

cup to extract histamine-containing tissue fluid through the skin of a rat immediately over the site of a subcutaneous injection of an irritant substance.

In the Bacteriology Division, demonstrations were given of the various techniques used in the screening of new substances for possible activity against bacteria, viruses, and pathogenic fungi. In the Tuberculosis Section, the animal room was shown in which infected animals are maintained behind glass in a continuous current of air drawn into the room and expelled through filters. Laboratory demonstrations showed *in vitro* tests by the floating pellicle technique, and *in vivo* tests using guinea pigs and intracerebrally infected mice, and the method of assessment of drug activity on the basis of gross pathology. Groups of lungs taken from tuberculous mice, treated with known drugs such as *p*-aminosalicylic acid, thiacetazone, streptomycin, isonicotinic acid hydrazide, etc., were shown.

In the Virus Section, the use of bacteriophage as a screening virus was demonstrated. Methods with embryonated eggs for screening against influenza A and other viruses were shown, and with chicks against the Rous sarcoma virus. In the General Chemotherapy Section, a demonstration was given of an *in vivo* test in mice for the assessment of delay activity in penicillin preparations.

The Antibiotic Section showed the types of small-scale fermenters used for the experimental study of antibiotic production by new mutants of *Penicillium chrysogenum* or by newly isolated organisms. These included revolving tubes, shaker flasks, and larger fermenters. Methods of isolation and study of new organisms were displayed, as also were the biochemical studies carried out on the cultures during fermentations.

In the Bio-Assay Division, demonstrations included the assay of routine batches of insulin using the mouse convulsion method, and the determination of the delay activity exhibited by protamine zinc insulin in rabbits. The use of thermocouples for the determination of the rectal temperature of rabbits in pyrogen tests was shown. Other exhibits included the sulphated ox blood method of heparin assay, the rat 'line test' technique for the estimation of vitamin D and the standardization of posterior pituitary extract using the isolated uterus of the guinea pig.

On June 13 the Group visited the Veterinary Science Division at Thurgarton Priory. Demonstrations were given of the symptomatology and pathology of blackhead infection in turkeys, and methods of producing infection artificially were discussed: the use of artificially infected poults for drug assessment was described. Methods employed for the evaluation of new drugs against the common helminth parasites of domestic animals included a simple *in vivo* screening method using the free-living nematode *Turbatrix aceti*, cultured in serial dilutions of the drug.

A demonstration of work on Johnes disease in cattle included pathological specimens showing massive infection of the tissues. A brief account of the naturally occurring disease was given, and attempts at treatment with streptomycin and thiacetazone were described. A biochemical study of the digestive metabolism of ruminants was discussed. The changes which occur in the leucocyte picture and in certain blood constituents of the ewe in late pregnancy were described, and their possible relation to the adrenocortical hormones was discussed. An account was given of a method of field evaluation of

sheep dips, in which an attractant solution is applied to the skin and wool of sheep at intervals after dipping, and the efficiency determined by the effect on blowflies attempting to oviposit on the wool.

Demonstrations were given of the methods used in the evaluation of disinfectants for dairy use. Disinfectants for hatching eggs were tested on eggs infected on the surface with a *Salmonella* culture. Disinfectants for dairy utensils were assessed by their effect on plate counts on standard metal strips infected with cultures suspended in milk. Field trials of dairy disinfectants under working conditions were described.

The meeting ended with a short scientific session at which papers by Dr. G. F. Somers on "The Assay of Adrenaline in Creams", and by Dr. P. W. Muggleton on "The Standardization of Pertussis Vaccine" were read and discussed. The chairman of the Group, Dr. H. O. J. Collier, expressed the appreciation of the members to Mr. W. A. Broom and his colleagues for organizing the meeting.

## TRANSPARENT CONDUCTING FILMS OF GOLD

IN an article in *Nature* describing recent work in the Light Division of the National Physical Laboratory, Teddington, on methods of producing transparent electrically conducting films on glass, the films then mentioned were oxide films; and, although the conductivity of some, especially tin oxide, had been abnormally enhanced by special treatment, the *modus operandi* is not yet fully understood. One object of the work was to provide means for heating the glass electrically; but it was noted that the resistance of the films was rather high, making necessary the use of voltages of some hundreds for the effective de-icing of coated aircraft windows in adverse conditions.

A further investigation has rapidly followed this, by the same workers, and with the same practical aim. The results are noteworthy because they touch upon a rather different field of research. It has long been known that metallic films, made by no matter what process, almost always have a much greater resistivity than the bulk metal, even after allowance for an expected increase due to the thinness of the films. This discrepancy between observed and predicted resistivities is assignable to the difference between the granular or non-coherent structure of the actual films, and the homogeneous plane-parallel model assumed in the theory.

The starting-point of the new investigation was a study of the influence which the condition and material of the substrate might have upon the properties of superposed gold films. For example, a gold film laid down on glass cleaned with dry precipitated chalk was found to have a resistivity less than half that of similar films on glass cleaned by more ordinary methods, while the colour of the film was a dull yellowish-green instead of the familiar bluish-green. These experiments were made with gold films about 70 Å. in thickness, laid down under strictly controlled conditions by cathodic sputtering. Similar films were then laid down on glass freshly coated with substrate films of various oxides, also made by sputtering. In some such cases, especially with substrates of the oxides of cadmium, lead, bismuth and zinc, the properties of the gold film were even

more strongly modified. Films on zinc oxide were always blue, with almost infinite resistance. Films 70 Å in thickness (on a weight-bulk density basis) on bismuth oxide were, however, of a pale-straw colour, and had a resistance of about 15 ohms between opposite edges of a square sample. The transmission factor for white light was about 70 per cent. On heating such a sample to 200° C. for a few minutes the colour became paler still, the transmission factor rose to about 73 per cent, and the resistance dropped to about 10 ohms. Moreover, these results were very closely reproducible from sample to sample. For comparison, it is to be noted that a similar film on glass cleaned by ordinary methods would be blue-green in colour, and have a transmission of about 65 per cent and resistance of unpredictable value in a range of roughly 80–200 ohms.

It is further of interest to note that, with these films of gold on a substrate of oxide, the transmission can be further enhanced by using various methods analogous to 'blooming'.

For the moment, the structure of the highly conducting films is a matter of speculation but is being immediately investigated. It is, however, remarkable that the resistance value obtained is very close to the theoretical value for a plane-parallel lamina having the same weight of gold per unit area as the actual film. It seems also that the low optical absorption may be consistent with the optical constants for gold in bulk, with some form of 'thinness' correction, though this has not yet been fully investigated.

Whatever film-structure may be revealed by further examination, this work appears to offer an interesting new field for the study of surface forces and states, as well as providing for practical applications a transparent film of a novel type and exceptionally low resistance. It is understood that the Ministry of Supply, for which the research is being undertaken by the National Physical Laboratory, is actively engaged in studying the problems of producing and using windows having a coating of this double-layer film.

<sup>1</sup>*Nature*, 169, 829 (1952).

## HOMING ABILITY IN BIRDS

A RECENT issue of *Ibis* contains two important articles on the direction-finding abilities of birds (94, No. 2).

In the first article G. V. T. Matthews describes an extensive series of homing experiments carried out with 249 lesser black-backed gulls (migratory species) and 91 herring gulls (a restricted nomad), together with twenty other sea birds. On release the lesser black-backed gulls showed a significant homeward orientation which was absent when the sun was obscured by clouds; some direct evidence and an analysis of the homing success indicated that a large proportion of the gulls were homing by an inefficient method, probably random exploration for known visual landmarks. A minority, however, were homing by a method not dependent on the distance or area of release, the orientation behaviour suggesting some form of sun navigation. The herring gulls showed a much lesser ability to 'home', and this could be explained by there being a much smaller proportion of able navigators among them. Matthews also carried out experiments in which the earth's magnetic field was masked by airborne magnets; this in no way affected homing ability.

In the second article Gustav Kramer describes experiments carried out with starlings and homing pigeons. The starling's ability to reproduce constant compass directions was demonstrated in two ways: first, by using migratory activity as an indicator, the bird tending to take up a constant direction; second, by training the birds to choose one of several (up to twelve) feeders symmetrically distributed around the cage. If the incidence of light were changed by use of a mirror arrangement the direction chosen by the bird changed correspondingly. The sun was shown to be a governing factor, the orientation faculty (in experimental conditions) vanishing if the sun were hidden. The correct direction was reproduced regardless of the time of day.

Experiments with homing pigeons showed that these birds were able to home over an unknown stretch of two hundred miles. Some sort of astronomical navigation is suggested by the fact that the pigeons seemed to be orientated even before starting. Apart from this orientation method direction, learning could be produced by training the pigeons along one homing line; by displacing the bird sideways they are misled, this being taken as the test of direction learning.

Like starlings, pigeons were trained to choose food from a definite direction under experimental conditions, and here again the sun was the physical clue for orientation.

## BRITISH COAL UTILIZATION RESEARCH ASSOCIATION

REPORT FOR 1951

WITH an annual fuel crisis tending to become an accepted feature of British life, means of increasing the output of coal from all indigenous sources have been widely publicized and implemented, so that coal production has been rising steadily during recent years. The nation's fuel problem remains, however, for coal consumption has also increased, so that now a gap exists between demand and supply which will doubtless widen unless and until coal is used more wisely and far more efficiently than at present. It is gratifying to note, therefore, that the resources of the British Coal Utilization Research Association are being devoted to bringing "in our time" a real improvement in the efficiency of using coal in all its conditions of availability.

Progress towards that aim is described in the annual report of the Association\*, which was presented by the president, Sir Charles Ellis, to the annual general meeting on May 7. The many investigations being pursued include a new method of conditioning slurry, the automatic control of coal-fired gas producers, the reduction of smoke from domestic open fires, and the use of coal for chemical purposes.

Several million tons of wet coal slurry are produced each year in colliery washeries. As produced, the slurry is a water-logged aggregate which, even after dewatering, is too finely divided to burn satisfactorily. If it could be converted into a usable form, however, this material would make a substantial contribution to the nation's fuel supplies. A pelleting process has

\* British Coal Utilization Research Association: Annual Report for 1951. Pp. 52. (Leatherhead: the Association, 1952.)