S. W. Brown

SIDNEY GEORGE BROWN

1873–1948

AFTER a life of brilliant inventive achievement in the wide field of applied science, S. G. Brown passed quietly into what he believed to be a new spiritual world on the evening of Saturday, 7 August 1948, in the house on Salcombe Hill, Sidmouth, where he went to live upon his retirement in 1945. Sir Norman Lockyer, one of the sixteen leading Fellows of the Society who supported Brown's certificate of candidature for the Fellowship in 1923, died in the same house in 1920. When Lady Lockyer died there in 1943, she bequeathed her home and its grounds to the Norman Lockyer Observatory Corporation, which had its buildings and great telescopes in domes on a site of 44 acres on the summit of Salcombe Hill. The whole property, with the exception of the Observatory site, was purchased by Mr and Mrs Brown from the Corporation in 1948. He had been a member and benefactor of the Corporation since its formation, and was present with his wife at the Observatory when the buildings and instruments and the freehold site upon which they stand, together with a substantial endowment fund, was transferred to the University College of the South-West, Exeter, as a research department of the College.

Sidney George Brown, the second child and eldest son of his parents, was born in Van Buren Road, Chicago, on 6 July 1873. His mother, who before her marriage was Miss Clara Napier, of Salisbury, England, was a direct descendant of John Napier of Merchistoun, the inventor of logarithms. His father was an Englishman, Sidney Brown, who after the great fire in Chicago, U.S.A., in 1870, went there to introduce an invention of his to builders which consisted of a concrete block system to surround the stove pipes passing through the wooden walls of houses. This was a novelty much needed at the time, and it was extensively used. In 1879 the family returned to England, and bought areas of land around Bournemouth, in the early development of which the father played an important part. At the Meeting of the British Association in that town in 1919, S. G. Brown gave one of the Evening Discourses on 'The Gyroscopic Compass', and it was published in the Annual Report of the Association of that year. The only other discourse given by him upon this subject and his own invention was at the Royal Institution on Friday, 30 January 1920. This was published in full in *Nature* of 11 and 18 March 1920.

Brown's early education was at a private school in Parkstone, near Bournemouth, and later at Harrogate College, Yorkshire. Having shown intense interest and aptitude in mechanical devices and experiments, his father in 1892 was induced to send him as a paying pupil at the works of Messrs Crompton and Co.,

Chelmsford, which was founded by the eminent electrical engineer, Colonel R. E. B. Crompton, F.R.S.; and he was first put in the pattern shop.

One day while at Chelmsford, Brown saw exhibited on a platform in the market place what was then considered a marvellous novelty in England, an Edison phonograph. He had two opportunities of inspecting the apparatus, and these were quite sufficient for him to remember the necessary details to construct one himself. Working at night in a workshop of one of Crompton's employees he completed the phonograph, and it worked satisfactorily. However, he was not satisfied with the mechanical engraving tool used for recording on the wax cylinder, so he evolved an electrical heating needle which considerably increased the delicacy of the records and worked perfectly, giving clear reproduction. He was granted a patent for this in 1892, but he forgot to renew the patent at the end of the first year, and the Edison Bell Phonograph Company adopted it almost at once.

In 1894 Brown became a student at University College, London, taking the two years' course in electricity, engineering, mathematics and physics. During his second year he constructed a steam turbine in the engineering shop entirely at his own expense, after college hours. This turbine weighed about 2. cwt and was the largest piece of mechanical engineering done at the time by any student. It was constructed on novel principles. The steam pressure on the blades was taken by a ball-bearing steel thrust block, which eventually under the great strain of high speed running, stripped some of the balls of their outer coating and cracked the ball-race. At the time when it was really dangerous to run, the University College authorities were holding their annual conversazione and desired a demonstration. Though Brown knew of the danger, he decided to run the risk. The worst time of the many anxious moments during that evening occurred when Professor Carey Foster had his head a few inches from the cracked thrust block, minutely examining that part of the machinery.

In 1896 Brown returned to Crompton's for the third year of his pupilage and immediately began to invent improvements in dynamo electric machinery with the view of increasing the output. One of these machines had a combination of a diameter and cord winding device, and this combination was successful in increasing the output by 50 per cent with sparkless running. About the same time, the well-known consulting engineer, W. M. Mordey, invented a similar device but finding that Brown had a prior patent he purchased the rights for a substantial sum.

During his fifth year at Crompton's he went through the Testing, Designing and Calculating Departments. When his pupilage was over he was employed by the firm at a salary of £1 a week and designed among other things a large multipolar arm generator for the Glasgow Electric Tramway Company. This was the largest generator which Crompton's had, up to that time, quoted for and supplied.

At the end of 1897 his father became dangerously ill and Brown was recalled to Bournemouth to look after the family estate. While at home, he studied Sir Charles Bright's book on *Submarine telegraphy*. The outcome of this was

that in 1899 he patented his world famous drum cable relay with magnetic shunt and a satisfactory local correction system which relayed messages from submarine cables for the first time.

The introduction of his three important inventions on submarine cables not only expedited all cabled messages but saved time and reduced costs and the number of clerks at each station. This system worked automatically, transmitting and magnifying the incoming signals sufficiently to re-transmit them to the next station without human aid. Later, he produced successful high speed methods, also duplex and quadruplex and a number of other improvements which were quickly utilized in cables throughout the world.

At that time, when Brown was twenty-six years of age, he started investigations in the radio field and in conjunction with Sir Henry Hosier, then Secretary of Lloyd's, who was greatly interested in any form of communication for insurance purposes between ship and land. The result was experiments which demonstrated a system of directional beam wireless. Using a parabolic wire reflector he succeeded in transmitting signals between a coastguard station and the old lighthouse on Beachy Head, a distance of a mile and a half; and later with larger reflectors, signals were transmitted across much greater distances. This was the first practical 'beam system' ever invented; for though Hertz and later Marconi used reflectors, they were of the solid steel type and could not be used on a large scale in the open air. Brown patented his system in 1899.

In 1902 he invented important improvements in the manufacture of condensers for long submarine cable lines to allow signals to be sent from both ends simultaneously. To supply these, he formed the Telegraph Condenser Company for their manufacture, and since 1904 this firm of his has made large and small condensers incorporating a number of his inventions for all kinds of electrical purposes.

In 1908, after his marriage to Miss Alice Stower, only daughter of the Rev C. J. Stower of Sudbury, Suffolk, and niece of Professor John Perry, in whose house he met her, he had a private experimental room in their house at Kensington. It was there, aided by his wife's clear voice, that he produced, after months of hard work, the first telephone relay for magnifying speech and ordinary music. This was his single point iridium microphone relay which actuated a reed and a spun aluminium cone. It became the famous A-type telephone and earpiece by means of which wireless messages could be heard which were otherwise inaudible. Later, he brought the sound loudly and clearly into the room and the Browns named the device a 'Loud speaker'. They were the first to give this name to the instrument but they had no idea at the time that the words would become a permanent term in radio vocabulary throughout the world.

As Brown patented more than a thousand of his inventions during his life, a catalogue of them would obviously be out of place in this general appreciation of his work and discoveries. At the end of this notice, a copy is printed of the certificate, dated December 1913, of his candidature for Fellowship of the Royal Society, to which he was elected in 1916. The scientific value of his

work up to that time can be judged from the names of his sixteen supporters, among them being Sir Joseph Swan, Sir Charles Boys, Sir William Ramsay, Sir James Dewar, Sir J. Wolfe Barry, Sir Richard Glazebrook, Sir Charles Parsons and, as already mentioned, Sir Norman Lockyer.

Brown's highest achievement and that which he himself ranked as his best, was the design and construction of gyro compasses for use on sea and land and in the air. A few of his other inventions may be mentioned appropriately here. A single point microphone relay for use between ground batteries and aeroplanes was devised by him and used by the Royal Air Force in 1914. This was at the time the first wireless instrument introduced into such active service. Another used by the Royal Navy widened the range of wireless communications between ships and the shore stations. This was before the thermionic valve had come into use in the radio field.

Brown was also the first to make a simple and successful device which applied to bones of the head enabled deaf people to hear even when the ear-drum had become useless. Following this, at the request of the London Hospital, he constructed an electrical stethoscope for medical class demonstrations to enable students to hear and diagnose heart and other functional sounds during lectures. He also devised several effective turning indicators for aeroplanes and artificial horizons and pitch azimuth for blind flying. After he had produced the first loud speaker, he made many types and included the cone diaphragm in his specification in 1910. He produced numerous original sets of the reed and valve type and also electrical megaphones for ship and land use without valve amplification.

Brown began to tackle the intricate problems involved in the construction of gyro compasses at the outset of the First World War in 1914. Shortly before that time, two types of gyro compass had been constructed and introduced into battleships. One of these was the German Anschutz compass, and the other was produced by the Sperry Gyroscope company of New York. It was obviously desirable from a national point of view that we should not be dependent upon other countries for the supply of gyro compasses to supersede magnetic compasses in navigation and for other practical purposes. After discussing the problem with Professor John Perry, Brown wrote to the Admiralty upon the subject, and their reply was that they were greatly interested in it but expressed the opinion that to produce a British gyro compass of a novel type was a colossal proposition.

As the Sperry gyro compass had been introduced into British battleships, it was evident to such an inventive mind as that of Brown's that he also could solve the problem, however difficult the task and however complicated were the scientific and engineering factors involved. Professor Perry's approach to the problem was that of a mathematician, whereas Brown's was that of a scientific engineer. It was therefore decided that each should work independently of the other and that the instruments should be made by different workmen in separate workshops at the works of S. G. Brown Ltd, and when completed the instruments should be separately tested there on the same rolling tables. After

several months, Professor Perry's compass was the first to be tested, but it did not fulfill his expectations whereas Brown's compass was acknowledged to have passed the trials satisfactorily. After he had examined the equipment carefully, Professor Perry remarked to the observers, 'Brown's intuition is better than my mathematics'.

At that time, however, the compass was only in what may be called the laboratory stage of its development. When a ship turns in its course, and especially when it describes a quadrant or semi-circle, an oscillation is set up in every gyro compass; and the swings have to be damped to bring the compass back to true north. On a merchant ship this damping error is of little consequence but in a warship which is manoeuvring it can be serious, as it may swing the compass off its correct reading by several degrees.

When a ship's course is neither N or S, nor W or E but between these directions and particularly NW or NE, or SW or SE, and if she rolls steadily, the gyro compass gradually gets away from the north, settling itself sometimes with an error of 20 degrees or more. This was called the 'quadrantal error': and its elimination had more to do with drastic changes of design of all forms of gyro compass than anything else. Brown showed how this error was corrected in a new type of compass with an entirely new system of construction which he called the Liquid Ballistic Control and was described in a specification at the Patent Office in 1916.

In the Anschutz compass, the means of getting rid of the quadrantal error was by multiplying the number of gyro-wheels and by making the instrument as symmetrical as possible. A small auxiliary gyro was similarly used for stabilization in the Sperry compass. An entirely new system of correction was introduced by Brown. Instead of letting gravity act as with a pendulous weight, two bottles connected by a horizontal tube and containing oil were attached to the sides of the master compass. The gyro-wheel, running at 15,000 revolutions per minute, acted as a powerful blower, thus sending air under pressure to a valve and establishing a pressure difference between the bottles proportional to the tilt of the ship; so that the weights of oil in the bottles were also adjusted to the tilt. Another smaller pair of bottles is acted upon in the opposite sense, so as to oppose the first pair, but the tube connecting these smaller bottles is greatly restricted, with the result that the oscillations are effectively damped.

This invention opened a new chapter in the history of the gyro compass and was a distinct departure from systems of construction of other types in use at the time. It was soon found, however, that Brown's mobile system could be applied to other types of gyro compass, the result of which was several costly patent actions. He spent thousands of pounds personally on this invention and never had any return during the life of the patent or even the extension period of ten years granted to him in the High Court in 1932 by Mr Justice Luxmoore, but the same system is now used in the British and other navies as well as in the mercantile marine and is just as he designed it.

The significance and originality of Brown's discovery of Liquid Ballistic Control in gyro compass construction was clearly stated in the Report of the

Committee appointed by the Lords Commissioners of the Admiralty on Gyro Compass Developments in 1927. Professor W. E. Dalby, F.R.S., and Sir Thomas Holland, F.R.S., were two of the five members of this Committee; and the following is an extract from the Report :

> 'A review of the developments up to 1916 leaves the general impression that the various modifications introduced to meet each newly discovered source of error were all leading (apparently without conscious recognition by the inventors themselves) to a system less and less distinctly pendulous, whereas Mr Brown made the definite and distinct departure from the previous line of evolution by adopting a system which was in neutral equilibrium, and thus, in one step he was able to remove the pendulous bail, with all its necessary accompaniments, and put in their place an arrangement for applying to the compass a mobile medium to counteract the effects of all the combined and complexed series of movements that might follow rolling, pitching and changes of direction and speed when on inter-cardinal courses.'

To work in connexion with his compass, Brown devised in 1928 a new 'automatic helmsman' which makes it possible to steer the course of a ship without constant human control. Before that date instruments of this kind had been used with the Anschutz and Sperry compasses. They save time as well as wear and tear of steering gear and are now fitted to a great number of ships with gyro compasses. Brown also constructed a multiple repeater for ease of steering by hand, and a recorder in which the course of a ship was plotted on a moving chart. His last great invention, upon which he worked for ten years, was a directional finder for gunnery and bomb dropping. The instrument was, however, not ready for sea trials until June 1939 when the imminence of war made such tests impracticable. This was a bitter disappointment to Brown, who regarded his gunnery control compass as his supreme achievement. After his death, the invention was offered as a gift to the British Admiralty, which at the time was unable to deal with it. It was, however, accepted by the French Admiralty with all Brown's notes and the works-drawings and patents and is now being made and used by the French Navy.

Brown began the manufacture of his inventions on a small scale at a place in Devonshire Street, London, in 1911. Three years later he had built a factory at North Acton for the works of S. G. Brown Ltd, covering an area of five acres and employing more than a thousand people entirely occupied with constructing instruments and machines designed by him, particularly electric condensers. The two factories were always privately owned by the Browns; and when their Telegraph Condenser Company was converted into a public company in 1941, they continued to hold financial control and management. Their connexion with the Company ended in 1943 when, on account of failing health, Brown retired and the firm was purchased by a syndicate. In the same year the works of S. G. Brown Ltd were purchased by the British Admiralty, which

thus became owners of the gyro-compass and wireless equipment together with all existing patent rights.

The business management of the works at North Acton was entirely in the hands of Mrs Brown, who was secretary, director and general manager of the firm of S. G. Brown Ltd throughout its existence; and also director, and for some years secretary, of the Telegraph Condenser Company. Like most original scientific investigators, Brown had little interest in administrative details which would divert his attention away from new problems continually arising in his own mind or being sent to him by Government officials and others for solution. He was often working out several such problems at the same time and seemed to possess a kind of switch-board brain which he could plug in and out at will. He made almost no notes and worked out all details with an uncanny power of visualizing his mechanical devices. Being also a skilled draughtsman, he always drew complete drawings ready for the workshops; and he watched the process of manufacture daily. On some occasions and without even referring to the drawings he would point out a slight variation and order its correction.

Brown was a very modest man who never spoke with personal pride about any of his successes or took interest in writing papers upon his inventions or giving lectures upon their principles of construction and scientific service. When approached to do so, his usual reply was, 'I haven't the time: I like producing'. He was physically never very strong and was in failing health for several years before he died. He had no outdoor recreations, but had an intense love of flowers, especially orchids, which he grew in several large glass-houses at the riverside house which his wife and he had on the Thames at Shepperton while they were living in Kensington.

He was indifferent to money as such, either in the making or expenditure of it; and he disliked being consulted even about costs of extensions in his factories. All these matters he left to his wife, to whom he was devoted with deep and loving regard and upon whom, it may truly be said, the maintenance and growth of the manufacture of his inventions depended, and whose stalwart protection of his interests gave the name of Alice S. G. Brown chief prominence in patent actions and similar cases brought before the courts and official committees.

Brown was never known to have said an unkind word about anyone involved in such infringements, though in nearly all cases his patents were maintained. In creative ideas he was in the first rank of British scientific engineers; and like all workers of his type he preferred to think out things for himself and without external guidance or help of any kind. Not once did he ever accept the slightest financial aid for experimental work on any subject or towards the cost of production of an original device. He preferred to retain his independence and to work out problems alone; for he said, 'if I had any control over me or my work every idea would stop'.

In 1914, before Brown was elected a Fellow of the Royal Society, he was appointed by the Council to serve as a scientific adviser to the Admiralty Ordnance Council. Later he was appointed a member of the Board of Awards to Inventors, and scientific adviser to Lord Fisher's Investigating Council. He

was a Fellow of University College, London, and Honorary Associate of the Manchester College of Technology: also a member of the Institution of Electrical Engineers and Fellow of the Physical Society of London.

Mrs Brown, who survives her husband, lives in the house at Sidmouth where he died after two years of failing health. They had three children, and the early deaths of these, particularly a boy of fifteen years of age in 1924, was the greatest sorrow of their lives. Mrs Brown has presented the complete gyro compass to the Science Museum, South Kensington, where it will take its place among the mechanical achievements of historic importance accomplished by British engineers; and with a number of experimental models of various inventions and complete instruments, will form a permanent memorial to Sidney Brown's genius.

R. A. GREGORY

Copy of S. G. Brown's certificate of candidature for Royal Society Fellowship. Dated, 3 *December* 1913.

Electrical Engineer and Inventor. Author of Papers read before the Institution of Electrical Engineers (1902) on his submarine relay, used by all the cables in the world, and the telephone relay, of great use in wireless telegraphy (1910). These two papers gained Fahie premiums. 'Modern submarine telegraphy' (*Roy. Inst.*, 1909); 'Magnifying feeble currents and other inventions' (*Phys. Soc.*, 1912); 'The production of rapidly alternating current between a copper block and a rotating aluminium disc' (*The Electrician*); 'Reverse action of the Wehnelt electric interrupter' (*ibid.*). Some of the following inventions are described in the above papers and in ordinary textbooks: Drum cable relay with magnetic shunt and local corrections which first relayed messages from long cables (see article, 'Telegraph', in *Ency. Brit.*) in which Brown's interpolator and his thermoelectric relay are also described. Discovered method of stopping sparking in dynamos. Experimenting with Sir Henry Hozier discovered method of directing Hertz waves, first by two elevated wires placed half a wave length apart, second by a reflector composed of wire netting. Such a reflector 14 feet high enabled signalling to be made over a distance of 14 miles in 1899. In 1903 discovered the first dry wireless detector (composed of a lead or thallium anode and a platinum cathode); in 1908 the single point iridium microphone relay which first magnified inaudible telephone current (use in telephone transmitters of this material, 1910); the carbon telephone relay; (1911) Syphon recorder which increased speed of signalling by 20 per cent; Granular carbon microphone relay for telephone lines with electric regulators magnifying currents twenty times with clear articulation; (1912) Simplex switching, whereby it is for the first time possible to use a relay in the middle of a telephone line speaking both ways. This is a quite new departure in telephony, and by means of it conversation can be carried on at any distance;

(1910) Telephone receiver using magnet and steel reed operating a cone of aluminium instead of a magnetic diaphragm. It is exceedingly sensitive and is greatly in use in wireless telegraphy; (1911) A method of getting good quality of sound and speech articulation in a gramophone, using an aluminium cone; (1910) An electrical stethoscope enabling the beats of the human heart to be heard out in the room; tested at the London Hospital. On one occasion five physicians in the Isle of Wight studied the heartbeats of a patient in London, electric transmission occurring through the ordinary telephone wires of the post office; (1912) A loud speaking telephone receiver by which the voice is transmitted with great clearness into a room; (1901 to 1908) Discovered various methods of correcting defects of transmission in cables; (1911) A mechanical relay by which varying forces exerted by a silk fibre are magnified enormously; the amounts of motion remaining unaltered; (1913) Methods by which for the first time airships and aeroplanes can receive wireless messages. These are now in use by the Government Flying Corps. Messages have been read in an aeroplane from an ordinary field at 120 miles distant at an elevation of 2,000 feet. The messages are read by ear or by a flash lamp; (1910) Discovered several interesting phenomena in sound, notably the elimination of the nasal effects produced by funnels. Also the great magnification of sound passing along a glass rod when the rod terminates in a large, very thin bulb; (1906) Improved the efficiency of the aluminium rectifier for alternating currents by making a pole of copper touch the wet aluminium face of the other pole; (1905) The stimulation of oxidation and other chemical actions by the (catalytic(?)) action of alternating currents of extremely high frequency; (1908) When receiving currents of all sorts of frequency in submarine signalling, a method of sending currents of only one frequency through the telephone and shunting the other currents. An alternator of very high frequency; (1909) Discovered methods which enable very deaf people to hear clearly, in some cases using the teeth; and many other inventions.