The method of isolating the inhibitor consists in evaporating water under reduced pressure to produce a concentrate of the inhibitor. The inhibitor is precipitated from this as a copper salt, and a hydrochloric acid solution of this precipitate is extracted with ether. Distillation of the solvent leaves a crude concentrate of inhibitor which is then subjected to vacuum sublimation. Paper chromatography has been used for attempting to identify the constituents in this crude inhibitor and to compare these constituents with known substances. The stage has now been reached when substances reacting in the same manner as the extract of natural inhibitor have been shown to inhibit pitting corrosion of copper when added to water in quantities as small as the amount of natural inhibitor present in many water supplies.

Another interesting exhibit concerned the use of ion-exchange resins for analytical work. These are now being used extensively in the Association's laboratories for facilitating the analysis of electroplating solutions and for general metallurgical analysis. One example is the accurate determination of the amount of trivalent chromium in chromium-plating solutions. The method in common use involves titration of the hexavalent chromium of one sample and, after oxidation of another sample, titration of the total chromium. The trivalent chromium content is given by the difference between the two titrations, and this may sometimes be as little as 0·2 ml., so that small errors in measurement can easily give a misleading result. Using an ion-exchange column, the small amount of trivalent chromium present can be separated from the hexavalent chromium and titrated with ferrous ammonium sulphate of appropriate strength. The solution is passed through a column which retains the trivalent chromium. After washing the column with water to remove all the hexavalent chromium, the column is eluted with dilute sulphuric acid and the solution of trivalent chromium so obtained oxidized and titrated.

It is of interest to note that the laboratories have also recently built a demineralizing plant for the production of water for use in analytical work. The plant consists of an ion-exchange column with a mixed bed of anion- and cation-exchange resins. It will produce about 80 gallons of water between regenerations at the rate of about 10 gallons/hr. The water is purer than that obtained from ordinary laboratory stills, and running expenses are considerably below those of electric stills.

The mechanical testing section of the laboratories has recently developed a short-term fatigue test enabling a rapid assessment to be made of the endurance limit of many materials. The test is based on the Wöhler type of fatigue machine ; but the load is applied by means of a spring. The load is gradually increased during the course of the test by extending the spring, using a slow-motion drive from the main drive of the fatigue machine, and the specimen is broken in a period which may range from four or five hours up to about a day. The extension of the spring at the moment of failure gives the 'dynamic breaking stress' for the specimen, and it has been found that, for lead alloys, copper alloys and steels, there is a direct correlation between this stress and the endurance limit of the material. The test is likely to expedite considerably the exploration of the fatigue properties of new materials.

The development of a non-destructive method for measuring the thickness of electroplated coatings has long been needed by the plating industry. This problem has recently been solved in the Association's physics laboratory using a method based on a thermoelectric effect. A heated probe is applied to the surface of the electroplated specimen, and a cold probe is placed on the coating at some short distance away. The interface between the coating and the basis metal under each probe can be considered analogous to the hot and cold junctions of a thermocouple, and the e.m.f. generated is amplified and measured on a galvanometer. The reading obtained is proportional to the thickness of coating for any given coating–basis metal combination and, if necessary, the instrument can be calibrated to read directly in terms of coating thickness. Already several firms have made extensive field trials with the equipment, and arrangements have been made for two firms of instrument manufacturers to produce it commercially.

In the physics laboratory there has also been shown a method for vacuum-etching metallographic specimens, which is used where ordinary chemical or electrolytic etches have proved unsatisfactory. In this method the specimen is made the negative electrode and is etched at 1,000–4,000 V. in argon at a pressure of 1–100 μ of mercury. The etching time has been found to vary from fifteen minutes to several hours according to the nature of the specimen. It appears to yield particularly good results on some aluminium alloys, such as the aluminium–1¼ per cent manganese alloy, and has also been used for revealing grain boundaries in copper which could not be seen by ordinary etching techniques.

One exhibit in the general metallurgy section of particular interest to the fundamental scientist concerns work which the Association is carrying out on the properties of grain boundaries. For this work bi-crystals of copper, the orientations of which with respect to each other are known, are being subjected to shearing forces tending to move one crystal relative to the other. The magnitude of these forces is such that at the test temperature plastic deformation of the crystals themselves is negligible. Optical interference methods are being used for tracing the relative movements of the crystals, and by this technique movements as small as 500 A. can be observed. Eventually it is hoped that this work will give an indication of the part which grain-boundary movement plays in the behaviour of metals in slow creep.

THE WATER POLLUTION RESEARCH LABORATORY, STEVENAGE

THE Water Pollution Research Laboratory—one of the fourteen research stations of the Department of Scientific and Industrial Research—was set up in 1927. Until recently it had no permanent buildings of its own, and its work was carried out in a number of temporary laboratories in different parts of Britain. The official opening on June 20 of a permanent central laboratory at Stevenage therefore marks an important stage in the history of the organization.

In 1927 there were many urgent and serious problems of pollution of surface waters, particularly by industrial effluents, and indeed the organization was formed as the result of representations made at that time to the Lord President of the Council by a

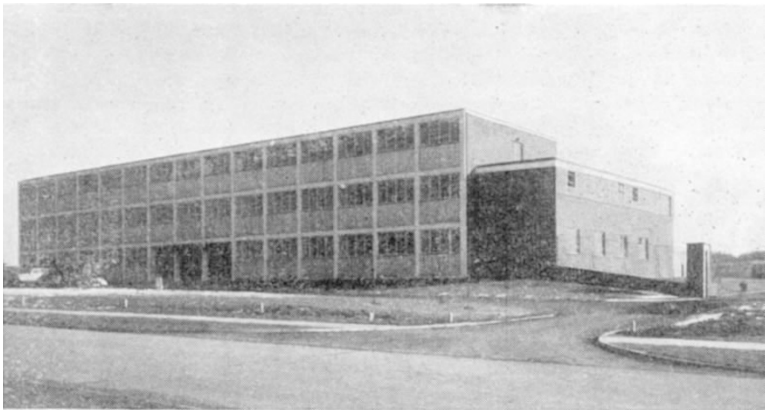

Fig. 1. Water Pollution Research Laboratory, Stevenage

deputation representing water supply undertakings, medical officers of health, and fishery authorities. At first, therefore, the work of the organization was mainly on the development of methods of purifying particular industrial wastes; several years, for example, were spent in working on waste waters from the beet-sugar industry and from the milk industry, both of which were causing serious pollution in rural districts. In 1927 very little was known in detail of the effects of different types of polluting substances on fish, though it was clear that fisheries in many parts of Britain were rapidly being destroyed. Accordingly, during 1929–33 a survey of the estuary of the River Tees was undertaken; this was chosen as typical of several estuaries which had become impassable to migratory fish, and in which the numbers of salmon caught by anglers in the upper river and by net fishermen in the estuary itself were declining rapidly. As a result of this work, a better understanding was obtained of the effects on a fishery of directly toxic substances and of depletion of dissolved oxygen brought about by the oxidation by bacterial action of organic substances discharged as constituents of industrial wastes and sewage effluents. At that time, also, some local authorities were finding difficulty in purifying domestic sewage, as a result of the discharge to the sewers of industrial liquors containing substances which inhibited the microbiological processes on which the treatment of sewage very largely depends. The discharge of industrial wastes to domestic sewers —which is admitted to be on the whole a good policy—has increased considerably since the formation of the Laboratory, and a great deal of work has been done to determine the effects of important constituents on sewage treatment, and the maximum concentrations which can be tolerated. It is now becoming common practice in industry to remove particularly noxious constituents so that the remaining effluent can be treated in admixture with sewage without interfering unduly with the purification of the mixture at a sewage-disposal works. There are, for example, plants in many parts of Britain for removing chromate, cyanide and toxic metals from effluents from the metal industries before these are discharged to sewers.

Since 1927 the view taken of pollution by industry has changed considerably, and it is now generally realized that it is essential in an industrial and thickly populated country such as Great Britain that rivers should be maintained in a reasonable state of purity. There has been a substantial increase in the volume of water distributed for domestic supply, and of this a large proportion is drawn from surface sources. Many of these sources have already received industrial and sewage effluents, and the cycle of discharge and re-use can only be operated if these liquids are effectively treated before discharge, so as to permit further natural purification to take place in the river, giving a water suitable for subsequent treatment at a water works. Industry is in much the same position, since the water supply of one factory commonly contains effluent from another factory—and often from a great many factories—discharged farther upstream. Since 1927, therefore, many industries, realizing the importance of effluent treatment, have themselves undertaken research, either at individual factories or through research associations. Examples of the kind of work done and of the success which has in many cases been achieved were given in a recent symposium organized by the Society of Chemical Industry (see *Nature*, **175**, 790; 1955). It is an excellent thing that research on the treatment of an industrial effluent should be undertaken within the industry itself, since often the best and most economical solution is found, not by devising a method of treatment for a liquid already being discharged, but by modifying the processes of manufacture so as to reduce both the volume of the effluent and the quantity of material which it carries away with it to waste.

Fig. 2. Section of a pilot-scale laboratory for work on the effects of pollution on fish

The Water Pollution Research Laboratory is in close touch with much of the work of this kind which is carried out in Great Britain ; but now that industry is taking an increasing part in the solution of its own problems, it is becoming possible to devote a bigger part of the resources of the organization to work of a more general and basic kind. The need for such work has become more important with the formation in 1948 of river boards with powers to lay down standards of quality of effluents which may be discharged into particular rivers. It is clear that before this can be done effectively, a river board must be able to predict, within reasonable limits, what will be the effect of discharging a given effluent on the general properties of a river—on its suitability, for example, for a domestic or industrial water supply or on its ability to support a fishery. To give an accurate answer to such a question requires much more information than is at present available on rates of oxidation of different substances in rivers, on the rate of absorption of oxygen by water from the air, on the effect of plants on the oxygen balance, on the long-continued effect of toxic substances on fish, and so on. This kind of long-range investigation is at present occupying a large proportion of the effort of the Laboratory. For example, a detailed study is being made of the conditions in the very polluted estuary of the Thames, some fifteen miles of which now contain no detectable oxygen in solution in dry weather. Here information is required on what the effect on this condition would be of changing various factors—for example, the input of oxidizable matter in sewage and industrial effluents, the temperature (which is appreciably raised by the discharge of cooling-water from power stations), and the fresh-water flow. Having studied, so far as possible, the components of the problem in the laboratory, the distribution of dissolved oxygen under present conditions has then to be predicted, taking into account the complex system of mixing and flow of fresh and salt water in an estuary. The validity of the data used in the calculations can be checked by comparing the predicted distribution of dissolved oxygen with the observed distribution ; when it has been shown that the data used are reliable, it is then not unduly difficult to predict what changes will follow from altering any of the factors which affect the oxygenation of the water. On such information, it is hoped, future policy concerning the estuary will be based.

In collaboration with the Ministry of Agriculture, Fisheries and Food and the Freshwater Biological Association, a study has been begun of the effects of pollution on freshwater streams. Much of the information gained in the survey of the Thames Estuary—particularly on the factors which affect the oxygen balance—will be immediately applicable in this new work.

The present staff of the Laboratory includes chemists, physicists and biologists ; usually these work in combined teams—an arrangement which is often of great mutual benefit. The new Laboratory was designed for a research staff (scientific officers and assistants) of about eighty-five ; the present number is fifty-three. It has a floor space of about 40,000 sq. ft. and includes under one roof a three-storied block of which the top floor includes the library and office accommodation and the other two floors small-scale laboratories, and a single-storied wing containing four pilot-scale and associated analytical laboratories. One section of this wing is designed as a low-activity radiochemical laboratory. In this, work is being carried out on the removal of radioactive substances from water ; this section also undertakes for the rest of the Laboratory work involving the use of radioactive tracers. Two of the pilot-scale laboratories are specially designed for work with fish, and these are provided with a separate unchlorinated water supply from a bore-hole. A feature of the Station is that up to 70,000 gallons of domestic sewage can be pumped daily from a sewer crossing the site for use in large-scale experimental work in plant built in the open. The services are in general simple and orthodox ; but where advantageous, use has been made of modern techniques and materials. Each laboratory contains an electrical circuit, operated from a master clock, from which impulses can be taken at intervals of 1 or 30 seconds ; these operate relays and are widely used for marking time-scales and for controlling automatic apparatus. Another feature which has proved generally acceptable is that on suitable walls of each laboratory there are permanent metallic studs to which 'Dexion' or similar frame-work can be attached without boring holes in the wall. Distilled water is prepared centrally, using an automatic gas-fired boiler and a set of strip-action condensers in 'Pyrex' glass. Waste waters from the laboratories are drained through polythene waste pipes.

There is a transport section to assist in field-work, and metal-working and wood-working shops are provided for the construction of prototype apparatus designed and used in the laboratories.

OBITUARY

Prof. E. Regener

Erich Regener, who died on February 27, was born in Schleussenau near Bromberg on November 12, 1881. He studied physics under E. Warburg in Berlin, worked from 1909 onwards with H. Rubens at the Physics Department of the University of Berlin, and became, in 1911, professor of physics and meteorology in the Landwirtschaftliche Hochschule, Berlin. In 1920 he was appointed director of the Physics Department of the Technical High-school at Stuttgart, which, under him as experimental physicist, and with P. P. Ewald as theoretical physicist, soon became a lively centre of learning and research.

Regener is perhaps best known for his work on the intensity of cosmic rays under water and in the upper atmosphere. He was a pioneer in both fields, and at one time held both the depth and height records for cosmic-ray measurements : 230 m. below the surface of Lake Constance and 25 km. up in the atmosphere. These two achievements revealed his great experimental skill and ingenuity in the design of apparatus. Regener also made many important contributions to atmospheric physics, particularly in the study of ozone and of the physics of the crystallization of water.

During the Hitler regime, Regener had to resign his post at Stuttgart as his wife was a non-Aryan. However, he found support from the more liberal Kaiser-Wilhelm-Gesellschaft, as director of a laboratory at Friedrichschafen for the investigation of the stratosphere. When, during the War, his laboratory was destroyed during an air raid, he built a small research station at Weissenau on Lake Constance, which, after the War, became part of the