.

This led to a series of joint meetings with Air Ministry officials from 16th January 1940. These were held at Wembley where they were chaired by Clifford Paterson, the head of research at GEC, and at Hayes where Isaac Shoenberg was in the chair. In addition to the chairmen some senior people for each company attended. For EMI these were Alan Blumlein and Eric White.

Over the next few months a 25 cm radar system was designed. GEC took the lead with the EMI group providing parts such as the modulator, and plugs sockets and cables. While these latter might sound trivial, items such as these working at these frequencies were very difficult and they stemmed from the television work a few years earlier. By March a 'lash up' of the set was available to be demonstrated. However there was considerable pressure for the wavelength to be shortened further; ideally to 10cm or even shorter.

Fortunately for the radar development, there had been a lucky discovery by two members of the group at Birmingham University. While there were a whole range of devices that might be useful starting points, the main team concentrated on the klystron. However two young men, John T. Randall and Henry A.H. Boot, were set to work on another device a Barkhausen-Kurtz detector. To test this they needed a microwave source, and so they thought they would just make one. Despite the rest of the team working on this problem they went their own way. Their thinking was that it might be possible to combine the best features of the klystron with its cavities and the magnetron which was a type of valve where an applied magnetic field caused the electrons to rotate.

What they almost certainly didn't know was that considerable work had been undertaken in other countries on variants of the magnetron and most had been abandoned. They decided that the easiest way to make such a device was to drill seven holes in a copper block, one in the middle and the others spaced around with narrow slots connecting them to the central one. The cathode to emit the electrons went through the centre and then ends were put on so that it could be pumped down to achieve a vacuum.

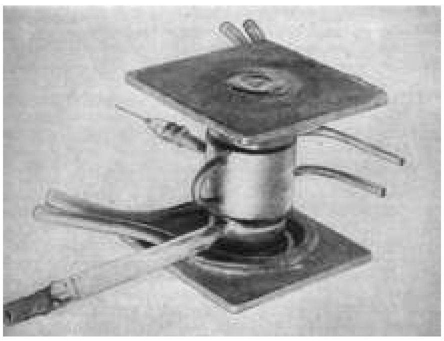
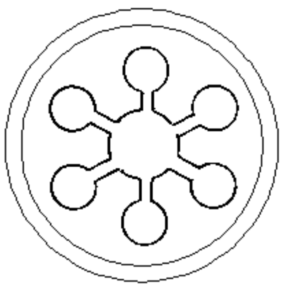

Fig 18.1 Randall and Boot's experimental cavity magnetron which needed to be pumped down to obtain a vacuum. An electromagnet applied the field vertically through the device. On the right is the form of a 6 chamber magnetron like the original prototype.

Virtually all previous versions of the magnetron had been inside a glass envelope like a normal valve. Their version had the immediate advantages that it was easily cooled and that a magnetic field could be applied across the device with only small gaps, hence increasing its strength. It was delightfully simple and robust.

On the 21st February 1940, when they finally switched it on, they kept burning out bulbs that they were using as loads. Eventually they realised the device was generating a staggering 400W of power at about 9.8 cm wavelength. This was so much better than other lines of investigation that work was immediately switched to developing it further. In April, the GEC research laboratories were brought into the project to convert it to a practical device.

The objective now was to convert the AI radar into a 10 cm unit. The reason for this was that with the Mark IV to Mark VI units working at 1.5 metres there was a considerable problem with ground echoes which meant that the maximum range was only as far as the height of the aircraft. With the shorter wavelength a dish aerial could be used which produced a much narrower beam which was sent straight ahead of the aircraft, hence minimising the ground return.

Unfortunately further progress became rather slow. AMRE wanted to take over the work, but they didn’t have the resources in either personnel or equipment that GEC could provide. Relations between them became strained. However, in September of 1940 an AI 10cm committee was set up with representatives from the companies including EMI as well as the AMRE to try to speed things along.

In February 1941 there was the first flight trial which, though it went quite well, showed the need for more work on the aerial system, and it took until July to iron out the issues. By November a refined system was completed. All the time, though GEC were in the forefront, Isaac Shoenberg’s team were constantly being called upon to solve particular problems and provide solutions in all areas of the system.

It was thus late in 1941 before some Beaufighters were equipped with the 10 cm AI system which had now been named the Mark VII. By this time the night attacks had greatly diminished and with it the urgency to bring the mark VII into service in a big way. However, a much greater problem had emerged. A survey had found that the accuracy of our own bombing was very poor. On moonlit nights around one third of aircraft dropped their bombs within five miles of the target and on a new moon around one twentieth. Churchill had become aware of this and was demanding solutions.

On 26th October 1941 a meeting was held at the Telecommunications Research Establishment (TRE as AMRE was now named) to discuss how towns could be accurately detected rather than depending on a navigation system that was subject to considerable error. At the time they were not hopeful but a few days later Philip Dee’s teams decided to try modifying an early Mark VII radar so that it pointed down and fly this to see if it worked.

Great excitement grew from this as towns gave a clear echo and photographs of the displays were soon shared, which led to pressure to proceed at full speed. By the end of December members of TRE were visiting the Royal Aircraft Establishment to examine the latest bomber aircraft and decide which one was most suitable for their tests. Their choice fell on the Handley Page Halifax and by January they were meeting with the manufacturer to get a Perspex radome fitted underneath to house the aerial scanner.

At this point EMI were brought into the project and given an order for 50 units of what was now known (for reasons which are not really clear) as H2S. The aerial and scanner were supplied by other companies but EMI were now needed to design a suitable unit, based on the AI Mark VII, and make them as rapidly as possible. However when Isaac Shoenberg went to a meeting on 26th January 1942 the difficulties multiplied as it was dictated that the danger of the magnetron being lost and falling into enemy hands meant that it was not to be flown over Germany.

Instead, another device called a klystron was to be used as the prime source of the microwaves. It worked on a different principle and being in a glass envelop would easily be destroyed if an aircraft crashed. There were two problems with using a klystron: it still needed further development work to boost its power and it was unlikely to be able to produce the sort of outputs that could be achieved with the magnetron. The result would be a considerably reduced range.

The TRE team tried reducing the power of the magnetron in their test aircraft to simulate what could be achieved with the klystron. They reported that it seemed to have little effect; an erroneous result that was to cause a great deal of problems later. All the ducking and weaving was a considerable headache for Isaac Shoenberg as he needed to try to get a clear contract and ensure that they would get an adequate return for the amount of work, as yet very much unknown, that they would need to put in.

There was an additional complication in that a very similar set was needed for the detection of submarines to aid the grim Battle of the Atlantic. This Air to Surface Vessel (ASV) radar was also much needed as the previous version based on the 1.5 metre radars had proved fairly useful for a time, but the Germans had soon developed a detector so that the submarines would crash dive as an aircraft fitted with the radar approached.

The problem was that if the klystron had to be used for the H2S and a magnetron was used for the ASV then there would be two different systems. This started to bring pressure to rescind the decision about not using the magnetron over Germany. In the meantime the EMI team, headed by Alan Blumlein tried to design a system with as many common parts as possible between the two types. Isaac Shoenberg was fending off all the other ideas for different manufacturers to make the two versions and several other combinations that were considered.

Once that was resolved he was under pressure to accept orders for 200 by Christmas and 1500 ultimately. Understandably, with something still not fully developed he was concerned about the timescales, knowing that as they went along there would be changes necessary when the system was tested in the field and also with changes of mind by the military as to their exact requirements.

One particular deviation from the AI system was to use a Plan Position Indicator (PPI). Instead of the linear indications of range and azimuth this produced a display like a map. Though more complex to achieve, and it required a rotating scanner linked to the rotation of the indication on the display, but it was much easier for aircraft crews to interpret.

Two experimental systems were being produced: the first was a magnetron based system heavily derived from the AI Mark VII and largely using its units which was being produced by TRE. The team was now under Bernard Lovell who was later to become well know for his work with the Jodrell Bank radio telescope. The second was the klystron based unit being designed by EMI's experienced team.

TRE started testing their equipment in April, but with disappointing results. The continued well into May but problems with the aerial system persisted. On 28th May it was necessary for the Ministry of Aircraft Production to warn the Secretary of State for Air not to be too optimistic about the H2S system. However he had spoken with Dr (sic) Shoenberg of EMI and they 'were pressing forward with this apparatus to the greatest extent possible'.

At this point the ministry changed the rules and said they would be satisfied if the system could meet a less severe specification. It meant that the system was really required to ensure that the aircraft was correctly over a target to achieve accurate bombing rather than being used as a navigational aid. In May TRE felt that their system was reaching this standard. Also on 14th May EMI's prototype system was bench tested and ready for installation in another Halifax aircraft.

However there was another disruption. At the end of February there had been a Combined Operations raid on a German radar station at Bruneval in France where the important part of the set was stolen. As TRE were now based near Swanage on the south coast there was a considerable worry that the Germans would reciprocate with a raid on their premises. TRE was hastily moved to Malvern with its flying programme run from Defford aerodrome a few miles away.

Eventually, after various problems and bad weather, the EMI team headed by Eric White were finally able to run a test on 2nd June. It performed reasonably well apart from the range which was poor at only six miles. There were also still aerial problems which were common to the TRE version and not part of EMI's remit. While the scanner and aerial were being modified Eric White took the opportunity to make a number of improvements including increasing the power from the klystron.

Fig 18.2 The Halifax bomber with the prototype H2S system before the crash. The radome with the scanner can be seen under the roundel towards the rear.

At this point politics started to impinge on the subject. Lord Cherwell, Churchill's scientific adviser sent him a report on how well the H2S tests had been going. These were not the current ones, where results were not quite so happy, but earlier ones with equipment installed in a Blenheim fighter. Churchill was very encouraged and two days later wrote to the Secretary of State for Air that it was imperative that the whole programme was speeded up and that 3 sets in August and 12 in November was nowhere near fast enough as they were needed now to improve the efficiency of the bombing and cut losses of aircrew.

However, things were improving at Defford. The TRE team had managed to improve their set and were reasonably happy when Alan Blumlein, Cecil Browne, Felix Trott and Frank Blythen came up to Malvern and they spent most of Saturday 6th June 1942 in discussions with Bernard Lovell and Gerald O'Kane. In the evening Bernard Lovell and some of the TRE team went up for a short flight to check that the equipment was now working reasonably well. This was a preliminary to a run the next day where it was intended to let the EMI team see the performance for themselves. There was now great doubts in both the TRE and EMI teams that the klystron based unit could be satisfactory due to its limited power.

There is some doubt about who was originally intended to be on the flight on the Sunday with various stories of one or more people giving up their place on the flight so that others could go. Whatever the truth of this, it was Alan Blumlein, Cecil Browne and Frank Blythen from the EMI team who went. With them were Geoffrey

Hensby, the operator, and Pilot Officer Vincent from the TRE team together with Squadron leader R J Samson, the Bomber Command's scientific liaison officer, and 5 RAF crew in the Halifax bomber.

There had been various delays while some problems were resolved but they finally got away just before three in the afternoon. By 5 o'clock Lovell, who was waiting to continue their discussions, rang the control tower but there was no news of their return. Continued contacts over the next two and a half hours produced no result. Then at 7.45 came the dreadful news that the plane had crashed in the Wye Valley and all 11 people on board had been killed.

Gradually the news filtered back to Hayes, partly by a telegram from TRE and partly by Eric White ringing George Condliffe. There was a stunned silence everywhere. Not only had many of the people involved in the development of H2S been killed, but also the TRE prototype with the magnetron in it had been destroyed, with only the body of the magnetron found when Bernard Lovell went to the site. He felt that the project could not continue.

What happened the following morning was described by Doreen, Alan Blumlein's wife:

> It was 10 in the morning and I saw two cars draw up. One was Shoenberg and Mrs Shoenberg, the other had Condliffe and his wife. I knew what they had come for when I saw them; and Shoenberg's face would have told anybody anything. They didn't know a lot then, only that there had been this crash. He said to me: "There is just a chance that one of them may have bailed out." So I said: "It wouldn't have been Alan would it?" and he said "No it wouldn't have been Alan". Apparently Alan was in the tail of the plane. I think someone recognised him, but the others were… I mean we had three coffins, but there were three masses of bones I think …They didn't know.

Later she was to add a bit more to what happened: 'When Mr Shoenberg told me of the crash I said, "Oh, what was he thinking when he knew they were crashing." Our dear Isaac Shoenberg said, "Of you and the children of course".' It was a pointer to the close relationship there had been between the two men that even Doreen Blumlein knew him well. This was made even clearer at the funeral service for the three men arranged by EMI on the 13th. Due to the secret work they had all been engaged on, there was only the briefest announcement in the press that Alan Blumlein had been killed on active service and the other two in an accident.

Alan Blumlein's mother, known as Nusie, described the funeral arrangements as very good and the whole service as beautiful. Afterwards she said:

> 'Mina [Alan Blumlein's sister] introduced, at their request, the Directors of [EMI] to me. I was glad to have an opportunity to meet Mr Shoenberg and to thank him for his kindness and encouragement and appreciation of Alan. He said, very feelingly: "I loved him like a son. There is no one who can take his place in the work he was doing."
> 'Mr Clark, the Chairman of [EMI] took me to a seat and had much to tell me of the place Alan held in the esteem of his fellow workers and in the world of science and engineers. He said the firm had received letters from members of the Government which they would have liked to pass on to his family, but they were so strictly private. They, the Directors, had written to ask leave to photograph these letters and keep them for us to see after the war. One thing he quoted from Sir Archibald Sinclair's was "His death is more than a loss, it is a national loss."

On the 19th a memorial service was also held for the three men who had died, again organised by the company. This gave an opportunity for others to pay their respects as the details of the cremation service could not be widely publicised. Generous settlements were made by the company to Doreen Blumlein, Cecil Browne's wife and Frank Blythen's mother, no doubt instigated by Isaac Shoenberg.

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[1] British patent 423932

# 19 Wartime production

After the crash, the question for the remaining people was: what to do now? Gently they were persuaded that the work must go on. Fortunately Bernard Lovell had not been on the plane and nor had his right hand man Gerald O'Kane, though Geoffrey Hensbury took with him a considerable amount of knowledge about the testing. For the EMI team the problems were greater but the obvious person to take over was Eric White. There was also Felix Trott who had got tired of the waiting about and gone for some refreshment and so was not on the flight. Also Maurice Harker who had returned to London on the fateful weekend, but had been installing the units, could carry on.

Fig 19.1 Eric White

If there had been any doubt about continuing, Bernard Lovell was summoned by Winston Churchill to a meeting in the Cabinet rooms on the 17th June 1942. This was postponed as Churchill went to see Roosevelt on that day, but was reconvened on 3rd July. The Prime Minister had just survived a furious debate in the Commons as it looked as though Egypt was about to fall to the Germans. Such was the importance that he ascribed to H2S he still wanted this meeting. Also summoned was Isaac Shoenberg.

In addition to the Prime Minister there was J Llewellin, the Minister of Aircraft Production, Sir Archibald Sinclair, the Secretary of State for Air, Arthur Harris, Commander-in-Chief of Bomber Command, Lord Cherwell and numerous others. Churchill was quite determined that they should continue at top speed and that they must have 200 sets by the 15th October. It was explained to him that the prototype had been destroyed and that in reality H2S didn't exist, but he kept insisting that they needed 200 by mid October.

It fell to Isaac Shoenberg to explain that this timetable was not possible. It was a brave man who said no to Churchill when he was on the warpath, but Isaac Shoenberg was that and more, and he knew there was no point in pretending that something could be done, when he knew perfectly well it wasn't possible. He believed in telling the truth, even when it was unpalatable, and only promising deliveries he was confident that could be achieved.

The upshot of the meeting was that the whole programme was reinvigorated. Sir Robert Renwick of the Ministry of Aircraft Production was put in charge to push things along. Meetings were held on the next two days to decide on a programme.

Isaac Shoenberg stuck to his offered programme of producing an increasing number each week beginning in September, with a total of 50 sets by the end of the year made by model shop methods in the Research Department. This meant that if there were to be 200 the other 150 were to be made by TRE's Research Prototype Unit (RPU). The decision was also taken that all of these would be to the EMI design and not based on TRE's 'lash-up'.

On the 7th flight testing began again, in a replacement Halifax aircraft with a set largely produced by EMI but using a magnetron, and reasonable results were achieved though there were still aerial problems. By Monday the 12th the joint EMI and TRE team had decided to remove the klystron system in the second aircraft and replace it with a magnetron, because the tests showed the klystron unit gave an unacceptable range of 8 to 12 miles while the magnetron version achieved 38 to 40 miles. There was really no contest.

This rather prejudged the meeting held on the 15th, chaired by the Secretary of State for Air, where the main subject for discussion was whether to risk the possible loss of a magnetron over enemy territory for the much improved performance that it gave. As the magnetron was difficult to destroy it was inevitable that sooner or later the Germans would get their hands on one. However, it was felt that they would take a considerable time to develop anything like it and time was the great element in war. Thus it was decided that only the magnetron would be used. This made life much easier as there would only be one version which could be used both in bombers and in Coastal Command aircraft hunting submarines.

As it had been decided to use the EMI circuits, and in any case the modulator even for the magnetron version was their design, there was not a great deal to be integrated into the system to use the magnetron. The team also became very involved with the performance of the magnetrons with many of them being tested on behalf of John Randall and Henry Boot at Birmingham. Such was the pressure, Isaac Shoenberg helped in any way he could, even becoming involved in some of the correspondence with them.

The furious work, day and night, culminated in their prototype H2S being flight tested on 19th September flying over Cheltenham, Gloucester and Coventry. They obtained 'outstanding views of the river Seven on their display. It was one of the features of the system that water didn't give a reflection and so appeared black on the display. This meant that coastlines, lakes and rivers showed up very well and could be used to determine exactly where the aircraft was and whether it was on course.

Ten days later they flew the first production version. Great risks were being taken as normally in a development the results of testing a prototype would be awaited before building production units. Isaac Shoenberg and the team had built up enough confidence in the design to fold up the programme. Fortunately their confidence was not misplaced and one observer on the flight reported that they were easily able to pick out Gloucester from 25 miles and home in on it despite taking violent evasive action to simulate what a bomber might have to do approaching a target.

As more units became available they were taken by the Bomber Development Unit (BDU) for testing and training of flight navigators. While they did not like the unit's serviceability in actual operations, they felt it would be 'valuable to a high extent both as a navigational aid and as an aid to locating targets'. However trials of 'blind bombing', when they couldn't see the target, showed almost 100% of the bombs fell within one mile of the target. This compared with the average results of the Pathfinder force where 15% fell within 2 miles of the target. Though this was expected not be as good in real operations, it was likely that the improvement would be very significant.

By the end of the year EMI had met Isaac Shoenberg's schedule of 50 units and 24 of these had been fitted in bombers. Subsequently they were able to squeeze out another 11 units. However, of the 150 that we supposed to come from TRE's RPU they had delivered precisely none. In fact it was to be well into the new year before they delivered any at all.

At the end of January bombers guided by pathfinders equipped with the H2S sets made their first attack, this time on Hamburg. It was found that they enabled them to know exactly where they were and accurately find the targets. This was repeated on other targets over the next few weeks. This was despite the often very poor weather conditions. In fact this now became an advantage as it severely hampered the German defences. The result was much reduced losses of aircraft and more accurate bombing.

Things didn't stand still in the Research Department as before the deliveries had even finished consideration was being made to tidying up some of the items on the units to produce a Mark II version ready for full scale production. In May these began to appear and before the end of the war some 3600 units were manufactured of a number of versions which were constantly being improved.

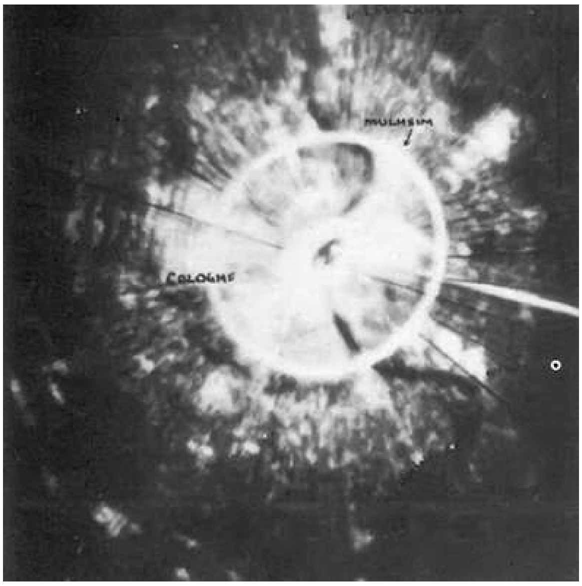


Fig 19.2 H2S display of Cologne. The images took a bit of understanding, but the river Rhine can be seen snaking through the centre.

Very soon the inevitable happened and a bomber fitted with the H2S crashed near Rotterdam and the Germans were able to get their hands on the magnetron. Ironically it was the Telefunken Company who were to examine it and eventually work out its function. The subject was taken seriously and soon a receiver was produced to guide fighter aircraft on to the bomber stream. This increased the losses until it was realised that the sets were being left on the whole time. The simple solution was to only switch them on for a few seconds every few minutes, which wasn't long enough for the fighters to obtain a fix on them.

The system worked well where the coast or large lakes could be identified, but was easily blinded by the strong echoes from large cities, particularly Berlin. This made it difficult to determine particular targets within those areas. As a result work to modify the system to use an even shorter wavelength of around 3 cm was started. Though this presented some problems, much of the existing electronics could be used. These units gave a greater resolution of large urban targets and were used to guide the bombers for the rest of the war.

Even before this had been completed another contract was received; this time from the Navy. What they required was a radar system for the anti-aircraft Bofors guns used on the ships. To get the required precision this needed to be the 3cm system and once pointed in the general direction of the aircraft should be able to track it. Coupled with a fast slewing gun mounting and an automatic predictor, it could cope with attacks from fast travelling aircraft. It was destined to be the Naval Type 262 radar but the first installation in a ship didn't come until late 1944 and it was really too late to have an impact during the war.

By the spring of 1943, the war seemed to be going better. Montgomery's 8th Army had won the Battle of Alamein and was driving Rommel's forces back across North Africa. In the East the Russians had destroyed Paulus' Sixth Army around Stalingrad and had halted the German's progress and put it into reverse. However there was one area of particular concern; the loss of shipping in the Atlantic to German submarines.

The main defence from the beginning of the war had been convoys protected by surface ships, but a development of the first generation 1.5 metre AI radar called the Air to Surface Vessel (ASV) had been brought into service in 1942 and had some success in finding and destroying German submarines particularly as they made their way to and from their bases on the west French coast.

The method the submarines used was to surface at night to charge their batteries and also they could travel faster. Using the Radar to find them when they were on the surface and then using a powerful searchlight known as a Leigh light to hold them while they were attacked, worked well. That was until the Germans developed the Metox receivers which could warn the submarine of the aircraft's approach and they could quickly disappear by crash diving.

By early 1943 the shipping losses were reaching an unsustainable level and something needed to be done. However, the bombers were getting all the H2S sets. Eventually Coastal Command managed to get their hands on some and fit them into their planes. Now they had a set which worked on the 10 cm wavelength outside the range of the Metox receivers and the submarines didn't know they were coming.

On the 18th March the first attack was made on a submarine and then the numbers rapidly increased as more and more aircraft were fitted with the sets. With constant sweeps over the Bay of Biscay they were finding the submarines easily and destroying them in large numbers. In May of 1943 the Germans lost 41 submarines, more than in either of the two previous complete years, mostly by aircraft attacks.

For some time the Germans didn't know how this was being achieved and Doenitz had no option but to withdraw the whole submarine fleet. The shipping losses fell dramatically and Churchill could breathe a sigh of relief. It had been a close run thing, but though Doenitz tried other tactics and eventually a receiver that could detect the 10 cm radars, they never again gained the initiative.

Before the war and at the beginning, Isaac Shoenberg had had to work hard to try to interest the military in what his teams and the company had to offer. Now the tables were turned with so much work coming in both for the Research Department and the manufacturing that it was difficult to cope with it all in the timescales being demanded. With the trio of Alan Blumlein's innovative designs, George Condliffe's careful management and Isaac Shoenberg's inspired direction now broken it was just as well that most of what was now required was incremental improvement and more and more production.

The work on radar had exploded in all directions with involvements in Gun Laying radars, ship-bourne devices and many marks of all of these. The television tube business metamorphosed into making displays for radars including the complicated Plan Position Indicators for the H2S and ASV devices. It was necessary to expand the works to cope with it all. It had been Isaac Shoenberg initially pressing the military and particularly the strategic work on sound locators and the '60 MHz job' that had brought this bonanza.

There was also another line of development stemming back to the television tube business. The basic photocathode material used in the Emitron tubes was sensitive to infra-red light which had been a problem with the television cameras. However, James McGee and his team were able to exploit this in another way. By having a photocathode and then a phosphor taken from the television display tubes on discs close together with a high voltage between them a useful device could be made. It was and infra-red to visible image converter which allowed the observer to view a scene, only lit by infra-red light, in the dark.

Before the war Isaac Shoenberg had tried to interest the Admiralty Research Laboratory in these but though they could see their use, it didn't lead to anything. However, once the war started in 1940 small numbers were made for use in Special Operations. These RG tubes, as they were known, then went through a number of versions as improvements were made but it wasn't until the later half of 1941 that a serious order was received from the Admiralty for signal use. This required manufacture at the rate of 2000 a week and this was maintained throughout 1943 and eventually 150,000 devices were made.

With the Russians pressing westward, and the Allies working their way up Italy things were looking up. Preparations were in hand for a full scale invasion from the west, which finally took place on 6th June 1944. While the Germans tried to hold the beachhead in Normandy they also reacted in another way. A week after the landings they began firing their new vengeance weapon, the V1 flying bomb, from France across the Channel aimed at London.

It took a while to get all the defences in place to deal with this new threat and quite a few were getting through. They had a crude mechanism that when they reached the required range their ramjet engine cut out and the nose was pointed down so that the almost ton of explosive could be powered into targets on the ground. People soon learnt its behaviour and if the engine was still running as it came overhead, you were safe. If the engine cut out you needed to take cover immediately as it would be coming down very soon.

Three weeks later on the 7th July one reached west London. Its engine cut out and it started to come down on a trajectory right over the EMI works at Hayes. It passed over the multi-storey machining factory, which was lucky as there were a thousand people working there and the shelters were just reinforced areas in the corners of each floor. It passed over the Head Office building where Isaac Shoenberg had his office. It passed over the Pattern Shop and the Foundry, narrowly missed the Tube Factory and finally landed on a set of brick shelters with concrete roofs.

The shelter wasn't sufficiently strong to cope with the huge blast and collapsed onto the people inside. Thirty-seven were killed and 56 injured. The timing was lucky in one way as the Nissen huts alongside, which housed the canteen, were empty; otherwise the loss of life would have been much greater as they were mostly destroyed. It being wartime, the bodies and the casualties were cleared away and production went on as before. It seems hard now, but in war this sort of thing had become commonplace.

The landing of the 'Doodlebug', as they were commonly known, must have concentrated the minds in one particular part of the works: those making proximity fuses. At the beginning of the war anti-aircraft gunnery had a very poor success rate. It took something like 18,500 rounds of ammunition fired to bring down one enemy plane. While gun laying radar improved this rate there was still a considerable problem. The difficulty lay in setting the 'fuse' which would cause the shell to explode.

This used a timing system that was started by the firing of the shell and then it would explode after a time that could be preset. It thus fell to the gunners to try to establish the exact position of the aircraft and make allowances for its movement and then calculate the required timing for the shell to reach the aircraft and then set it to that value. Needless to say they didn't very often get it right.

Not long after the war started there were multiple efforts to develop a circuit which would cause the shell to explode when it came close to a target. Various schemes were investigated but the choice eventually came down to what amounted to a very simple, and crude, three valve radar. A signal was transmitted and when a receiver could see the correct sort of return signal the shell would be detonated.

Fig 19.3 EMI proximity Fuse in the nose of a 3.7 inch anti-aircraft shell with the nose cone removed to show the electronics.

The idea was simple, but making a valve circuit that would fit into the nose of a rocket or shell and withstand the forces of the firing was not. Initial work took place in a number of places, including the Air Defence Experimental Establishment (ADEE), Salford Electrical Instruments which was part of the GEC group and Pye at Cambridge. EMI was also involved but little is known of their part in this. The circuit was settled at an early stage, but the main problems to be solved were the producing of components, particularly the valves, to withstand the forces involved when fired.

At the beginning of 1942 EMI (in the form of the Gramophone Company) was given a contract to develop and manufacture Proximity Fuses (PF). At this point there was still considerable work to be done to get the design into a satisfactory state. However as part of the Tizard Mission to America, when a number of ‘secrets’ were disclosed to the Americans, the Proximity Fuse Circuit was part of it. The Americans immediately saw the value of this and started to put considerable additional effort into the development.

Though there was some interchange of information each side to some extent went its own way dependant on the available components. Once the design was proved, EMI ramped up production to 1500 fuses a week with a total of 130,000 being made. This was total dwarfed by the American production as their navy needed vast numbers to defend their ships from aircraft attack in the Pacific.

When the Doodlebugs started it took a while to get a defence system organised and move the guns to the coast. Once they were in place the combination of radar controlled guns, predictors and proximity fuses meant that it required less than 100 rounds to bring down a flying bomb. Though the efficiency of the defence rose rapidly to bring down around 80% of them, mostly by the guns, it only began on 19th July; too late for the EMI works at Hayes.

As the war gradually reached its conclusion, Isaac Shoenberg could look back and consider what had been achieved, and at what cost. His teams had made a useful contribution to gun laying with the sound locators which filled a gap until radars were available. They had solved the problem of range on the early Air Interceptor radar and turned it into a very practicable device which contributed to the decline of night bombing.

They had made very considerable contributions to the centimetric radars which led to the H2S, and that transformed the accuracy of bombing and also reduced the losses of bomber crews. Virtually the same device was decisive in overcoming the submarine menace and drastically reducing the shipping losses in the Atlantic without which the America armies couldn’t have been brought to Britain ready for D-Day.

That wasn’t the end of their contributions to radar, but then there were the infra-red image converters that the Royal Navy found so useful for signalling. Again there was the contribution to the Proximity Fuses and their manufacture which contributed to the defence against the flying bombs. Altogether it was quite a list, and he could feel that he, his teams and the company, had made a difference in the fight against what he knew was an evil regime.

The other side of the coin was the loss of his key engineer in Alan Blumlein. He had been effectively the Chief Engineer of the Department and had been essentially the inspiration to the rest of the team. Isaac Shoenberg had always had a policy of patenting anything that seemed useful for the company’s future, but still the 120 patents that Alan Blumlein filed in the thirteen years that they were together is an extraordinary achievement, and many of them were of fundamental importance.

That was not to decry the two other men that were lost with him. They were essential parts of the team. Frank Blythen was the one who did the detailed work after Alan Blumlein had sketched it out. Cecil Browne was the person who converted the prototype circuits into a practical design. Isaac Shoenberg had always understood the importance of a mix of skills to make a balanced team. That was why they were able to turn basic ideas into practical products in such short timescales.

There was something else to concern him. Pinsk was now in the Soviet Union, and contact was difficult, but still the silence was worrying. As a well informed man be almost certainly had a fairly good idea what this meant, but no detail was available and the situation was left hanging. A section of his and Esther‘s families had vanished and there was always that nagging doubt as to their fate.

# 20 Postwar

As the war came to an end in 1945, Isaac Shoenberg was already sixty-five and at the normal retiring age. However, he was not the sort of man who would want to go off and play golf or go fishing. He was far too involved with his work to want to retire and stop completely, and so he went on as long as he thought there were things for him to do and he could make himself useful.

The great challenge for the company was to refashion itself from one that was undertaking almost entirely military work, to the civilian and domestic supplier it had been before the war. Had it not made this change it might not have survived. It had been the research work that had enabled the company to get into important new fields, particularly radar, and here Isaac Shoenberg's development of equipment as private ventures was the key to getting into the position of a military supplier.

One of the main challenges was to get back into the television business as soon as the BBC started broadcasting again. This matter had been considered as far back as September 1943 when a Television Committee under Lord Hankey was set up to 'prepare plans for the reinstatement and development of the television service after the war'. Of course, Isaac Shoenberg was amongst the witnesses that gave evidence to them. It was a measure of the confidence by this time that the war would have a satisfactory outcome, though there was still some 20 months to go in Europe and nearly two years in the Far East.

When the report was finally published in March of 1945, with the war coming to its end, unsurprisingly, it recommended that the 405 line system should be used, as it was, and that though developments should take place, it should still use the standard that Isaac Shoenberg and Alan Blumlein had introduced back in 1936. This made life a great deal simpler for the BBC as it meant in principle it could carry on using the existing equipment, as long as it still worked. Any improvements could be brought in gradually.

As early as the end of August in 1945 the television set makers were requesting that a fixed test signal was transmitted so that they could test receivers. EMI, like the rest of them needed to update its receivers though this was handled by the works design department which was separate from the research department. However, there was a need to modify the cathode ray tubes that had been developed for radar to be suitable for television receivers and this needed the research department.

The Emitron camera tubes that had been used before the war had a particular problem of 'shading' caused by secondary electrons and so required the complicated 'tilt and bend' corrections. At the time the ultimate solution to this was understood but there wasn't time to pursue it. It was now time to revisit the idea of the Cathode Potential Stabilised (CPS) Emitron which they had patented at the time.

The problem then had been that it required a transparent photosensitive mosaic and at the time nobody knew how to make such a thing. With the developments that had taken place subsequently it was now time to tackle this again. With the use of very thin glass substrates, instead of mica, and developments which produced a transparent photosensitive mosaic, the way was open to a much more satisfactory camera tube design.

It meant that the electron gun could be on the opposite side of the mosaic from the lenses and the whole device could be in a single tube. This did away with the awkward shapes of the earlier tubes and also meant that the electron beam was meeting the mosaic straight on and not at an angle hence requiring keystone correction. The net result was a much smaller and more efficient tube.

The other feature of the design was that the electron beam was slowed almost to a stop by the time it met the photosensitive layer which meant that it didn't eject secondary electrons, and so the shading, which had been such a problem with the earlier tubes, was avoided. The result was a camera tube even more sensitive than the Super Emitron and was thus very suitable for outside work, particularly when the light was beginning to fade.

The BBC reintroduced television programmes from Alexandra Palace on 7th July 1946 using all the pre-war equipment. They were keen to develop the service further both in terms of technical equipment and also in coverage. There were plans to build transmitters in Birmingham and other parts of the country to give as wide coverage as possible. Thus there was a clear future for the service and for EMI's involvement.

However, in the company things were not as happy. In 1939 Alfred Clark had eventually managed to ease out Louis Sterling (or Sir Louis as he now was). He was replaced by Sir Robert McLean who had been the manager of the Indian Railways. He created a very different atmosphere and was rather dictatorial. Isaac Shoenberg found him difficult to work for, but with all the looming war work, he stayed on.

After the war, and the retirement of Alfred Clark, the company was run by Chairman Sir Alexander Aikeman. The Managing Director was now Sir Ernest Fisk who, in 1946, decided to divide up the company into 12 sub-companies largely along functional lines instead of products. This was a crazy way of organising a company and was bound to be inefficient. Isaac Shoenberg asked Fisk what he thought he was doing and explained why it would not work.[1] He was told to mind his own business, but surprisingly was not sacked.

In 1947 there was a ferociously bad winter with supplies of coal being interrupted as everything had frozen. Supplies of electricity became limited and for a time even the television service was shut down. In February, right in the middle of this, Isaac Shoenberg, whose health was always a bit suspect, was sent a menu card with a note to get better soon, signed by a group of his senior colleagues[2]. He had had a heart attack.

For most people this would have been a warning that it was a good point to retire, but not for Isaac Shoenberg who soon returned. At this moment Fisk's reorganisation took place and Isaac Shoenberg became Managing Director of the new EMI Research Laboratories Ltd. He now realised that he needed to step back and so George Condliffe took over as the day to day Director of the Research. Confusingly, Isaac Shoenberg was still sometimes known as the Director of Research of EMI

There is some ambiguity about what his precise position was after the war. His contract of employment from 1946 onwards describes him as 'serving the company in an advisory capacity'[3]. However, he was still nominally in managerial position rather than just a consultant. The limits of this were shown when he wanted to remove some of the 'manufacturing' work that was still being undertaken by the research department so that they could concentrate on the real research. George Condliffe wanted to hang on to everything, and though Isaac Shoenberg could have forced the issue he was in no state to take over the reins again.

It seems likely that as he handed over an increasing amount of the work to George Condliffe he took up more of a role as a consultant to the company. From 1st September 1948 he was only required to attend for one day a week, though he seems to have worked for more like three days in the week. For this he was paid the curious sum of £4089.14.0 which was a considerable amount at that period for part time working though it included any fees as a director of sub companies.

One area he still was very much involved with was the patents. This seems to have continued for many years.[4] His expertise on what was worth patenting, and particularly what applications were worth pursuing to final patents, was still of great value, particularly in the area of the television developments. Despite the change of roles, he was obviously still involved with the television developments.

On 20th of November 1947 Princess Elizabeth was to marry Lieutenant Philip Mountbatten in Westminster Abbey. It was hoped to televise the ceremony from inside the Abbey, but the authorities would not permit that. However Isaac Shoenberg had arranged the demonstration of the prototype CPS Emitron cameras to the BBC and they jumped at the chance to use two of them, even if only for the procession. Two weeks later the cameras were again used to cover the visit of the King, Queen and Princess Margaret to Broadcasting House for a special performance of *ITMA* (*It's That Man Again*), a war-time radio comedy.

The BBC were reasonably happy with the trials, sufficiently so to place an order for a new type of outside broadcast unit to be ready in time for the London Olympic Games in the summer of 1948. The unit was to use the new CPS cameras which would have a turret with three different lenses in the production version as well as a proper viewfinder. The other great advantage was that in the new vans the crew could be seated instead of having to stand the whole time as in the pre-war vans.


Fig 20.1 CPS Emitron Cameras in use at the Wembley Empire Pool for the 1948 Olympic Games

Ian Orr-Ewing, the Head of Television Outside Broadcasts was thrilled by the new equipment, and the sensitivity of the cameras that could produce good pictures in light far too dim for cine cameras. Harold Bishop, the BBC Chief Engineer wrote to Isaac Shoenberg[5]:

> I write to send you our thanks and congratulation for the work done by your engineers in getting the O.B. equipment to Wembley in time for the Olympic Games. I know that much hard work has been necessary to meet the target date and that many long hours of overtime have been involved. We all think however that the results have been well worth the effort. I

shall be glad if you will convey our thanks to all who have been concerned with this achievement.

There are of course many imperfections yet to be overcome in the equipment. No doubt these will be attacked when the equipment is returned to you at the end of the Games. But inspite of these imperfections, the broadcasts from the Empire Pool have in our opinion been a great success, and not only have they been of value in giving us operational experience with the new equipment but the excellence of the pictures have been a fine advertisement for British Television to the many foreign visitors in this country at the present time.

Despite the dig to ensure that any outstanding faults were corrected, he couldn't hide that the BBC was very pleased with what had been achieved.

At the same time Isaac Shoenberg was writing to the Sunday Times paper to correct, as he saw it, some technical points in an article 'American Television and ours'. The author, Denis Johnston, while not liking much of the American programme content had suggested that as the American system used a higher number of lines the resolution must be better. As Isaac Shoenberg pointed out this depends on many other factors as well and that many observers found no perceivable difference between the systems.

Johnston had praised the depth of focus of the American cameras and how good this was for baseball games and other outdoor activities. Isaac Shoenberg gently suggested perhaps the article had been written before the author had had the opportunity of seeing the pictures of the swimming from the Empire Pool which had great depth of focus and had been widely praised. The Americans had had more time to develop their systems as their involvement in the war had been much shorter, but it was still felt that though their Orthicon cameras were more sensitive than the CPS Emitron they were more noisy.

Fig 20.2 EMI Flying Spot telecine system. On the right of the operator is the 35 mm film section and the left the 16mm.

The least satisfactory part of the original studio equipment in 1936 that had been supplied to the BBC for Alexandra Palace, had been the telecine film scanners. These had used a standard Emitron camera looking at a modified film projector. They had never been fully satisfactory as the cameras didn't like the sudden changes of light as the frames of the film were quickly advanced. Again after the war there was the opportunity for Isaac Shoenberg to return his team to this problem.

The arrangement that was produced worked on an entirely different principle and in a sense went back to some of the earlier ideas such as the Mechau film projector. Instead of having the film frame shown for a moment and then quickly advanced to show the next frame, it was moved at a constant speed. To obtain the static image a mirror drum or multifaceted prism was used that rotated in synchronism with the movement of the film. This produced a static image for a period and then dissolved into the next frame.

The static image was scanned by a bright cathode ray tube which produced the required raster and then on the other side of the film a photocell collected the light from the spot and produced the television signal. What the team produced, was an arrangement that could deal with the interlacing of the signal needed for the television standard, but could also cope with television with frame rates that were different from the 24 frames per second normally used by the film industry.

Of course this system, known as a flying spot scanner, was patented. This was after Isaac Shoenberg had had to step back and so George Condliffe had his name on the patent as well as Maurice Harker and William Lucas.[6] It was turned into a product and offered to the BBC who took a number of them. A variant of the same system could be fed with unexposed film and the beam from the CRT modulated with the television picture. This would 'write' the picture on the film, which was then processed in the normal way. This meant that a film record of a television programme could be simply achieved.

At the end of the war representatives from the victorious allies scoured Germany for any useful technologies. In some of the radio stations they discovered that programmes were being stored on plastic tapes, with a magnetic iron oxide coating, for playback at a later time. They were recorded and played on machines known as Magnetophons made by AEG. Some of these found their way to America but a few also came to Britain. The BBC had a couple, but it would seem that EMI had got their hands on at least one.

Fig 20.3 BTR1 Studio tape recorder

As these machines, and particularly the tape, were in short supply the task of the research department was to produce a similar machine and even more importantly the magnetic tape that it used. By the autumn of 1947 they had succeeded and the first machine, the BTR1, was produced. Naturally this was tested in the Abbey Road studios, but a couple of these were loaned to the BBC so that they could test them.

The BBC found they worked as well as the Magnetophons. Though these early machines were quite big, it meant that they were very valuable for intermediate recording in the record business, a good deal of which was in house. Radio stations were also interested as it meant that they could get away from having to broadcast everything live or from records. It had opened up yet another new market for the company. The machine was later replaced by a new version, BTR2, which was used for many years and most of the Beatles recordings were made on them.

With the war coming to an end it was inevitable that there would be a trail off with the military contracts. However, the incoming Labour government didn't cancel everything. While most of the work no longer needed to be in the research department there were loose ends where work was still needed.

During the war the naval type 262 3cm anti-aircraft tracking radar had been developed, and though the radar development itself had been completed, there were still outstanding problems with the gun mounting which tended to lose 'lock' when the twin 40mm Bofors guns were fired. This mounting was known as the Stabilized Tachymetric AA Gun (STAAG) and curing its problems was now the task for Eric White and his team in the research department.

Just as the Navy needed faster tracking radars, it also needed to upgrade the main surveillance radar the Type 293, which had seen good service but couldn't cope with the threats of faster aircraft. In 1944 Isaac Shoenberg managed to obtain a request for proposals to develop a more advanced system. The research department produced an outline system design and then it was transferred to a specialised department in the Dawley works to turn the ideas into a finished Type 992 radar system.

Similarly all the work on more advanced versions of the H2S radars was gradually transferred to the Works Designs department and the Research Department's involvement with them gradually faded out. The work in the Research department was no longer in one or two large projects but spread of many smaller ones. Thus its work was no longer the driving force of the company's development.

Into the 1950s the subsequent managements blamed the arrangement of numerous functional sub-companies for the poor performance of the company during this period. Sir Ernest Fisk was sacked in 1951 and he was later replaced by L J Brown and things started to improve. Though Isaac Shoenberg remained with the company, it would seem likely that his skills were not particularly valued during Fisk's time.

The nature of the work of the company had changed considerably. There had been some research work necessary for the new television cameras, but the developments were now more evolutionary than revolutionary. Engineering work is like that. There are periods of huge change such as the introduction of television in the 1930s and then there is a considerable period of refinement and tidying up before the next sudden large change. The post war period was mostly in the evolutionary stage.

This could also be seen in the radar business. Isaac Shoenberg's pushing and speculative radar development just before the war had got the company into the radar business. Now, because it had the technical ability to design systems it remained in the business after the war and had become a major supplier. It was now a considerable part of the company's turnover.

However, these changes meant that Isaac Shoenberg's real skills were no longer so valuable. There wasn't the need to lead teams into areas where no one had been before and where there was such a premium on fine engineering judgement. The requirements were now largely coming in the form of specific requests by the potential customers, rather than the supplier having to judge what was possible and practical. It was clearly time for him to have a different role.

His experience and wisdom were starting to be appreciated by the board, particularly from 1952 onwards. The chairman described him as 'elder statesman' and said: 'I should like to thank you for all the thought you have given to the many problems we have had during the past year and the wise counsel you have offered from time to time'[7]. Not only had it been offered but quite often his advice had been followed.

The following year it was the managing director writing to him at the end of the year thanking him for 'the tremendous help and support you have given me during the past year. The value of what you have done for the company as a basis and background to whatever it may have to face in the future is something that I understand and appreciate very much indeed. My earnest hope is that your talents may long continue to be used in giving new strength to the company and guidance and support to my efforts'[8].

The following year the managing director was so pleased with his 'extremely valuable help and guidance' that he was awarded an ex gratia payment of £1500; a considerable bonus at the time[9]. He had found a new role where, though he was well into his seventies, he could still be of value.

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1 Interview with Isaac Shoenberg 1957, Shoenberg Family Archives
2 IET Archives NAEST, 62/1.20
3 IET Archives NAEST, 62/2.13
4 eg IET Archives NAEST, 148/1.58; 148/1.64; 148/2.16; 148/5.76; 148/7.17
5 IET Archives NAEST, 62/3.7
6 UK patent 656292
7 IET Archives NAEST 62/ 1.25
8 IET Archives NAEST 62/ 1.27
9 IET Archives NAEST 62/ 1.11

# 21 Rewards and Awards

Though Isaac Shoenberg had been concentrating on his work and in particular on the radar systems during the war and the return of television after, there had been things happening in the family. His sister Zlata, who still lived with them, had been working as a teacher, but in her spare time had teamed up with Jessie Domb to translate some of the Russian classics into English. With the Russians being allies during the war this produced a greater interest in the country and its literature. The first for these, Gogol's 'The Greatcoat' appeared in print in 1944. This was part of a bilingual series where the Russian was on one page with the English translation opposite.

In 1945 this was followed by Turgenev's 'Mumu', Tolstoy's 'A Captive in the Caucasus' and 'Bela' by Lemontov. These, particularly 'The Greatcoat', are still regarded as the definitive translations today. This was a considerable achievement, but the translators were lucky to find publishers in the narrow slot in wartime when Russia and its doings were in favour as 'our heroic allies'. Before it had been regarded as a communist state and hence more or less an enemy, and after the war the 'Cold War' soon took over.

Isaac and Esther Shoenberg must have been proud of their children. They had all made their way in the world though in different fields. Mark had various jobs, undertaking administrative work for the Navy during the war. Later, after working in the insurance field, he became Assistant Secretary of the Royal Meteorological Society, a role in which his contribution was much appreciated. He also pioneered the use of calculating machines in school mathematics. In his forties he married Rita Harris, with whom he had three daughters.

Fig 21.1 Shoeberg Children when they were older. L to R Rosalie, David and Elizabeth

Rosalie married Mark Burke, a doctor like herself and a psychoanalyst. They had two children, but later divorced. Rosalie then married James Taylor, also a psychoanalyst, and it was under this surname that she built her reputation as a specialist in psychosexual medicine. She had worked with Marie Stopes and was one of the first doctors to provide family planning. She was a founder member of the Institute of Psychosexual Medicine and in her own work as a gynaecologist was regarded as a kind, sensitive and dedicated doctor.

Alexander, not as academic as his siblings, worked as a travelling representative selling gramophone records and later developed a career as an insurance broker. In later life he married Juliette Marres, a Dutchwoman, who, like him, was a keen rambler. In his spare time he enjoyed participating in amateur dramatics.

David, after completing his PhD at Cambridge University, continued his work there in low temperature physics. He was Head of the Cavendish Mond Laboratory for several years and from 1973 held a chair in physics. He was awarded an MBE for his war work on mine detection and delayed action fuses. In 1953 he was elected a Fellow of the Royal Society and in 1995 was awarded the Society's Hughes Medal. He married Kate Fischmann, a physiologist, born in Belgium and, like David, of Russian Jewish ancestry and naturalised British. The couple had three children.

Elisabeth, the youngest of Isaac and Esther's five children, was the only one born in England. Like Mark and David, she took her undergraduate degree at Cambridge University, reading English and later archaeology and anthropology. She had intended to become an anthropologist but instead switched to medicine, qualifying at King's College Hospital in London. After training as a GP, she began to specialise in psychiatry and she became a consultant at Claybury Hospital, Essex. She was regarded as an inspiring psychiatrist and was a pioneer in the field of therapeutic community work.

Altogether the achievements of their children were enough to make their parents proud. When it is remembered that four of them were born outside this country and had to switch language to go through the education system, it was quite remarkable. It meant that in what should have been retirement they could watch their children's progress and their grandchildren grow up.

Isaac Shoenberg had always been publicity shy. It probably stemmed from his background in the Russian Empire when it was always a good idea to keep your head down. As a result he and his team had never been really given the credit for their achievements in bringing in the 405 line television system in 1936. He didn't seem to want to attract publicity to himself to publicise their achievements, but there were those who thought this situation should be changed and he should get his due credit.

Chief among these was Lord Brabazon of Tara. John Moore-Brabazon was a colourful character. He had been one of the earliest to take to the air in 1908 and saw service in the Royal Flying Corps and the Royal Air Force in the First World War. Between the wars be became a Conservative MP and in the Second World War he was in Churchill's government first as the Minister of Transport and then Minister of Aircraft Production. He was forced to resign in 1942 when his mouth ran away with him.

He was too useful for him to be lost to the government and he was elevated to the House of Lords as Baron Brabazon of Tara where he chaired the Brabazon Committee planning the development of the postwar aircraft industry. Also by 1946 he had become a director of EMI and was proud of the fact. Opening a debate in the House of Lords, in July of that year, on renewing the BBC's Charter he said[1]:

> I think it is well worth while to point out that the system of television as used today at Alexandra Palace, which is acknowledged to be the best in the world, is the product of E.M.I.; it is the product of Mr. Shoenberg and of his staff. I noticed the Postmaster-General, when reopening television at the Alexandra Palace the other day, paid no sort of tribute or thanks to the originators of this successful system. The general impression was that it all happened through the B.B.C. and the Post Office. That is not true.

It was just a nudge in the right direction as the BBC had been very ready to take the credit for the system and not mention EMI's contribution. There was also the publicity that John Baird and his company had put out which had left the impression in many people's minds that he had been responsible for inventing television. In 1953 Lord Brabazon repeated much of this during a debate of Television Policy, but this time he called him the 'great Shoenberg'.

When Isaac Shoenberg heard about this he wrote him a letter thanking him for his 'kind remarks' but he went on that 'I certainly do not claim that I am "great", but you are right when you said that I produced television in this Country and that it was not Baird.'[2] The avoidance of publicity had come back to haunt him as others, particularly the Baird Company, had managed to put out their version of the history.

In 1952 Gerald Garratt for the Science Museum in London and his associate A H Mumford presented a talk on The History of Television to the Institution of Electrical Engineers. Before this was printed in the Journal, Gerald Garratt began to feel that the article would not give due credit to Isaac Shoenberg and his team[3]. He then wrote to him and they met and together concocted a contribution to the 'Discussion' printed with the article. It helped to start to set the record straight and Gerald Garratt became one of his supporters in this endeavour.

For many years Isaac Shoenberg had been a member of the Institution of Electrical Engineers the premier body for professional electrical engineers. Each year they awarded their Faraday Medal to someone 'either for notable scientific or industrial achievement in engineering or for conspicuous service rendered to the advancement of science, engineering and technology'. The list over the years contained many illustrious names such as Oliver Heaviside, Charles Parsons, Sebsatian de Ferranti, J J Thompson, and Ambrose Fleming.

In 1954 the recipient was Isaac Shoenberg. Whether Lord Brabazon had something to do with this isn't known, but it was a clear recognition by his profession of his contribution. The award was made on the 7th January and the citation said: 'for his distinguished work in electrical engineering; in particular, the outstanding contributions which he has made to the development of high-definition television in this country.' Isaac Shoenberg, of course, gave a short speech in reply in which he said:

> 'Mr. President and fellow members. Thank you very much for the great honour which you have conferred on me. I naturally consider this award as a recognition not only of my personal efforts but also of those of the team which I was privileged to direct. My team included several men of outstanding ability, and the names of some of them are well known to you. They were equal to the very heavy demands I made upon them. As soon as our research revealed a new possibility we tried overnight, so to speak, to turn it into a practical proposition with a view to applying it to the job in hand… You can imagine that in this rapid industrialization of our freshly acquired scientific knowledge we were sometimes working on a narrow margin…'

It was typical that he should want to deflect some of the honour onto his team. It must have brought home, once again the loss of the three men who had died in the crash, particularly Alan Blumlein.

In June of 1954 a new person was persuaded to join the EMI board and that was Joseph Lockwood. At first sight he seemed an unlikely candidate as he had spent most of his adult life involved with the flour milling industry, and was an expert on that. He was chairman and managing director of the millers Henry Simon Ltd. However, he was also a director of the National Research Development Corporation and a man with leadership qualities.

In a month he was made the deputy chairman, and then just before Christmas the existing Chairman Alexander Aikman stepped down and Joseph Lockwood took his place. It was a position he was to hold for twenty years and rejuvenate the record side of the business particularly leading it into the ‘pop’ business. His greatest triumph was in the 1960s with groups such as the Beatles and this transformed the fortunes of the company.

His first act on taking over was to call an Extraordinary General Meeting of shareholders on the 11th February 1955. There were two items on the agenda; raising more capital so that they could buy Capitol Records in the US, and the appointment of Isaac Shoenberg as a director of the company. Needless to say both resolutions were passed and so Isaac Shoenberg joined the main board of EMI just short of his 75th birthday.

In his comments Joseph Lockwood briefly outlined Isaac Shoenberg’s background and contributions to the company. He then said: ‘His unique experience is helping today to keep EMI in the forefront of peacetime electronic developments. There can be few such men, however, who have been so self effacing, or who have succeeded so well in evading the credit and publicity which usually attach to such accomplishments.’ In the six months Joseph Lockwood had been on the Board he had quickly assessed Isaac Shoenberg’s value to the company and acted.

Fig 21.2 Isaac and Esther Shoenberg in later life relaxing at their home, 203 Willesden Lane.

Though vinyl records had been introduced in America in the late 1940s it wasn’t until 1952 that they appeared in Britain. The then board of EMI were not keen to get into these new formats because it meant spending large sums of money to modify all the manufacturing equipment. It wasn’t until the arrival of Joseph Lockwood that the subject was taken more seriously.

One of the opportunities that this opened up was the practicability of making stereophonic records. Though Alan Blumlein had made some shellac recordings in the early 1930s, the noise level meant that they were not a practical proposition particularly in the depressed market in those years. However in 1957 a number of companies started to look at the subject and some were in for a nasty surprise.

After spending large amounts of money some discovered, when they went to patent their ideas, that Alan Blumlein had got their first and patented virtually every possible variant. Unfortunately for EMI the patent, even though it had been extending to compensate for the war years, expired in 1952. There was nothing they could do except join the fray themselves. In a sense it was an accolade to Isaac Shoenberg's team, and it just showed how far ahead they had been working in the early 1930s.

By 1957 the BBC, having had a great success with the televising of the Coronation, and the continual rise in the number of viewers, was taking a much more positive attitude to the Television Service. So that year it decided to have a dinner to celebrate 21 years since the service started and this grand evening dress affair took place in the Dorchester Hotel in Park Lane on Friday 1st November. This was as close as they could get to the actual anniversary on a convenient day.

In a recognition that he had made a contribution, Isaac Shoenberg was invited[4]. He was pleased that the Director General Sir Ian Jacob, mentioned both him and his team in his speech as did Sir Alexander Cadogan the Chairman of the Governors. He, of course, wrote a polite thank you letter[5]. With people at the helm of the BBC who were not involved in the original service there was no longer the need for them to try to take all the credit.

In 1960 Isaac Shoenberg was 80 and maybe this was the trigger of a Profile article on him in the New Scientist magazine. The unnamed author of this was Gerald Garratt and he didn't communicate directly with Isaac Shoenberg but the many factual questions were answered via Stanley Preston so that the article 'would not be influenced by anything I might say in conversation'.[6]

The article appeared in the 9th June number of the magazine and was a fair, but brief, outline of his career. What is curious is that despite the process by which it was created some small discrepancies appear in it. One sometimes wonders if he was perhaps a little vague about some of the names and dates of things that had happened many years before.

The following year was the 25th anniversary of the start of television transmission in Britain. On 19th July EMI decided that they were going to celebrate this and so held a party. They assembled a considerable amount of early television equipment such as receivers and cameras as an exhibition and invited some special guests: Isaac Shoenberg, Lionel Broadway and James (now Professor) McGee as he had taken up a post in the Physics department at Imperial College. They also had an open invitation to the Press.

A considerable number of them turned up and the one thing they all took away was that EMI, and in particular Isaac Shoenberg's team, and not Baird, were responsible for the first television system. A good example was the headline on the piece in the Daily Herald the next day: 'The shy genius behind your TV'. The subheading continued: 'Last night he came out of obscurity and a 30-year-old controversy is settled'. In articles in this paper, the Sunday Times, the Daily Telegraph, the Financial Times and oddly The Stage, the story of the early television system was laid out.

For once Isaac Shoenberg had met the Press and been forthcoming. Together with the other guests, he had made a short speech. Though the Evening News seemed more interested in the fact that he appeared to refuse to be the one to cut the anniversary cake, most seemed to have absorbed the message. They all seemed to find it extraordinary that at 81 he was still a director of EMI and went to the office three days a week.

In September Gerald Garratt was writing to Isaac Shoenberg to let him know that the BBC was planning a special TV programme to celebrate the 25th Anniversary and that he had been consulted about this[7]. He wrote back to say that he was interested but:

'… for many years the BBC was not giving any credit to EMI, then mainly owing to the influence of objective history (written for the first time by you) they adopted an ambivalent attitude: well, Baird of course was first in the field, but EMI might have produced some improvements. This stage will probably go on for another five years, and I cannot obviously expect to live long enough to see the BBC reaching the final stage of admitting that despite all discouragement (and a good bit of it from the BBC) EMI produced the system, the standards of which were selected by the EMI in every detail and every respect without the slightest contribution from the BBC.
I shall certainly cooperate, but I am fed up by mealy-mouthed statements which are supposed to show off the generosity of the BBC in giving some credit to some people who they imply don't quite deserve it.
Well I have let off a little steam. Perhaps it will do some good, but I doubt it.'[8]

It was rare for him to talk about his growing frustration over his team not getting the credit for what they had done, though Gerald Garratt had previously pointed out to him that he was partly to blame for avoiding all publicity. He wrote trying to give reassurance that all would be well this time.[9] It was going to be a colour film and be produced by Andrew Miller Jones and called 'The Origins of Television'. What happened to it isn't clear though the material may well have been reused in some of the later programmes on this subject.


Fig 21.3 Scroll presented to Dr! Isaac Shoenberg at the Second International TV Symposium in Montreux

The BBC had decided to celebrate the 25th anniversary of television with another grand dinner on the 7th of November. This time it was held in the Grocers Hall in the City of London and Harold Macmillan, the Prime Minister, was proposing the toast. Isaac Shoenberg was there and was positioned, according to the newspapers, 'well above the salt', indicating that he was an honoured guest. The dinner, or at least part of it, was televised and shown live.

Isaac Shoenberg was clearly winding down. He decided that his membership of the Royal Institution was not worth continuing. As he was well paid, it could hardly be due to shortage of money. However the response was to give him one of the small number of free memberships that the committee had available. Of course, it was the President, Lord Brabazon who was behind this.[10]

In the following year, 1962, The Second International Television Symposium was held in Montreux spanning from April into May. There were 350 delegates from 50 countries and some 50 papers were read; but they also decided to give a citation to a number of people that they felt had made a special contribution. Among those so honoured was Isaac Shoenberg for his 'outstanding contribution to the advance of television'[11]. At least he had achieved recognition within the industry, if not outside it.

That recognition appeared only a few days later on 2nd June when, as part of the usual honours list, it was announced the Isaac Shoenberg was to receive a knighthood, 'for services in the development of television and sound recording'. He was now Sir Isaac and Esther became Lady Shoenberg. This must have come as quite a surprise for them. It had been quite a journey from far off Pinsk. Quite why he was awarded this at this particular point isn't clear, but it was at last a recognition not only for him, but also for his team. It had come late in his life; almost too late.

A couple of months later Lord Brabazon took his opportunity again, during a debate in the House of Lords on the report of the Pilkington Committee on the future of broadcasting, to mention EMI's contribution to the development of television. He obviously took delight in mentioning Sir Isaac Shoenberg, making sure he included the new title[12].

Lord Nelson of Stafford had been the power behind the growth of English Electric to a major engineering company. In 1956 he had stepped down and his son became the Managing Director while he retained the Chairmanship. However, on 16th July 1962 he died and his son inherited the title. One the 8th August Sir Isaac Shoenberg wrote to the new Lord Nelson: 'I had not heard the sad news about your father until yesterday. I did not see the papers and no one told me about it, probably because my own health has not been too good lately…'[13] The long delay, and his presence at the Friston Cottage, suggests that his comment on his health was somewhat of an understatement.

Less than a month later, Semyon Aisenstein also died. He too had come to England after escaping from Russia in 1921, joining the Marconi Company where Isaac Shoenberg headed the Patent Department. After a few years managing valve making plants on the continent, he came back to England in 1939 and continued that work here ending up as the General Manager of English Electric Valve Company. The two men had kept in touch as they had been through a lot together in the early days of wireless telegraphy in Russia, and had since been working in similar fields. He was a few years younger than Sir Isaac and so it must have been a shock. It was yet another premonition that time was running out for him.

He lasted another few months an then on the 25th January in 1963 a Coronary Thrombosis, or heart attack, finally took him at his long term home in 203 Willesden Lane. He hadn't quite reached his 83rd birthday or the Diamond Wedding celebration of the long life that he and Esther had shared.

Zlata, the 'much loved sister, aunt and friend' only lasted another two and a half years, until 4th November 1965. Esther, awarded a generous pension by the company, only enjoyed that and being Lady Shoenberg for three years after her husband's death, dying on 6th January 1966. She was to join him in the Liberal Jewish Cemetery in Pound Lane.

[1] Hansard HL Deb 26 June 1946 vol 141 cc1173-218
[2] IET Archives NAEST 62/3.16
[3] IET Archives NAEST 62/3.11 and 62/3.12
[4] IET Archives NAEST 62/3.22
[5] IET Archives NAEST 62/3.24
[6] IET Archives NAEST 62/3.27, 62/3.28, 62/3.29, 62/3.30, 62/3.31
[7] IET Archives NAEST 62/3.32
[8] IET Archives NAEST 62/3.33
[9] IET Archives NAEST 62/3.34
[10] IET Archives NAEST 62/1.32, 62/1.33
[11] IET Archives NAEST 62/1.14
[12] Hansard HL Deb 19 July 1962 vol 242 cc771-847
[13] IET Archives NAEST 62/1/34

# 22 Aftermath

As a knight of the realm, Sir Isaac Shoenberg received numerous obituaries both in the national press and in local papers. Most of these merely gave an outline of his career usually with a number of facts that were not quite correct. The one that stood out was a letter written by his old friend Lord Brabazon of Tara published in The Times newspaper three days after his death. It said:

> 'The name of Sir Isaac Shoenberg will live for ever, for it was he and his team at EMI, who, when many talked of television, actually produced an electronic system that was possible and practical, which has endured until today. Through his efforts we in this country pioneered a television service before any other country in the world, and yet his name is little known.
>
> Gentle, unassuming, though an intellectual giant, he won the hearts of all with whom he came in contact. We who knew him and now mourn him were ever conscious of the greatness of the man and of the honour it was to be counted among his friends.'

Here was one, who many would describe as a great man himself, showing emotion in mourning his friend. It was a longstanding friendship and it is a measure of the impact that Sir Isaac Shoenberg could have on people who really got to know him. It was also shown in a letter he wrote to Isaac Shoenberg on 8th June 1953. 'I have had many congratulations on getting my G.B.E. but none is more welcome than your telegram. To be remembered by you touched me very much, as you know I have an almost holy admiration and respect for you.'[1]

Sir Isaac Shoenberg was not someone who easily made friends, but he did collect a number who were often people of prominence themselves. Among them were, of course, Sir Louis Sterling with whom he worked, and Sir Stafford Cripps. He had got to know Cripps in the 1920s and 1930s as he was a lawyer specialising in patent cases before entering parliament. After the war he was a member of the Atlee government first as President of the Board of Trade, and then Chancellor of the Exchequer. Sir Isaac was a great sender of telegrams and among these were ones each New Year to Sir Stafford Cripps. These would produce a handwritten reply in red ink.[2]

He was not an easy man to get to know and the impression he gave on those who knew him less well was summed up by Barry Vyse in his Saga of the Marconi-Osram Valves in the BVWS Bulletin in 2000 describing his impact on that company he said: 'Isaac Shoenberg was a very clever and innovative man and a prime-mover. My old colleague George Jessop remembers him as rather stern and self-opinionated but 'sharp as a tack'.'

There were, as would be expected, a number of obituaries in the technical press. Among these was one in the Journal of the Institution of Electrical Engineers written by Leonard Broadway who was by then the Director of Research at EMI. After a brief summary of his career he said: 'He was scrupulously honest, even ruthlessly logical, in his thinking, and a man of unchallengeable integrity in all his dealings with his fellow-men. He hated the slightest hypocrisy or prevarication. He also hated publicity, for he was modest and self-effacing to a fault. He was universally respected and admired, and those that were able to break through his reserve found in him a great capacity for real friendship.'

Isaac Shoenberg once described himself as 'a paid dreamer', but, as usual, he undervalued himself. There are plenty of 'dreamers' and some of them are even paid to do it, but he was capable of turning those dreams into reality. That is a much rarer skill. He was able to put together teams to tackle the major difficulties and motivate them to solve those problems. All the time, he had a clear view of the final objective, and wasn't deflected even when those outside his team started to doubt or even panic. That puts him into a very tiny category.

Professor James McGee, as he was later, who having worked for him for many years knew him well said: 'It was his personality, character, and ability to take a synoptic, long term view – and to carry other people with him – rather than his detailed technical knowledge that shaped and made successful his whole policy.'

Dr Eric White, another of his senior team members, who took over much of the electronics work after Alan Blumlein was killed, put it this way:' Shoenberg's incomparable talent lay in his combination of scientific vision with personnel management. Shoenberg's recognition of the future importance of television is shown in his quotation from 1935: 'I was saying to my boys that we are lighting a candle that will not be put out'.' This, of course, was before the opening of the television service and shows that he had a clear view of the importance of what they were doing.

This is a very rare combination of skills, but they are not flashy and likely to attract attention. Quite apart from his personal avoidance of publicity the company had many reasons to keep quiet about what they were doing in the early 1930s when developing television. That they were in competition with a company that depended on a public profile to raise finance led inevitably to them taking credit which was somewhat unbalanced.

John Baird and his company did much to publicise the possibility of television and certainly helped its early introduction in this country, but they were up a technological blind alley. They did, however, provide some competition which helped to motivate the EMI team as they wanted to prove that their system was better. It was Isaac Shoenberg's vision that saw where the future lay and steered the team away from mechanical systems even when the electronic ones looked poor by comparison.

It was thus only those inside the industry, and in particular in EMI, who truly understood what he had done. There he built up a phenomenal reputation. P Wilson writing in The Gramophone in 1961, and reprinted in the EMI News, put it this way:

> 'Everyone who has known (or tried to understand) the ramifications of EMI during the thirty years of its life cannot but be aware of the tremendous and beneficent influence that Isaac Shoenberg has had behind the scenes in a number of fields besides television development. I have not met him now for some thirty years, but I still recall his powerful personality; and even in recent times – and he is now over 80 years of age – one hears of his interest in and influence on, the current activities at Hayes, where is name is spoken almost with bated breath.'

It is easy to think his achievements were only in the development of television, but there was also work in sound reproduction, radar and guiding the company in other fields after the war. On top of this he had made himself a patent expert, a subject that requires much attention to detail. He had a dozen or so patents in his own name which is unusual for a patent agent, and the patent expertise seems at odds with the vision that he brought to his other work. The more one digs the more amazed one becomes at his apparently incompatible range of skills.

But he was much more than even these would seem to suggest. Professor McGee again: 'He was an intellectual in the best sense of that much-abused word. He loved ideas, and to discus ideas, in a wide range of subjects. His logic was rigorous, but his conclusions were tempered by a very human kindness.' A lot of this stemmed from wide reading often in subjects not closely related to science and technology. It was perhaps this that allowed him to look into the future, and as he put it – dream.

He was also a linguist, though he never managed to lose his heavy Russian accent, and spoke excellent English. In addition he spoke and read, German, French, Hebrew and of course Russian. On top of this he listed his hobbies as mathematics and music. His interest in music fringed over into an interest in improving its recording and that what was led him into Columbia and hence into the path he took.

He is not well known, despite his achievements, and this as Gerald Garratt had pointed out to him was at least partially his own fault. Often this is put down to shyness but it was clearly avoidance of publicity and pushing himself forward, which is not quite the same thing. With his background in the Russian Empire that would be understandable, but it also stemmed from his personality. He was thus an unusual mixture. He found it easiest to relate to people one to one or in small groups rather than in the mass, but he could inspire those.

Gerald Garratt in his 1960 New Scientist Profile said: ‘Isaac Shoenberg is not an easy man to know. He has few intimate friends; it is difficult for those outside his family circle and his closest colleagues to penetrate his barrier of reserve. Those few, however, who have known him well during the last forty years, are united in tribute to his humility, his kindliness, his sound judgement and his personal courage. By any standards he is a remarkable man.’

That was another aspect – his courage – which manifested itself in his ability to take calculated risks. His life, as well as his work showed many of these, from leaving Russia to his decision to jump to 405 lines for the embryo television service. At times he showed nerves of steel, and this is again a form of courage. Altogether an extraordinary collection of traits combined in one man.

However, closer to home, his daughter Elisabeth said: ‘He never seemed to do anything except go to work, read, listen to music, go for long walks, garden and talk… He was moody and dyspeptic, but also very lovable (to his family anyway!) and could be extraordinarily entertaining. His unsociability gave him time to read in a very wide almost indiscriminate way – novels, plays, biography, history, philosophy, science – and this meant that he had a fantastic stock of every sort of information. I still often feel I’ve lost my walking encyclopaedia!’[3]

And what of Esther, who only enjoyed being Lady Shoenberg for those few short years? It is one of those sad facts that the wives of such men rarely leave much of a trace. Fortunately there are those letters she wrote to him while they were in Russia, but later she barely gets a mention. She was the support in the background which allowed her husband the opportunity to do his work. As the mother bringing up five children, by the time she finished that she was too old to start thinking about returning to midwifery.

Apart from entries on electoral roles, in a few photographs and the odd census, she hardly appears. Professor McGee, though, had this to say: ‘Lady Shoenberg – that charming, hospitable, lady who was so kind to many of us young people and our families’. Perhaps she was best summed up by the reference to Proverbs 31:28 on her gravestone, the King James Bible version of which runs - ‘Her children arise up, and call her blessed; her husband also, and he praiseth her’.

When Isaac Shoenberg had been complaining to Gerald Garratt about the attitude of the BBC, he was right almost exactly as in 1966 they broadcast a programme called ‘The Discovery of Television’, to mark thirty years since the start at Alexandra Palace. Apart from the odd title as television was invented, not discovered, it did give the history of the development of television reasonably well. It was noticeable that the Technical Advisor behind this was Gerald Garratt.

It showed Isaac Shoenberg's story quite well giving him, for the first time a good deal of the credit. As he had said this would take another five years and he wouldn't live that long. He was only wrong to the extent that it was more like six than five years, but once again it was a pretty good prediction. However the producers couldn't resist the temptation to make this a contest between Baird and Shoenberg, when the history was much more complicated than that.

For each of the next two decade celebrations, a programme was shown marking this, with a more fictionalised 'The Birth of Television' in 1976 and the completely fictionalised 'The Fools on the Hill' in 1986. This last was written by the playwright Jack Rosenthal and though it had Leon Lissek playing Isaac Shoenberg it was in a slightly cartoonish fashion. Though he was getting some of the credit he deserved in the story, it is doubtful he would have liked the characterisation.

EMI did remember him and the Central Research Laboratories buildings were renamed as Shoenberg House during the 1970s. The company, however, seemed to lose its way, certainly in television work. Partly this was due to far more competition as others learnt how to make the crucial cameras, but one wonders if this would have happened if he had still been in charge.

There was an exception and that was the spectacular work of Godfrey Hounsfield on medical scanners which opened up a whole new field for the company. But despite the roaring success of the record business in the pop era in the 1960s the company never quite regained the verve it had before the war and during it. It was to end in the merger with Thorn's to form Thorn EMI in 1979.

Outside the company, the Royal Television Society honoured him by instituting an annual Shoenberg Memorial Lecture. The first of these took place in February 1971 and Professor James McGee talked about, what else but, 'The Life and Work of Sir Isaac Shoenberg'. Subsequent lectures focused on science and technology which would impact the world of television. The last of these occurred in 2006, after which they were largely replaced by an RTS/IET lectures.

He probably would have been flattered by these recognitions of him and his work, but he almost certainly would have been prouder that his advice had been taken. In 1954 the current Television Advisory Committee was starting to think about the possibility of colour television. He wrote them a long letter making suggestions, as he pointed out in his private capacity, not as a representative of EMI.[4]

As the author of the 405 line standard he would have been expected to champion that, but not Isaac Shoenberg. He was advocating a higher number of lines and recommended 625 to match up with the continental countries. He proposed that when a colour service was introduced it should be on the higher standard and it should be converted back to 405 lines to maintain a monochrome service for those who still had those receivers.

Though the Americans had introduced some colour transmissions, the high cost of the receivers had meant that they were not popular. He felt that the technology still had a considerable way to go. The colour cathode ray tubes needed further work and the increased complexity of the circuitry presented problems in keeping the cost down that should be overcome eventually.

He was basically right in that a decade later colour was still not available, but the BBC had plans for this. To prepare for this they started a second channel, BBC2, but on 625 lines in a different UHF transmission frequency band. Three years later, in

1967, this channel was converted to colour and then two years after that the old channel, now BBC1 was also available on the UHF band with 625 lines and in colour.

As he had recommended, the 405 line monochrome service was still maintained by standards conversion so that people with the old receivers could continue to have a service. This continued until 1985 when it was finally switched off. Thus the standard that he had determined on back in 1935 had lasted for 50 years.

He had always seen this as something that would not be the final answer, but would have a reasonable life. It was pushing the technology at the time, but he wanted something that had a future of more than a year or two. Time was to show he achieved that. This was his epitaph, that he had laid the foundations but was still influencing the course of British television even after he had gone. He had lit the candle and it was very much still alight.

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1 IET Archives NAEST 62/1.26
2 IET Archives NAEST 62/1.19, 62/1.21, 62/1.23 and 62/1.24 are examples of these
3 Letter Elisabeth Shoenberg to Professor McGee, Shoenberg Family Archives
4 IET Archives NAEST 62/3.18

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Much additional background information came from magazines, newspapers and films – in Particularly those noted below. This was inaddition to particular articles itemised above.

**Magazines:**

Journal of the Institution of Electrical Engineers
Nature
Proceedings of the Institution of Radio Engineers
The Electrical Experimenter
The Marconigraph
The Marconi Review
The Short Wave Magazine
Wireless World

**Newspapers:**

The Times
Local Newspapers at the British Newspaper Archive

**Films / TV programmes:**

The discovery of Television (1966)
The Birth of Television (1976)
The Fools on the Hill (1986)
The EMI Contribution to the Development of Practical Television – The Dream Team, Norman Green, IET video.

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