within that laboratory as well as acting as the focal point to which all the others are connected. It has 60-amp. plugs and sockets, and so has the Edgar Allen Research Laboratory. The others have 30-amp. circuits. Wherever possible, the wiring is carried in surface trunking and is easy of access.

With the exception of the photometry and standards laboratories, which have tungsten filament lighting, the laboratories are very adequately lit by fluorescent lamps. These are switched in groups of three or six, fed from 3-phase a.c., with 3-pole switches, so eliminating stroboscopic effects and reducing the number of wall switches.

The University surveyor was responsible for the design and supervision of the alterations and additions, the electrical consultants being Hoare, Lea and Partners. The main buildings and fittings contractors were Geo. Longden and Son, Ltd., and the electrical contractors were the Yorkshire Electricity Board. The special experimental panels and cubicles were designed and manufactured by Field and Grant, Ltd. (Birmingham).

INTERNATIONAL TIN RESEARCH COUNCIL

TWENTY-FIFTH ANNIVERSARY

By Dr. ERNEST S. HEDGES
Director

To celebrate its twenty-fifth anniversary the International Tin Research Council invited visitors to the open days held at the Tin Research Institute, Greenford, Middlesex, on July 10 and 11. The Institute was built in 1938 to house the Council's headquarters and research laboratories, but after the War extensions were necessary and new laboratories were opened by H.R.H. the Duke of Gloucester in 1951. This had the effect of doubling the accommodation. The staff of the Institute comprises about twenty graduates and forty-five assistants, including maintenance and services. The present director has served the Council during the twenty-five years of its existence.

During the open days approximately six hundred people visited the Institute, among them many well-known scientists, technologists and industrialists. The full tour of the laboratories was designed to show the main developments which have resulted from the Institute's research work. The general scheme followed wherever practicable throughout the laboratories was to show the actual experimental equipment employed on investigations, pilot or full-scale plant for operating the technique developed from it, and commercially produced samples illustrating the final product.

An example of this treatment was to be seen in the Electroplating Department. Work having as its aim the production of electrodeposits of new tin alloys was initiated on a beaker scale in the first laboratory, developed on a 10-gallon scale in the second laboratory and brought to practical success on a 200-gallon scale in the third. Among the practical achievements of the Institute presented in this way was a considerable range of metallic coatings containing tin. The decorative and corrosion-resistant electroplate of tin–nickel alloy (66 per cent tin) was shown as a finish on an electric toaster, a table lamp, drawing instruments, spoons, chemical balance weights, slides of trombones and pistons of trumpets. Speculum (a tin–copper alloy containing 42 per cent tin) was seen upon a lamp, a fruit bowl and a reflector. Tin–zinc alloy (75 per cent tin) was shown on undercarriage parts of aircraft, radio chassis and motor-car accessories. This alloy coating has gained wide acceptance as a corrosion-resistant finish for steel. A recent development in this department which attracted much attention was the electrodeposition of 'bright' tin. This is a process for producing, without mechanical polishing, a pure tin coating having a mirror-like reflexion. Bright tin was demonstrated on a radio chassis stamped from unpolished steel sheet.

In a suite of laboratories specially designed for hot-tinning, the hot-dip tinning of steel and cast iron was demonstrated on such objects as frying pans. After tinning, these were immediately centrifuged in equipment designed at the Institute to remove excess of the still molten tin, leaving a bright and flawless surface. Tinned cast-iron meat mincers showed the great improvement in surface brightness and smoothness brought about by the use of new techniques worked out in this laboratory. Adjoining laboratories displayed equipment designed for the study of electrolytic tinplate produced under controlled conditions, including 'flow-brightening' by momentarily melting the surface. The many testing procedures which have emanated from this laboratory for assessing tin coatings quantitatively and qualitatively were also demonstrated.

The Metallurgical Department showed stages in the roller-welding of steel strip to aluminium–tin alloy strip so as to form composite strip, from which half cylindrical bearing shells for high-duty internal combustion engines can be formed by pressing and subsequent machining. This new type of bearing, which is now in commercial production, is already being used in tens of thousands of road vehicles. The continuous casting of bronze rod was a demonstration of much interest. The rod, produced at about 12 in. a minute, is remarkable for its high quality and accuracy to gauge diameter. The machine, which was expressly designed at the Institute to be of simple and inexpensive construction, has been adopted by many firms in Europe.

The Corrosion Department had exhibits to illustrate the advantages of each type of tin and tin–alloy coating under specific conditions of usage. The remarkable permanence of tin–nickel coatings under severe conditions, such as industrial atmospheres, impressed many visitors. The structure of surface films on tin and tin alloys is also a subject of study in this laboratory, using techniques by which the films are removed intact from the metal on which they form: several specimens of such films were on show.

Organo–tin compounds are among the most recent studies of the Institute and perhaps the one for which the brightest future seems to be in store. Certain of these compounds, containing a tin atom linked to three carbon atoms, are remarkably toxic to fungi. A practical demonstration was afforded by two timbers recently removed from a damp mine where they had been for more than three years: the untreated timber was crumbling away while the timber treated with a trialkyl–tin compound was unaffected

and retained its full strength. Other exhibits showed the effectiveness of these compounds on timbers exposed to attack by *Teredo* and other marine organisms. Another type of organo–tin compound has exceptional ability to stabilize polyvinyl chloride plastics. Curiously, the same type of compound is used extensively in veterinary medicine as a worm cure and prophylactic for chickens and turkeys. The chemistry of organo–tin compounds is being rapidly extended by the Institute's research team.

Other departments shown included metallography, analytical chemistry, photographic studios, engineering workshop and a specialized library. Cinematograph films of processes devised in the laboratories were available for continuous showing to the visitors.

FULMER RESEARCH INSTITUTE

OPEN DAY

THE Fulmer Research Institute held an open day on July 2, to mark the tenth anniversary of the official opening by Sir Stafford Cripps on July 2, 1947. About 260 guests, representing industry, government departments and other research organizations, were present and were shown details of research work in progress.

The principal guest was Mr. R. Harmar Nicholls (Parliamentary Under-Secretary, Ministry of Works), who deputized for the Right Hon. Reginald Maudling. In a brief speech after lunch, Mr. Nicholls congratulated the Institute on its steady growth during the past ten years, and, in reflecting on the sources of the Institute's income, Mr. Nicholls was particularly gratified by the increasing number of dollar-earning research contracts, now constituting about one-third of the Institute's total income. He considered, however, that much greater use could be made by British industry of the facilities for research and development which are available at the Institute.

During the past ten years the Institute's effort has been principally devoted to some one hundred and fifteen major research programmes, and about thirty of these are in progress at the present time.

In the physical chemistry division of the Institute, headed by Dr. P. Gross, fundamental work on extraction processes relating to aluminium and titanium has continued. Pilot-plant work in industry on the catalytic distillation of aluminium has been in progress for some time and processes for titanium extraction which have been successfully demonstrated on the laboratory scale are now ready for extension to the next stage. A method of purification of silicon is now under experimental study and apparatus for the preparation of large single crystals of this element (by drawing from the melt) has been developed and is in use.

The work on extraction and purification processes is, of course, dependent upon accurate thermodynamic data, and specialized techniques have been used to study the equilibria of important industrial reactions and to establish activity data for various metallic systems. Accurate calorimetry has established the heats of formation of various compounds, in particular metallic halides, and new values for several of these important compounds have been published. Various reactions which might form the basis of new extractive methods have been studied in apparatus requiring highly efficient vacuum techniques. In the analytical laboratories, polarographic, absorptiometric, microchemical and spectrographic methods in addition to the more conventional techniques of analysis were demonstrated.

A study of the mechanism of precipitation hardening with particular reference to light alloys has always been a major item in the Institute's research programme. It was partly as a result of this work, much of which has been published, that Dr. H. K. Hardy, who has since joined the Atomic Energy Authority, gained the Beilby Award and Rosenhain Medal of the Institute of Metals. The X-ray techniques developed by the Institute's investigators for studying precipitation processes are well known internationally to specialists in the field. Trace elements have been shown to exercise a profound effect on ageing behaviour in some systems, and the influence of small quantities of cadmium, for example, on aluminium–copper alloys has resulted in the development of a series of alloys which, while free from room-temperature ageing after solution treatment, can be aged at elevated temperatures to yield properties approaching those of the duralumin type alloys. The effect of radiation on precipitation and ageing behaviour in aluminium alloys is now being studied, while in titanium and zirconium alloys attention is being paid to the crystallographic changes associated with the formation of the embrittling omega-phase. To assist this latter work and more particularly for studies on transformations in alloys of reactive metals, a special X-ray camera has been developed. It can operate with the specimen at temperatures up to 1,000° C. in a vacuum of 1×10^{-7} mm. of mercury.

Other X-ray studies have been concerned with the structure of liquid metals, and interesting results have been obtained with sodium and potassium (including binary alloys of these metals) and also gallium. The fundamental structure of glass is also being examined. Although in glasses the atoms are not arranged in a regular crystalline manner characteristic of metals, the arrangement is not completely random. On the slight degree of regularity which does obtain, an explanation of the variation of the properties of glass with heat treatment is sought. The problem is closely linked with that of liquid metals, and somewhat similar techniques of X-ray diffraction and refined interpretation are being applied.

A recent addition to the equipment of the physics section is the Metropolitan-Vickers electron microscope type *EM3A*. This instrument, which has a resolution of 20 A. under favourable conditions and which can also be readily adapted for electron diffraction, is being used principally to study the mechanism of oxidation of low-alloy steels and to supplement the X-ray and metallographic investigations on age-hardening phenomena. A detailed investigation of the slip characteristics of certain metals is also in progress.

New equipment on view in the physical metallurgy section included a Reichert metallurgical microscope, a precision dilatometer for use in isothermal transformation studies and a high-temperature (up to 2,000° C.) vacuum heat treatment furnace. The last two items, together with much of the other equipment in use, were constructed in the laboratory workshops.

While considerable attention is still being paid to aluminium alloys, developments in the atomic energy