

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.

¹ *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.)

now been devised in which the slurry, pre-treated to form a wet mud, is first broken up and then agglomerated into spherical particles of either $\frac{3}{8}$ – $\frac{1}{4}$ in. or $\frac{1}{4}$ – $\frac{1}{2}$ in. diameter. The pelleting device is simple; the pellets themselves, when dried, are strong enough to withstand moderate handling, and have been burnt successfully on a mechanical stoker plant and do not disintegrate in the fuel bed of a gas producer.

The work on the automatic control of gas producers is aimed at improving practice in respect of the coal-fired producer so that coal may compete more favourably with imported oil as a fuel for the steel and glass industries. Two systems of control of the coal feed to gas producers have now been developed which maintain, under conditions of variable load, a constant quality of the gas. In one, which is recommended for use in steelworks, the rate of coal feed is linked directly to the rate of air feed to the producer. In the other, which is simpler, the controller is operated by the gas off-take temperature, and is to be preferred for use in the glass industry. A recent development of the former system is the use of blast steam pressure as the main controlling variable instead of air flow.

The ever-present problem of smoke emission is being studied in four different ways, namely: an investigation of the factors affecting the release of smoke from burning coal; the destruction of tar vapours in smoke; the possibility of reducing smoke formation by chemical pre-treatment of coal; and reduction of smoke by modified appliance design. Work on the first three problems is still in its early stages. Modifications to the design of domestic open fires have led to reduced smoke emission, but only under such rigid control as cannot yet be obtained under normal home conditions.

Although the work of the Association is concerned primarily and inevitably with the use of coal as a fuel, the possibility of coal replacing oil as a source of essential chemical substances in the future has not been overlooked, and a first method of attack by solvent treatment is being made.

The work of the Association as a whole must be regarded as of great value to a country the economy of which is based on coal, and it is to be hoped that circumstances will permit of its future expansion and acceleration.

WILD LIFE IN ARABIA

OPEN plains, scorching and shadeless during the summer, windswept and freezing during the winter night, present a hard environment. Yet up to the beginning of the present century an interesting assemblage of animals existed in the Arabian desert. Even when modern rifles came into general use the species held their own to a satisfactory extent. But the last decade has witnessed the advent of a mechanized predator, the 'jeep', and, according to a recent article by Desmond Foster-Vesey-Fitzgerald, it cannot be long before motorized hunting parties will sweep Arabia's fauna away (*Oryx*, 1, No. 5; April 1952).

It may be of value, therefore, to record the status of some of the more interesting animals during recent years. The Arabian oryx is now extinct in the northern sands of the Great Nafud. Some interesting pictures of this species have been scratched by idle shepherds on sandstone outcrops in the vicinity of Hail. In the southern sands of the Rub Al Khali the oryx still exists.

Three species of gazelle are still widespread and reasonably numerous. The northernmost species is Loder's gazelle, the 'rhim' or the Arab (*Gazella leptoceros marica*), which inhabits the gravel plains, limestone plateaux and sands of Central Arabia. This is a gazelle of the steppe where perennial dwarf shrubs are supplemented by abundant annual herbage following winter rains. It is a stocky, whitish animal which congregates in large flocks composed of fifty to a hundred individuals. It has not been observed to leap or bound like the other species, but travels nevertheless at a deceptively fast speed. The 'rhim' is the only species found on the northern gravel plains and along the fringes of the central Arabian sands, being especially abundant on the Bisaita plain and Teisiya plateau. It extends southwards into the tropic, where it has been observed congregating with the other species.

The other two species, the dorcas gazelle (*Gazella dorcas saudiya*) and the Arabian gazelle (*Gazella gazella arabica*) are both graceful reddish animals which leap and bound in a manner quite unlike the 'rhim'.

The dorcas gazelle or 'afri' appears to be confined to those parts of the interior of the peninsula where *Acacia* grows. It ranges widely over the great gravel plains which lie to the east of the Hejaz mountains but is only encountered in very small parties or alone.

The Arabian gazelle or 'idmi' is also a gazelle of *Acacia* country and appears to be the common species of the coastal plains. But it also occurs on the highland plains of the interior with the dorcas gazelle and is, in fact, the commonest species in all the country to the east of Taif.

Gazelle in Arabia never drink and they are able to exist without green herbage or dew. It must be presumed that the necessary moisture for their welfare is obtained from buds of perennial plants which, although encased within dry scales during drought periods, remain viable and ready to burst as soon as rains fall. Probably the most important plant in this category for the 'rhim' is the dwarf shrub *Rhanterium eppaposum*, and for the other species the various kinds of *Acacia*.

The ibex exists in Arabia where a suitable habitat occurs. Such places include the sandstone gorges around Medain Saleh in the Hejaz, the basalt ranges of the Jebel Shammar around Hail, and the drier mountains of Dhofar in Southern Arabia.

The wolf (*Canis lupus* var.) is still fairly common in Central Arabia, especially in the limestone country where springs are frequent and caverns provide suitable dens. The striped hyena is widespread but nowhere common, although tracks are often seen on the Red Sea coastal plains.

The leopard is rare but exists in the Red Sea hills south of Jedda, where baboons are plentiful, and also in the more generously wooded hills of Dhofar.

In Arabia the ostrich is extinct, although it would appear that these birds existed in some numbers over the open gravel plains of the Bisaita in North-Western Saudi Arabia until about twenty years ago. During the 1930's there was a big massacre in order to obtain plumes; but a few survivors lingered on until about 1944, when the last were killed. In south-eastern Arabia the ostrich became extinct about sixty years ago; but fragments of egg-shell can still be quite frequently found in the Bainuna country between the base of the Qatar peninsula and the Trucial coast.