THE WATER RESEARCH ASSOCIATION

NEW RESEARCH STATION

THE Water Research Association (director, Dr. R. G. Allen) invited its members on September 20 to inspect the permanent Research Station on the River Thames at Medmenham, in Buckinghamshire, into which it moved earlier this year. The Association was founded by water undertakings and is now in receipt of grant-aid under the scheme for industrial Research Associations operated by the Department of Scientific and Industrial Research. Previously it had been in temporary accommodation at Redhill, and with the move into specially designed buildings on a site where there is a plentiful supply of raw water, and provided with appropriate facilities for experimentation, it can be seen that the organization has now attained its full stature as an established Research Association.

The removal to new laboratories made it possible both to extend the scope of the research on hand and to begin programmes in new fields. The internal organization was expanded to comprise the following eight divisions: chemistry; physics; biology; hydrology; plant process; information; workshop services; administration. Thus there are now staff and facilities for work on every technical aspect of providing potable water.

Perhaps the most interesting structure in the new buildings is the Pilot Plant Laboratory, which has a total floor area of about seven thousand square feet, with a maximum roof height of thirty-six feet. This laboratory is intended primarily for the testing of equipment and techniques on the industrial scale; raw water is brought in from the River Thames and the construction and fittings are designed specifically for such work.

Specialized laboratories include those for physics, and for physical chemistry, general chemistry, coagulation chemistry, chemical instruments, microbiology and hydrology. There is a well-equipped machine shop. The library is being enlarged with the object of maintaining a unique collection of the literature relating to certain technical aspects of the water industry which are not indexed together elsewhere.

Chemistry Division

In the Chemistry Division the main work has been on the use of coagulation in water treatment. In this commonly used chemical process the fine suspended particles of clay which cause turbidity in water are made to coagulate into a floc of larger particles by the addition of a coagulant such as aluminium sulphate, and are then removed comparatively easily by settlement.

This investigation has thrown a completely new light on the mechanism of coagulation. It has been found that the range of values of *p*H in which the coagulation process is most efficient in removing turbidity corresponds to that in which the hydrolysis product is most rapidly flocculated, that concentrations of various coagulants which are equivalent in terms of aluminium concentration are not equivalent in terms of coagulant efficiency, and that there is at least a rough relationship between the relative coagulant efficiency and the amount of hydrolysis product that is precipitated immediately on reaction of the coagulant with water. This suggests that the mechanism of the clarification of turbid water is not coagulation in its true sense; the only coagulation that takes place is that of the hydrolysis product, and the clay particles which constitute the turbidity are carried down in the mass of flocculating hydroxide particles. The precise nature of the interaction between the clay and the hydroxide is not yet clearly understood, but is being investigated.

A number of coagulants have now been studied in some detail, and other coagulants and materials assisting the coagulation process are also being evaluated.

Coagulation processes are also used for the removal of colour from water. To provide the quantities of the colouring matter (complex organic acids derived from soil humus) required for research, a technique has been developed in which this material can be isolated from raw Thames water at rates of flow of up to 100 gallons per hour. It is proposed in the near future to begin isolating the organic colour from a number of raw water sources in addition to that on the site, and to study the way these materials behave in flocculating systems.

An analytical section has been established within the Chemistry Division, and is making a systematic study of methods used in the analysis of potable waters. This section will investigate new techniques for the measurement of every aspect of water quality, and this experience will be of great value if eventually a water quality network is established in Britain, similar to that which operates in the United States of America.

Physics Division

The Physics Division is concerned with all the physical aspects of water distribution. Its principal research programmes at present relate to the application of plastic materials to the construction of water mains and service pipes, to methods of instrumentation (particularly for the detection of leaks) and to mathematical analysis of flows and pressures in water distribution networks.

In an investigation on plastic pipes it is hoped to establish optimum design criteria for long-term service. Plastics react to variations of stress and temperature in a more complicated way than iron and steel, and as their long-term strengths are not precisely known, deliberately conservative ratings are now being used. Progress has already been made towards determining the long-term effect of variations of pressure in plastic water-distribution mains, employing accelerated tests, and the present programme relates to the measurement and specification of impact strengths. The impact resistance must of course be high enough to withstand reasonable shock loads in transit, when being laid, or when other services are being installed in the ground alongside.

It is estimated that leakage from water distribution systems in Britain exceeds 10 per cent of the

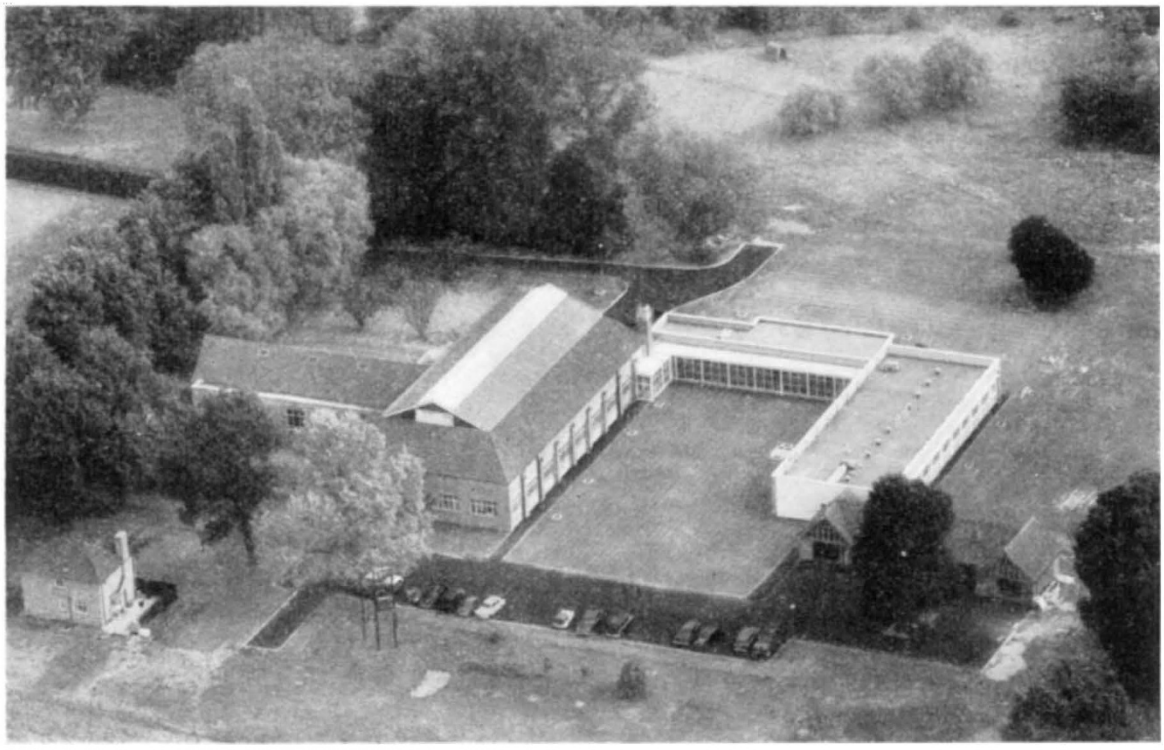

Fig. 1. The new Research Station of the Water Research Association, at Medmenham, near Marlow, Buckinghamshire. The grounds extend nearly to the River Thames, from which water is taken for experimental purposes

input, and a strong economic demand exists therefore for a device which will accurately locate leaks from buried water mains. The object of the programme in this respect is to develop a telemetering system in which an instrument carrier will be drawn along inside the pipeline and will transmit readings to an observer on the ground surface. Plunger devices (termed 'ferrets', 'go-devils' or 'pigs') which are driven through distribution mains by the fluid pressure are already in use for cleaning and other purposes, and such devices would also be suitable for carrying instruments. The first phase of the programme has therefore been the development of suitable signalling equipment, and devices have now been demonstrated which transmit a magnetic signal from a small piece of equipment inside a buried pipeline of any material including iron and steel, through the earth or other top filling, to light-weight portable receiving equipment.

While the work on the development of a complete telemetering system continues, the method of transmitting a signal from inside a buried pipeline is being put to good use in the design of a device to detect the position of a 'ferret' in service. This has now reached the prototype stage. An electro-magnetic beacon is attached to the 'ferret', so that its position can be found by moving the receiving equipment until the signal is loudest. It has been a major objection to the use of 'ferrets' that if they should stop in the pipeline it might be a very difficult matter to find and recover them, and a reliable 'ferret' detector should encourage their wider use.

As areas of water supply are extended, and rising demand brings many of the supply mains nearer their limits of capacity, it becomes increasingly important that it should be possible to calculate pressures and flows rapidly and accurately under existing and postulated conditions of supply and demand. Such calculations are altogether too time-consuming to be done by hand, and investigations have therefore been made of the use of both analogue and digital computers to produce methods of rapid and precise computation.

Plant Process Division

The Plant Process Division was set up when the Association had moved to its new establishment. The present programme is as follows: to investigate existing water-treatment processes; to develop from the findings of the Chemistry Division new processes which may be applied to full-scale waterworks plant; to investigate particular problems which may occur in the plant of members of the Association.

The equipment which is at present being designed will occupy a large part of the Pilot Plant Laboratory, and will include two treatment processes, one as a standard of reference. It will be large enough to ensure that the processes developed in it can be transferred to full-scale plant without further difficulty, while still being small enough to be flexible in operation. This plant will use raw water from the Thames at a maximum rate of about a thousand gallons per hour.

Hydrology Division

The study of hydrological problems is the responsibility of another newly established Division. The work of the Water Research Association in this field is part of an integrated national programme, and its present aims are: to encourage the improvement, both in quality and quantity, of hydrological measurements made by water undertakings; to advise the water undertakings in membership on ways of using their own hydrological data; to co-operate in the

scientific study of evaporation and rainfall measurements in upland catchment areas of the British Isles.

The Hydrology Division is devoting its main attention at present to surface waters. The water industry is immediately interested in calculating effective reservoir capacities, and in the effects of different types of land use on water yield. Several continental countries and the United States of America have made considerable progress in this respect and their results, although not directly applicable to the very different conditions in Britain, suggest a number of ways by which substantially increased yields might follow if the necessary data were determined and applied. The research aspects of the work of the Hydrology Division work are designed to assist in this.

In addition, since 30 per cent of the raw water taken by water undertakings in the British Isles comes from underground sources, these must be assessed as regards their long-term yield in terms of infiltrating rainfall. Natural replenishment by this means is a very slow process, but artificial replenishment by pumping from surface water sources offers storage at low capital cost. This method is already in use in Sweden, Germany, The Netherlands and the United States of America; the Association's programme provides for research to assist in collecting reliable data and overcoming technical difficulties.

Biology Division

The biological aspects of the water supply process are clearly of the utmost importance, not only because biological purity is required equally with chemical purity but also because biological as well as chemical processes are employed in water purification.

The Biology Division has only recently been established, and is still engaged on a preliminary examination of the problems. It is expected that its first programmes will be concerned with aspects of water sterilization, with the development of faster techniques for bacteriological examination and with the control of algae in stored waters.

Information Division

The objects of the information services are to see that new information from all sources is readily available to members, to provide assistance with day-to-day problems where the necessary information already exists, and to maintain communication with the water industry, other research establishments and other organizations with appropriate interests throughout the world.

In addition to the material supplied to staff and members by the library, numerous technical inquiries from members are answered. The staff of the Association is in a position to accumulate extensive experience of such problems, to maintain contact with specialists and to keep abreast of the published information.

The problems presented are normally within the experience of the technical staff of an undertaking but outside their special province. They cover a very wide range of topics; a typical selection might include complex cases of corrosion, attacks by insects (even on polythene water-supply pipe), the infestation of water supplies by various organisms, the chemical contamination of supplies, and such practical problems as the protection of reservoirs from birds.

In addition to its technical papers the Association publishes a periodical, *Water Research News*.

The Future

In its recent annual report, the Council of the Water Research Association comments: "It is now apparent that considerable changes will be required in the nation's water systems if the rapid increases in agricultural and industrial demands are to be met everywhere. The techniques of every stage of the water supply process are open to review, and a large part of the work must properly fall on the Water Research Association".

A visitor to the Water Research Association will realize that this consideration underlies all the planning at the new Research Station.

MUSCLE RECEPTORS

THIS year the University of Hong Kong, as part of its golden jubilee celebrations, held six symposia during September 11–16. One of these, under the chairmanship of Prof. Ragnar Granit (Stockholm) was on muscle receptors. It was organized by Prof. D. Barker, professor of zoology. There were about thirty participants, who represented both the physiological and histological aspects of work on receptors in mammalian muscle. The muscle spindle was considered from many angles and the papers, which ranged from accounts of the exacting work of electrical recording and single nerve fibre stimulation to details of the intricate structure of spindle innervation were given to full audiences and provoked lively discussions.

Prof. Granit opened the proceedings with a summary of much of the earlier work and a statement of some of the outstanding problems. A special lecture by Sir John Eccles (Canberra), who was unable to be present, on the "Central Connections of Muscle Afferent Fibres", was read by Prof. A. K. McIntyre (Otago, New Zealand). In the papers and demonstrations that followed, evidence was given of new advances which we may expect to see developed further in the future. H. Shimazu and T. Hongo (Tokyo) directed attention to brain-stem influences on the motor supply to muscle spindles, while E. Eldred (California) spoke of cerebral influences. McIntyre considered that any discharges passing up muscle nerves and reaching the cerebrum probably came from Pacinian corpuscles and joint receptors and not from spindle primary endings. Y. Laporte (Toulouse) described elegant work in which both the primary and secondary afferent endings in a single spindle could be subjected to controlled stimulation of the spindle motor nerves and the responses compared. C. Eyzaguirre (Salt Lake City) spoke of spindle motor innervation and described how some of the intrafusal muscle fibres were actually seen to contract slowly. I. A. Boyd (Glasgow) gave a graphic account, with many beautiful colour slides, of the whole structure of muscle spindles in the cat, based on de-afferented and de-efferented material and much work on nerve fibre spectra. He directed particular