or bearing of bronze where one metal part moved in close contact with another. Later on, other alloys of tin provided still better bearing metals, and nowadays some of them contain more than 80 per cent of tin.

Many uses have been found for compounds of tin, as, for example, in producing rose tints for ceramic decoration, the white background for majolica and delft, the glaze of modern sanitary fittings, and the enamel of refrigerators, thus adapting to modern requirements a practice dating back at least to Babylonian times.

The foregoing notes show that a heterogeneous collection need not of necessity be haphazard, for with specimens ranging from part of a Roman pump to an electric kettle, and photographs ranging from Egyptian tomb-pictures to a pea-cannery, it is possible to complement the more usual kind of museum exhibit, based upon a desire to separate things which belong to different ages, or were put to different uses. This aspect of the exhibition can be illustrated by reference to one section only, that relating to bronze: approach from an archæological point of view leads to exhibits showing the kinds of implements that Bronze Age man could make, how they were related in time, and how they became more and more efficient, particularly in the direction of better fixture to their hafts: here the museum story usually ends, for iron superseded bronze, and Iron Age cultures demand consideration, and that there is any connexion between the palstave and a machine-component cast in bronze does not appear.

When, however, we add to the archæological information what modern methods of examination have taught us about the properties of alloys, we realize that the improvements in early implements ran concurrently with man's increasing knowledge of the materials he used; we connect up the oldest of metallurgical practice with the newest of metallurgical theory and research, and in our stride we can take in all the things for which the varieties of bronze have been employed—bells and guns, statuary and friezes, measures and machine-parts, and even the wire cloth on which paper is made.

We find that although the modern foundryman can deal with tons whereas his predecessor could only handle pounds, the principles on which he works are just the same. Bronze Age man discovered the principles of all the methods of casting that are used to-day, and learned to make metal reproductions of his moulds that could be used again and again, thus speeding up production and ensuring uniformity of results. Nowadays permanent moulds are made of steel, not bronze, and powerful machines force the molten metal into cavities more complicated than the old-time workers either needed or could have made; nowadays we call it die-casting, but the principle is the same, and so are the advantages claimed—speed of production and uniformity of result.

The experiment seems to have justified itself because the archæologically minded visitor, caring little for modern machinery, has discovered that in his ancient bronzes he has the beginnings of a story that is still in the process of writing; and the engineer, not a whit interested in axes and palstaves, has found that when he tries out a new method for 'babbitting' a connecting rod, he is contributing to a story of which the opening chapters belong to a period so remote that they have to be reconstructed, not read.

An exhibition like this shows how arbitrary are the conventional dividing lines between cultural and academic studies on one hand, and science and industry on the other, and how unsubstantial are the lesser dividing lines within these groups. Material that one would expect to see in a 'trade show' is displayed in the same gallery, and often in the same case as the 'cultural' objects normally associated with a museum, but there is no apparent incongruity either in the arrangement of the specimens, or in the ideas they are intended to suggest.

Taking a dictionary definition of culture as "a state of intellectual and artistic development", it would seem that museums can do much to show culture what it owes to industry, and, by illustrating the methods and results of industrial research (not merely the products of industry), to show that industry is itself specialized culture, for as Pope once put it, all are, indeed, but parts of one stupendous whole.

EXHIBITION OF PHOTOGRAPHY

THE eighty-sixth annual exhibition of the Royal Photographic Society of Great Britain was opened at the Society's Galleries, 16 Princes Gate, S.W.7, on September 5, by the Right Hon. J. T. C. Moore-Brabazon, the Minister of Aircraft Production. This is the second exhibition that has been organized under war-time conditions, and it would be foolish to pretend that it has not suffered in any way.

The Pictorial Section is up to strength, and appears to have maintained its high peace-time standard of quality, and it is gratifying that even this year most of the Dominions and the United States are represented.

The Scientific Section unfortunately suffers from a marked absence of exhibits from abroad. Photography is much used in Great Britain for scientific and industrial purposes, but few examples seem to find their way to the exhibition. It is also regrettable that few university laboratories in the country carry out research directly related to photography, though they certainly make use of it as a tool. In past years exhibits from abroad, such as the illustrations of ultra-high-speed photography of Edgerton and Germeshausen, and illustrations of the use of photography in research on cosmic rays and atomic particles, have been a feature of the Scientific Section. However, apart from these absentees, all branches of the section are represented by exhibits of high standard. There are examples of both low- and high-power photomicrography, the latter being illustrated by two striking examples of diatoms.

The number of exhibits illustrating the use of photography in medical work clearly shows the value of this application of photography. Many of the photographs taken for demonstration purposes are made during the course of surgical operations, and the operator is beset with many difficulties, such as obtaining sufficient light and suitable modelling to show up the desired features without interfering with the course of the operation. Other examples show

the value of the combination of a schematic diagram of an organ and actual photographs of the object. The use of infra-red photography for rendering fine detail of structure in relatively thick sections of fossil stems of plants is illustrated by a number of examples.

Radiographs are well represented, the subjects being mainly of medical interest. The Rodman Medal, which is awarded for the best exhibit of a non-pictorial nature with special reference to radiography or photomicrography, has been given to R. M. Leman for his "Radiograph of Arum Lily" and "Radiograph of Larch". These were presumably taken with soft X-rays, and a relief effect has been obtained possibly by combining a positive and a negative of different contrasts and slightly out of register. The effect is certainly very pleasing from a pictorial point of view.

The remainder of the Scientific and Technical Section consists of a number of exhibits grouped under the name of "Survey and Record Photography". These are largely records of carvings, interiors of churches, etc., of which there are some excellent examples to be seen, and in these times such records assume a greater importance. The outstanding example of record work is the series of ten photographs, by H. Bedford Lemere, of famous London buildings, most of which have been seriously damaged by enemy action within the last twelve months. This exhibit has gained the Hood Medal. The Natural History Section is well filled and contains examples of all kinds, botanical, birds in their natural habitats (always a popular subject), and mammals, mainly feline, photographed in captivity. Natural history photography attracts a number of amateurs who master the technique of photography in order to apply it to their hobby. The pictorialist enjoys his search for good composition; the photographer of Nature gets his excitement in another way, an excitement akin to that of the hunter. There is a photograph of the grey hare appearing out of a burrow set in trackless wastes of snow, and one can imagine the preparation and care necessary to obtain such a photograph.

The Colour Photography Section has suffered seriously this year, which is scarcely surprising, considering the difficulty of obtaining colour film. The transparencies are chiefly taken with miniature cameras on Kodachrome, Dufaycolor and Agfacolor films, while the colour prints on paper are reduced to six examples, three each on Wash-off Relief and Tritone. The lantern slide exhibit is mainly confined to natural history subjects, and both these and the purely 'pictorial' slides are well worth seeing. The slides are mounted in viewing boxes in a darkened room, and clearly illustrate the advantage of the transparency over the paper print due to the greater range of tones that can be reproduced by the former.

In the opinion of many, the most effective photographic reproductions are to be seen in the stereoscopic section, which contains some hundred transparencies, of which about half are in colour. The combination of the extended tone reproduction of the transparency with the stereoscopic effect, and in some cases colour, can produce a realism that may not satisfy the modern pictorialist, but can be very attractive to those who like to see things as they are.

The Exhibition as a whole, which is open to the public daily (except Sunday) from 10 a.m. until 5 p.m. until October 25, is well worth a visit. Though there are some notable absentees among the regular exhibitors, the Ministry of Information has supplied a series of more than a hundred British official photographs illustrating some applications of photography in depicting various phases of the Navy, the Army, the Air Force, in the manufacture of munitions, in home defence, and for propaganda and Press purposes.

LIGHTNING OVER-VOLTAGES IN UNDERGROUND CABLES

THE occurrence of lightning over-voltages on underground cables is ordinarily supposed to be impossible except when a cable is connected to an overhead line. In this case surges initiated in the latter may be propagated into the cable. In a recent paper by Dr. H. Einhorn and Prof. Goodlet of the University of Cape Town*, new facts are adduced which prove that the ordinary opinion is untenable. They describe some curious faults on underground telephone cables experienced during the lightning season in the vicinity of Johannesburg which cannot be explained in the general way. Briefly described, breakdowns occurred between the outer cores and the lead sheath and armouring of telephone cables buried to depths up to three feet in dry sandy soil. All the faults occurred during the lightning season, and faults were most frequent in the worst storm areas traversed by the cables.

In one case voltages up to 1,000 volts were measured (by electrostatic voltmeter) between cable-end and earth during a storm. The faults could therefore with certainty be ascribed to lightning; the potential of the cable sheath must in some manner become raised relative to the cable cores. The problem the authors set themselves is to find out how this occurred and investigate possible remedies.

Direct strokes to earth are first considered. If a lightning flash of current I strikes an overhead conductor of surge impedance Z somewhere in a span, a travelling wave of amplitude $\frac{1}{2}ZI$ is propagated along the line in both directions away from the fault. Our knowledge of the propagation of electric disturbances along bare buried conductors is not extensive but is sufficient to allow us to picture events as happening in a similar manner, modified by the considerable leakage into the ground. Tests indicate that if an impulse voltage is suddenly impressed upon a long buried conductor the "effective surge impedance" (defined as the ratio of instantaneous voltage to instantaneous current) will fall from an initial maximum value of the order of 100 ohms down to the ohmic earth resistance of the conductor.

The attenuation of waves along uninsulated buried conductors is very rapid, being usually complete in a distance of less than 100 m., so that reflexion pheno-

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