

of the kiln, render fish-smoking an art which is difficult to practise. In 1939 a mechanical kiln was developed at Torry which simplified the process and made it much easier to control. Although the industry was at first slow to adopt the new kilns, an increasing number of firms are now doing so. Intriguing possibilities are, however, now being suggested as a result of basic physical and chemical work on the composition of wood smoke. It has been shown that virtually all the smoke constituents on smoked fish are derived from the invisible vapour phase and not the visible particulate phase. The practicability of smoking fish with 'smokeless' smoke and further developments as well are envisaged.

There is a continuous programme of work at Torry on the improvement of the efficiency of conventional fish-meal plant. Emphasis is put upon methods of

increasing production, plant efficiency and nutritive value of the product.

It is important to stress that the high standing of the Torry Research Station within the fish industry itself is very largely due to the considerable amount of consultation and discussion which takes place with the industry and, not less important, the very good relationship built up between individual scientists and various people 'in the trade'. Much of the development and survey work carried out within the past ten years would have been quite impossible without the close and friendly co-operation of the industry; on this personal contact between government research workers and the industry the future development of this relatively undeveloped and traditional industry, without any research organization of its own, depends.

G. H. O. BURGESS

## FISHERY RESEARCH

DR. BREDER has prepared a valuable review of work on social grouping in fish\*; it also contains new data, though it is sometimes a little difficult to pick these out. He discusses in detail the various types of groups: the aggregation, where the individuals are not 'polarized'; the school, where they are; and the pod, where the fish are in physical contact. These types of groups are illustrated by outstandingly good photographs, those of pods and fish in 'orderly files' being the most interesting.

Descriptions of new work are mainly of the effect of light intensity and colour on a number of species and the analysis of the internal structure of schools. In the experiments on the effect of the wave-length of light the fish were given a choice between different colours, the intensity of the different colours being equated photometrically. No attempt was made, by determining the spectral sensitivity of the fish, to equate the subjective intensity, or intensity as it appeared to the fish. Of particular interest are Dr. Breder's discussions on the leadership of schools, the school as a super-organism and the evolution of schooling behaviour. There is also a section on schooling in terms of cybernetics, where the point is made that the survival of a species which has grouping tendencies should perhaps be considered from the

point of view of how they have got over the danger involved, rather than that such tendencies automatically have survival value.

Dr. Loukashkin's and Dr. Grant's work on *Sardinops caerulea*\*, a species of great commercial importance, has much in common with Dr. Breder's but is more limited in extent. It is again well illustrated with photographs. Like other clupeoids, *Sardinops* is not an easy subject for experiment, but results have been obtained which show the importance of light for the maintenance of school formation and that fright reactions are elicited by red lights and by flashing white lights. When given the choice between red, green, blue and white light, the fish avoided red and preferred blue and green to white. As in Dr. Breder's work, this technique has a limitation in that the intensities of the different colours were not equated subjectively but only photometrically.

This type of behaviour work, which may be considered important as an aspect of fisheries research, is now being produced in much greater quantity than before the War, and it is particularly welcome to the fisheries research worker when it is concerned with species of commercial importance.

J. H. S. BLAXTER

\* Bulletin of the American Museum of Natural History. Vol. 117, Article 6: Studies on Social Groupings in Fishes. By C. M. Breder, Jr. Pp. 393-482+plates 70-80. (New York: American Museum of Natural History, 1959.) 1.50 dollars.

\* Proceedings of the California Academy of Sciences. Vol. 29, No. 15: Behavior and Reactions of the Pacific Sardine *Sardinops caerulea* (Girard) Under the Influence of White and Colored Lights and Darkness. By A. S. Loukashkin and N. Grant. Pp. 509-548. (San Francisco: California Academy of Sciences, 1959.)

## THE ONTARIO RESEARCH FOUNDATION

THE annual report of the Ontario Research Foundation for 1958 (pp. 36. Toronto: Ontario Research Foundation, 1959) includes, besides the report of the director, Dr. H. B. Speakman, a summary of the work of the various sections, a list of papers published during the year, the financial statement and details of the Board of Governors and professional and technical staff. There is also a list of grants for postgraduate studies in science for the period 1958-59, for which grants in 1958 totalled 145,204 dollars. In biochemistry three major projects, dealing with the development of an all-temperature biscuit spread for the Defence Research Medical

Laboratories, tea, and the recovery of pure individual amino-acids from wheat gluten after hydrolysis, were completed, and two major studies are in progress under the Rice Mills Fellowship. In chemistry, activity was maintained at a high level. The three-year survey of air pollution of the Hamilton area was completed, while the development of gas chromatography proceeds apace. In a study of factors controlling the crystallinity of polymers, techniques developed for preparing polymers of butane with 50 per cent of crystallinity are being used to study the relation between the type of catalyst and polymer structure. A novel ion-exchange process for recovering ammonia

from ammonia-base waste sulphite-liquor has been developed and a pilot plant constructed. A comprehensive study has been continued of various sulphite-liquors and their fractions and has led to a patent application; there have been utilization studies on by-product lignin from the manufacture of vanillin, while research on phosphate glasses has been continued in the  $\text{Na}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$  system centred largely on the constitution of sodium acid glasses of intermediate composition, using filter paper chromatography.

In engineering and metallurgy basic research was directed at the concentration of hematite by a combination of magnetic and mechanical methods or by roasting methods followed by magnetic separation. In work on dry magnetic separators the 'Fast Eccentric Drum Separator' has been developed to the point of commercial production. In basic research on the fatigue of metals three stages have been distinguished: (a) the first four thousand cycles; (b) a slow steady decline in cyclograph (magnetic test); and (c) the last 15,000–20,000 cycles in which the final crack is developing. A precision camera was designed and built for stress determination in X-ray work.

In the Department of Parasitology most of the work was a continuation of earlier projects, and

persistent effort has provided an understanding of the prevalence and mode of transmission of some of the many parasites of Ontario's wild animals. Similar studies on wild birds are in progress, and during 1958 the blood parasite of ducks, *Leucocytozoon simondi*, was successfully grown on tissue culture in test-tubes. Continued studies of two types of blood parasites of birds have shown that certain types of black flies transmit them to ducks, while others transmit them to ruffed grouse. In physics some fundamental work dealing with beams of electrons has been planned, while other projects included development of an atmospheric X-ray spectrometer, design procedures for dynamic pressure stages, determination of gas density by electron beams and high-energy applications of electron beams. The Department of Physiography completed an extensive study of the fine sand fraction of representative soils and a five-year environmental study of soya bean is nearing completion. Research on the chemical modification of wool continued in the Department of Textiles as well as a study of the colour fastness of spun-dyed viscose yarn. Good progress is reported in the standardization of women's and children's garment sizes for the Canadian Government Specifications Board.

## INSTRUCTIONAL FILM RESEARCH IN PENNSYLVANIA

THE Pennsylvania Instructional Film Research Program was established in 1947 and terminated in 1955. Jointly sponsored by the U.S. Army and Navy, it represents the largest piece of co-ordinated research yet carried out on the teaching film. Accounts of the early part of the research have appeared in *Nature*<sup>1</sup>. It is the purpose of this article to complete the outline record by reviewing the last reports—now gathered into one volume<sup>2</sup>.

The later work follows directly on the earlier, confirming it, filling in details and dealing with specific problems. But some new and interesting notions of a general sort arise in this process. The very last studies, 100–104, deal with training aids such as models and other apparatus that are not films. Two of the studies, 46 and 50, are related to the use of films in psychotherapy. These two studies, as well as study 60, are concerned with films which influence attitude. The main classes of films dealt with in the research have been those which impart information and those which teach perceptual-motor skills.

A number of the studies yield information of general practical use. For example, study 37 by Philip Ash and Nathan Jaspén—see report *SDC* 269–7–37—examines optimum viewing conditions. Using a small rear projection daylight screen in teaching a performance skill—the assembly of a gun breech block—the optimum viewing area was found to be a sector 60° wide and 12 screen-widths deep. Increasing distance from the screen beyond 12 screen widths led to much sharper loss of teaching effectiveness than increasing angle of view beyond that of the 60° boundary. Outside the optimum viewing area loss was greater under daylight than under dark viewing conditions. These results may be compared with those found for a standard size screen and projector by J. J. Gibson<sup>3</sup>: he found that within a sector up

to 90° wide and 7 screen-widths deep there was no loss in teaching effectiveness.

The Pennsylvania film research organization has always stressed that teaching films should be tested "with adequate samples of appropriate target audiences using reliable and valid tests", rather than by viewing panels. Nevertheless, assessing teaching effectiveness by a viewing panel remains often the only practical alternative. Study 57 by L. P. Greenhill investigates such assessing, and recommends a particular type of film analysis form (or questionnaire); this panel testing procedure being used to select the best of several films, or to improve the teaching effectiveness of a film still under production. Study 59 by A. L. Edwards provides a statistical methodology which might be used when assessing films by the panel method. The report on study 48 about making simple demonstration films with untrained personnel includes—as an appendix—a 'manual for minimum film production'.

Infra-red photography offers an excellent means of recording audience reactions—of children and others—under conditions of little or no visibility. But infra-red motion photography is expensive. Study 56, by L. P. Greenhill, investigates the less costly use of infra-red memo-motion photography. This is essentially time-lapse photography. The photographs were taken on 16-mm. infra-red film at the rate of one a second, a rate which appears sufficiently frequent to show most types of human activity. The record was synchronized with the events on the screen, by the synchronous drive of camera and projector, and more satisfactorily by the use of a mirror reflecting a small image of the screen into the camera—so as to appear at one corner of each memo record frame.

In one of the earlier Pennsylvania studies<sup>4</sup> it was found that a rating profile for a film, showing peaks for an audience reaction of 'I am learning'<sup>5</sup> and