from water by processes normally used at water-treatment plants. Work on the biological filtration of sewage has confirmed the importance of periodicity of dosing in determining the efficiency of a filter; it has now been found that percolating filters can break down cyanides when these are supplied as solutions of potassium, zinc or cadmium cyanides in concentrations up to 160 parts of hydrogen cyanide per million. In an investigation on the effect on the River Colne, near Watford, of the discharge of effluent from a modern sewage treatment works, an attempt is being made to correlate the distribution of fish in the effluent channel with the chemical characteristics of the effluent. The survey of the Thames estuary is now mainly concerned with the factors affecting the oxygen balance in the estuary.

(*To be continued*)

THE PAINT RESEARCH STATION, TEDDINGTON

OPEN DAYS

THE Paint Research Station at Teddington was opened to visitors during May 2–7. Most research institutes have such occasions, which call for good planning and showmanship if past achievements and future trends are to be adequately demonstrated. These qualities are not always integrated in research workers, but the director of the Station, Dr. L. A. Jordan, and indeed all the staff concerned, are to be congratulated on a most admirable presentation of their work, which undoubtedly had an impact of consequence on those attending, some 750 in all.

The subjects studied at the Station fall naturally into four broad divisions: media, pigments, paint manufacture, and paint utilization. As the visitors passed into the various rooms they were met by experts prepared to explain and expound the subjects under study or the apparatus on show. In addition to receiving the general laboratory guide, visitors were able to read and collect brief statements detailing the work dealt with in each room. There were fifty or more of these papers and some necessarily ran to four quarto pages. The scientific detail thus made available was considerable, and its practical objective was brought into focus by a short preface to each paper.

The appreciation by visitors of the inter-relations between the demonstrations in various laboratories and their setting was greatly assisted by short talks lasting not more than 20–30 min. given at intervals throughout the days. This arrangement fully achieved its object and, moreover, was a factor in preventing physical fatigue. The subjects were: (*a*) atomic energy, drying oils and the future; (*b*) alkyd resins research; (*c*) synthetic resin emulsion paints, their structure and properties; (*d*) accelerated weathering studies. A film prepared under the direction of the staff was also shown more or less continuously entitled "Benard Cell Effects in Paints". A good alternative title would have been "the study of pigment flotation in paints and its control by the use of silicone oils". This was particularly interesting and intriguing, dealing with special features of a type of phenomenon with wide manifestations in Nature.

To-day paints are manufactured from a variety of new media, as well as from traditional materials, and provide an ever-increasing scope for study. Tracer techniques are widely employed, and the Research Station now has its own source of γ-radiation whereby the study of various polymerizations and other reactions in drying oils and related materials is proceeding apace.

The alkyd resin concept as it has come to fruition in the production of paint media of admirable quality is still a comparatively recent matter; by contrast, the heat-treatment processing of drying oils, such as linseed oil, tung oil and some others, is almost as old as paint itself. In these fields of work the Research Station continues to make an outstanding contribution, now assuming added importance since Prof. T. P. Hilditch is no longer at work at Liverpool.

Measurements of molecular weights necessarily enter into many of these studies. The methods employed involve measurements of osmotic pressure, boiling point, light-scattering effects and viscosity. By the use of new membranes such as those prepared from polyvinyl alcohol, the lower limit of molecular weight determinable by osmometry has been brought down to about 1,000.

Film formation from a variety of media has been studied by measurements of oxygen uptake and by examination of the products formed. Part of this study is concerned with the drying of films under adverse conditions, such as industrial pollution, tropical humidity or low temperatures.

Linoleum manufacture is akin to paint manufacture in that it involves the oxidation and polymerization of linseed oil. The chemistry of these changes has been considerably clarified by the application of such techniques as solvent fractionation, molecular distillation, infra-red and ultra-violet spectroscopy.

Colour and opacity form the main basis for the commercial evaluation of many pigments. While the Station must necessarily measure these properties, the work on pigments has been carried much further than is required for mere description. Particle-size, shape and distribution are important factors in pigment studies, and their measurement calls for various physical techniques, of which the most attractive is electron microscopy. The original home-made electron microscope—believed to be the second made in Britain, and in the early days of the War—is still in use. Crystal structure factors are examined by electron diffraction and X-ray analysis. The useful concept of 'specific surface'—the surface area per unit weight of powders—is being brought to its full significance for pigments. The values obtained vary from 20–900 sq. m. per gm. for carbon black to 0·5–2·0 sq. m. per gm. for barytes. The wetting and dispersion characteristics of pigments also have not been neglected.

Synthetic resin latex paints are a fairly recent introduction to the industry. To-day their use is widespread and well established; the medium employed consists of a highly viscous dispersed material in the form of swollen particles, and its study calls for new methods of approach involving problems in rheology, storage stability, permeability, inflammability and exterior durability. The nature of the pigment distribution, the structure of the film and the effects of plasticizers in such paints have been studied by various methods, including the application of radioactive tracers and the electron microscope.

Paint utilization involves the relationship between the paint film and the surface on which it is applied. Flexibility, hardness, adhesion and other mechanical properties of films are dependent on their molecular

and internal macro structure. Adhesion studies are carried out in gravitational fields produced by specially designed rotor apparatus, and with other equipment. The understanding of adhesion is not easy; both chemical and physical factors are involved, and a condition called mechanical adhesion seems to be dependent on the ability of a paint film to enter grooves and other deformities in the substrate. The Research Station is hopeful of making some new and significant contributions in this field.

Durability of paint in its many uses is the thing that matters to the customer. To anticipate the behaviour of paint in the sense of accurately forecasting its likely behaviour in various environments is still a dream; but the Research Station has for many years put a big effort into the study of accelerated testing procedures. The current approach is to utilize the results of testing the mechanical properties of films (tensile strength, flexibility, creep, recovery, etc.) after various periods of ageing or accelerated weathering, in order to show the trend of change and to interpret its meaning in terms of probable ultimate performance. A very interesting device in this section involves the use of measurements of the velocity of sound through paint films to determine Young's modulus.

In these ageing and durability studies, the electron microscope has proved a valuable tool for detecting changes in paint deterioration long before they become visible to the naked eye. Stains on painted surfaces, mould growth, paint inclusions, paint deposits, and the effects of atmospheric pollution all call for special techniques, many of which involve microchemistry. These specialized analytical methods, including the direct determination of organic oxygen by Unterzaucher's method, the utilization of ion exchange resins and colorimetry are features of the work of the Analytical Chemistry Section at Teddington.

The Library of the Station deserves mention for its unique collection of specialized books and journals dealing with paint, and for the information, loan and abstract review services which have been organized for its members. How much the Paint Research Station is valued by the trade is proved by the fact that members went there on more than four hundred occasions during 1954.

The results of the application of science to the paint industry are about us all to-day in our homes; a short visit to this Station will soon convince anyone that this chapter is not a closed one—only the opening paragraphs have as yet been written.

W. D. R.

ZOOLOGICAL SOCIETY OF LONDON

EXHIBITION OF WHALES AND WHALING

By DR. L. HARRISON MATTHEWS, F.R.S.
Director

ON May 23 an exhibition of unusual scope was opened by H.E. the Ambassador of Norway, Mr. Preben Prebensen, in the gardens of the Zoological Society of London.

Whales are of great interest to the zoologist by reason of their many peculiarities of structure and ways of life. They are of great economic importance for the valuable products that are obtained from them. But to the general public they are particularly striking by reason of their enormous size. They are the largest mammals in the world and the largest animals that have ever existed. Once or twice in the past the Zoological Society has attempted to exhibit alive the smallest of the whales—the porpoises and dolphins—but it can, of course, never hope to show the larger kinds in captivity. The next best thing is to exhibit accurate replicas, and the Society was therefore delighted to seize the opportunity of showing the impressive model of a sperm whale's head used in making some of the scenes in Moulin Productions' film of Herman Melville's book, "Moby Dick". Around this centrepiece a number of photographs and other exhibits have been grouped to illustrate the natural-history of whales and the history and methods of the whaling industry.

Open-boat whaling for sperm whales began some 250 years ago on the New England coasts of America, and by the middle of the past century no less than 735 American whalers were at sea. Many of these ships completed their crews with sailors from the Portuguese Atlantic islands, the Azores, Madeira and the Cape Verdes. Then there came a decline in sperm whaling after the introduction of paraffin for lighting—a new American industry killed the old one.

But besides the sperm whale there are other great whales—the baleen whales that have no teeth like the sperm whale but instead have numerous plates of whalebone that form a strainer in the mouth which is used for filtering out the shrimp-like krill on which these monsters feed. Their oil, too, is different from sperm oil and can be used for many other purposes, such as making soap and margarine. But they cannot be caught with hand harpoons, for they are extremely active and they sink when dead and would drag down any boat rash enough to harpoon them. They were therefore safe from whalers until about 1860, when the Norwegian Svend Foyn invented the modern whale cannon which is mounted on a small steamship and fires an explosive harpoon that kills the whale. The harpoon is attached to a rope stout enough to haul the dead whale to the surface. The great whaling industry of the Antarctic is based on Svend Foyn's invention and it produces some two million barrels of oil every year.

But the old-time methods are not yet dead; sperm whaling from open boats is still carried on in the Azores and Madeira by men who are the descendants of the Portuguese sailors who learned their trade in the American whale ships more than a century ago.

In addition to the model, which is slightly larger than life size, the exhibition includes an exact replica of a whale boat of the period 1842–48 with all its gear, and a replica of part of the deck of a whale ship of the same period, with the try-works used in boiling the oil out of the blubber. Much historical research has been devoted to obtaining information for use in the construction of these exhibits and every detail is believed to be correct. In contrast to these, a modern whaling cannon and harpoon, and flensing knives, give some idea of the present-day highly organized Antarctic whaling industry.

The photographs show several species of whales, the giant squids that form the food of sperm whales, and the Euphausian 'krill' forming that of the baleen whales. Another series of enlargements shows many stages in the hunting and capture of whales and the utilization of their carcases by the floating factories in the Antarctic. These are set off by a number of