PROF. PAUL LANGEVIN, For.Mem.R.S. (1872–1946)

ON May 23 and 25, scientific workers in Great Britain united to honour the memory of Paul Langevin, whose death last December was felt as a deep loss, not only to science but also to the cause of peace and social justice throughout the world.

The first meeting was a reception at the Society for Visiting Scientists, at which Prof. Joliot-Curie and the British Minister of Defence, Mr. A. V. Alexander, spoke of the contribution of Langevin to science and culture in France, and particularly to the development of the ultra-sonic detection of submarines in the First World War, which was used to such effect in the Second World War.

The second meeting, organised by the World Federation of Scientific Workers in conjunction with the Society for Visiting Scientists and the Association of Scientific Workers, was a public meeting under the chairmanship of Sir Henry Tizard, and was addressed by the Astronomer Royal, Sir Harold Spencer Jones; Sir George Thomson, who spoke of the early life and work of Langevin at the Cavendish Laboratory under his father, Sir J. J. Thomson, in 1897; Prof. J. D. Bernal, who had particularly close contact with Langevin in his later years; and by M. Biquard, of the French Commissariat of Atomic Energy and the Paris School of Physics and Chemistry, the assistant and friend of Langevin, whose moving address in memory of his master will long be remembered by those who heard it.

Paul Langevin was born in Paris in 1872 of working-class parents, and it was from his father in particular that he acquired the sense of popular republicanism that guided him throughout his life. He succeeded, through his own efforts and the obvious brilliance of his intellect, in securing an education in the École de Physique et de Chimie of the City of Paris, from which he had the great fortune of securing a scholarship to work in Cambridge in 1897. He had already absorbed the best of classical French mathematics and physics teaching, naming as his masters Brillouin and Pierre Curie, whom he afterwards succeeded as director of the School. Thus he was most fitted to profit by the really extraordinary opportunities of the Cavendish Laboratory, in the very first year that the University of Cambridge admitted foreign students, having among his companions, Rutherford, C. T. R. Wilson and Townsend. J. J. Thomson had just discovered the electron, and the significances of that discovery were being furiously pursued by these first Cavendish research workers. Langevin's own work was on the recombination and mobility of gaseous ions, and he showed his mastery of the practical and theoretical difficulties in the primitive but stimulating 'sealing wax and string' period of those days. His thesis on this subject (published in 1902), dedicated to J. J. Thomson, was shown at the meeting. His subsequent scientific work exhibited the combined influence of the practical and common-sense English school with the clarity and generalizing power of the French. Indeed, it went further, for Langevin contributed notably to the great theoretical clarifications of that period, both in the field of relativity and the quantum theory. Particularly he put forward, independently of Einstein, the celebrated law of the equivalence of mass and energy, $E = mc^2$, and he was largely responsible for the introduction of these modern views into French science.

The main trend of Langevin's scientific work lay, however, in the direction of the interaction of systems. He was able, in 1907, to explain the phenomena of paramagnetism observed by Curie as due to the mutual interaction of elementary magnets under the influence of thermal agitation, and thus, by the celebrated Langevin equation, to lay the foundations of the study of what are now known as co-operative phenomena, which are seen to-day to be the key to some of the most important features of the solid and liquid states of matter.

In the First World War Langevin turned his talents, as theorist and experimenter, to the development of ultra-sonic vibration by the use of piezo-electric oscillators. The immediate application of this was to the detection of submarines by the reflexion of these waves. In this new field he overcame all experimental difficulties, and already in 1917 was able to demonstrate the detection of submarines under water at a distance of a kilometre. This method was not in operational use in the First World War, but it was the basis of the 'Asdic' which was of such offensive and defensive value in the Second World War. Indirectly, it had even more widespread effects. Piezo-electric oscillation came to be used in many other applications in the electronic field, and echo detection, using electronic instead of sound apparatus, was, of course, the basis of radar and its modern application in war and peace.

The main value of Langevin's scientific contribution, however, was indirect and explicitly appreciated only in France. The many years that he taught at the École made that institution the centre of formation for a brilliant school of French physicists, of whom Joliot-Curie is the most illustrious. Langevin was always interested in scientific education, and in the latter years of his life was given the direction of the reform of this education in France, a reform long overdue, but one for which his particular combination of enthusiasm and breadth of outlook most fitted him.

Paul Langevin, however, will be remembered in France and throughout the world even more as a man and as a citizen than as a scientific investigator. From his early scientific days he realized the obligations of the man of science to fight for justice, in supporting the protests against the condemnation of Dreyfus. "Those were happy times," he said later, "when the fate of a single man was so valuable that it could excite the whole of mankind." The fight he began then he carried on for the rest of his life. He was active in the Ligue des Droits de l'Homme and became its chairman after the brutal murder of Victor Basch and his wife by French Fascists. The advent of the Nazis to power in 1933 put France in the forefront of the fight against Fascism, and Paul Langevin took a leading part in organising it. He was one of the founders of the Comité de Vigilance des Intellectuels Anti-Fascistes, and after the Fascist riots in Paris in 1934 he also took a great part in the formation of the Front Populaire.

It was at this point that his activity in the international sphere also began. He, first among eminent men of science of the world, called for a rallying of all forces against the threat to liberty and progress that Nazism represented. He was able, by his action, to show how possible, and indeed how necessary, it was, to combine, when the times demanded it, the role of citizen with that of scientist. He was instrumental in founding in Britain an analogous body "For Intellectual Liberty" which, together with the Comité de Vigilance, carried out an unceasing activity of protest against the successive surrenders to Fascism, beginning with the Anglo-German naval treaty, continuing through the farce of non-intervention to the capitulation at Munich.

As such, Langevin was inevitably a marked man after the German occupation. He had courageously refused to leave France, though he might easily have done so, and he had the honour to be arrested by the Gestapo on the basis of the *Führerprincip* as the most representative of all the intellectuals who had fought against Hitler. The main charges against him were his chairmanship of the Ligue des Droits de l'Homme, and because he had tried to prevent Germany from ridding itself of the Jews. He was released from prison partly as a result of the protests of French students and professors, but kept under confinement at Troyes, from which he was rescued by the Resistance after some years, and smuggled into Switzerland. He had to suffer more, however, from the fate of his family. His son-in-law Solomon was shot for his part in the Resistance movement, and his daughter Hélène was sent to the notorious death-camp at Auschwitz, from which, however, she managed to escape. Broken in health but not in spirit, Langevin returned to Paris after the liberation, where he took the place which had been occupied by his son-in-law in the Communist Party, and at a great meeting in the Sorbonne was accorded the homage not only of the French intellectuals, but also of the people of Paris and the fighters of the Resistance movement.

The last task of his life was the reform of education, in which he embodied his ideals of social reform. "The final objective would be to find for the individual in human society his rightful place in every respect. Society will then appear to every one of its members as a living entity in which each of us is entrusted for a while with a treasure of civilization acquired by our ancestors at the price of innumerable hardships and pains, which it is our duty to pass on after enriching it according to the extent of our ability. . . . Let us hope that every child, on leaving our schools of to-morrow, will be convinced that the two moral sins of conformity and selfishness respectively oppose the double imperative duty of personal achievement and social solidarity."

The meetings which have been held in his memory in Paris and now in London serve to emphasize the growing unity of science and society throughout the world, and in particular the close ties that have been forged by the experience of recent years between the scientific workers of Britain and France. It is in furthering this unity that we can best honour the memory of Paul Langevin. J. D. BERNAL

CENTENARY OF THE INSTITUTION OF MECHANICAL ENGINEERS

By R. H. PARSONS

THE Institution of Mechanical Engineers, which has celebrated its centenary this week, can look back upon a hundred years of invaluable service both to the profession and to the community. Its existence has been contemporaneous with almost incredible developments in engineering, metallurgy and general science brought about largely by the work of its members. When it came into being, engineers had no such materials as even mild steel or aluminium, no mineral oil, no artificial abrasives, no electrical generators and no internal combustion engines of any kind. Their machine tools were comparatively few and simple, screw-threads had not yet been standardized, precision measurements were impossible, and scientific knowledge applicable to engineering problems scarcely existed. The steam engine, much as it had been left by Watt, was, however, available for industrial purposes, locomotives were running on the railways, and steam had been applied to marine propulsion.

The Institution was founded in Birmingham on January 27, 1847, by a meeting of some of the leading mechanical engineers of the day, and George Stephenson, who had taken an active part in the proceedings, was elected by acclamation as its first president. The object of the Institution, in the words of its founders, was "to enable Engineers . . . to meet and correspond, and by a mutual interchange of ideas . . . to increase their knowledge and give an impulse to inventions likely to be useful to the community at large". Birmingham was decided on as its headquarters, as being the most convenient centre for engineers engaged either directly or indirectly with the development of railways, which then constituted one of the most important fields for engineering activity.

After the death of George Stephenson on August 12, 1848, his son Robert, who acquired the same unrivalled eminence as a railway engineer, was elected president of the young Institution. Other well-known names, such as Fairbairn, Whitworth, Penn, Armstrong, Napier and Siemens among the early presidents, bear witness to the prestige the Institution has enjoyed since its inception. In 1856 it took a step which greatly extended its influence and usefulness. This was the inauguration of its annual summer meetings, lasting two days or more, and held in some selected industrial centre or sometimes abroad. Such meetings have remained among the most appreciated functions of the Institution. An outstanding event in the history of the Institution took place in 1877, when the headquarters were transferred from Birmingham to London. At this time the membership was somewhat more than a thousand. In 1895 it began the construction of its present worthy home at Storey's Gate, St. James's Park. This was formally opened in 1899, and considerably extended in 1913. By then the Institution comprised more than six thousand members, and the rapidity of its subsequent growth is shown by the fact that at the end of last year it had almost 25,000 members of all classes, to which must now be added the considerable number of members recently admitted by the absorption of the Institution of Automobile Engineers.

The increase of membership from all parts of Britain led, in 1920, to a measure of decentralization, whereby local branches, managed by their own committees, which are represented by their chairmen on the Council of the Institution, were established in large centres of population. There are now nine such branches, covering between them the whole of Great Britain, each providing opportunities for its own discussions and other activities. Similar branches also exist in China, the West Indies and the Argentine, while advisory committees serve the interests of the Institution in seven other countries overseas. Another outcome of the increased membership has been the formation of specialized groups within the Institution. These are composed of engineers having a common