priate to barium titanate where the field in which the ion moves is anharmonic. The former gives with temperature a rapid change of χ, the reciprocal susceptibility or dielectric stiffness, while the latter gives a small change. Thus, the respective values of $\partial\chi/\partial T$ are 28·0 and 0·75. The Mason model for Rochelle salt was also considered. Here two sets of ions moving in unsymmetrical fields provide, as required for this material, a polar state stable only between two temperatures. A model for anti-ferroelectricity might be built on similar lines.

Both sessions were terminated by general discussions, Dr. Matthias presiding on the first day and C. G. Garton (Electrical Research Association) on the second. The subjects at both discussions were the practical uses of barium titanate crystals, with particular emphasis on digital storage. The fundamentals of storage and methods of investigation were described. Dr. Matthias said that the Bell Laboratories are concentrating on investigations into the serious deterioration in polarization properties caused by the protracted application of unbalanced pulse trains. Mr. Oxbrow said the deterioration is amplitude-dependent and is serious only if pulse amplitudes of the order of the coercive field are used. I. Carter (Ferranti, Ltd.) reported that, after the decay, a low-frequency property, sufficient storage effect exists for high-speed operation. Also, the initial state can be restored by periodic application of a small d.c. bias. Dr. A. Robinson (Ferranti, Ltd.) compared the merits of dielectric and ferrite storage. The advantages of barium titanate storage are compactness and a more convenient impedance for use in valve circuitry. Ferrite storage has the advantages of a more advanced state of development and, although offset by clumsiness, the versatility of variable 'turns-ratio' coupling. Very recent experiments with barium titanate indicate polarization times as low as 0·5 μsec., so that it might permit greater speeds of operation than ferrite.

A. C. Lynch (General Post Office) said that confirmation by Merz[1] that 180° walls do not move laterally has removed the fear that the polarizations of adjacent crystal areas might interfere. B. de Ferranti (General Electric Co., Ltd.) suggested that the non-linear characteristic of barium titanate capacitance versus field should be used in a dielectric amplifier. This would necessitate further investigation of noise in ceramics and single crystals. I. Ross (Services Electronics Research Laboratory) mentioned a possible use in infra-red switching, provided that the change in the 45° laminar domains is adequately fast. Measurements have been made of the infra-red transmission of one of the Bell crystals.

C. F. Oxbrow

[1] Merz, W. J., *Phys. Rev.*, **95**, 690 (1954).
[2] Remeika, J. P., *J. Amer. Chem. Soc.*, **76**, 940 (1954).

SHIFT WORK IN INDUSTRY

THE Institute of Personnel Management (2–10 Hill Street, London, W.1) has issued a broadsheet surveying the issues which affect the application of shift systems in industry. The broadsheet has been prepared by F. P. Cook, of Courtaulds, Ltd., but is based upon information obtained from a large number of different industries.

Among the conclusions brought out in the survey is that the economic advantages of shift work are greatest where capital charges and overheads are high in relation to labour costs. The greater the proportion of the total cost of production that is occupied by labour costs, the less the economic advantages of shift work become. When shift work is first introduced in a discontinuous process where employment has previously been on day work, the double-day shift system is probably the most advantageous for all concerned—for management because it is a second shift which offers the greatest alleviation to fixed charges, and for employees because the physical and social disadvantages are much less than those of shift systems which involve night work. The appeal of shift work to employees depends largely on how attractive it is made financially. Although it is only one factor, shift work can prove a sound economic way of meeting the natural urge towards shorter hours of work and higher earnings.

Quite apart from the ballot which is usually required by law before women and young persons can be employed on double day-shift work, the investigations show that full explanation and consultation are needed before any successful shift system can be introduced. Of all shift systems, those involving night work are most likely to have a deleterious effect on health; this is especially applicable to systems which involve permanent night work. Any unfortunate effects will vary with individuals, the nature and hours of their work, and their habits outside the factory, so that it would be hard to establish a general rule, even if more evidence were available. For most employees, shift work involves a balancing of material gain against social loss; thus, in pursuing the possible economic advantages of the extension of shift work, which can only be a gradual process, those in authority must take the possible social drawbacks into account.

Mr. Cook concludes that one of the temptations of these complicated times is to over-simplify, and this is typified by the search for the single solution to any problem. In personnel management, recent years have seen the fashionable development of joint consultation, job evaluation, communications, financial incentives, financial enlightenment, merit rating of management development, and work study. Despite the creation of much pseudo-technical supporting jargon, not one of these is a cure-all by itself, and together they can be no more than further aids to the vastly complicated business of modern industrial management. The extension of shift work will not alone revive the fortunes of a nation or concern; but, in the right circumstances, it can help.

FORESTRY COMMISSION

REPORT FOR THE YEAR 1952–53

IN the operations of the Forestry Commission during the year 1952–53*, economy in spending was a guiding factor in deciding the programme of work. In order to carry out the expanding programme of planting and thinnings in the young plantations with the funds available, it was necessary to postpone work such as building new houses and new roads. Many of the forest services of the British

* Forestry Commission. Thirty-fourth Annual Report of the Forestry Commissioners for the Year ended September 30th, 1953. Pp. 84. (London: H.M.S.O, 1954.) 3s. net.

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Commonwealth have found themselves in this predicament, which is by no means a new one. The rate of acquisition of land is still giving the Commission concern. The net additions of the past two years including acquired plantations have been substantially less than the areas planted. In 1951–52 they were less by eight thousand acres; this year by fourteen thousand acres. The total area of land acquired at September 30, 1953, was 1,909,400 acres. This comprised 1,181,400 acres classed as "Forest Land", which is either already planted or will be in due course, and 728,000 of "Other Land", which includes nurseries, rough grazing and agricultural land and other land unsuitable for planting. Twenty-six new forests were started during the year, nineteen in England, two in Scotland and five in Wales. The area planted was 67,610 acres, exceeding 1951–52 by almost six thousand acres. More than 118 million trees were used for the plantations and for replacing failures in recently planted ones. Fire damage was not high during the year.

The dedication scheme pursues its somewhat chequered course, dedication deeds being completed on 227 estates covering a total of 76,810 acres of woodland while another 139,730 acres of woodlands are in an advanced state of preparation; the total area thus approached a quarter of a million acres at the end of the year under review. It might be suggested as a matter for consideration, and to allay the difficulties of acquiring land, whether the Commission could not be advised to lay down a fixed minimum of land considered essential to be managed as State Forest and trust the private proprietor, with the Commission's advice and help where necessary, to work up to the balance of forest considered to be necessary for the requirements and protection of the population. France furnishes a good example. A considerable percentage of the French forests are privately owned and well managed. A question was once put to a senior French conservator of forests on the management of certain privately owned forests and whether the conservator ever gave advice, as they had a common boundary with the Government forests. He replied the private owner knew as much about forest management as he did. It may be concluded that British forest proprietors may in time attain as a body the same equality of knowledge as their French opposite numbers.

E. P. Stebbing

MANUFACTURE OF THE TEN-TOLA PRIMARY STANDARD WEIGHT FOR PAKISTAN

By Dr. G. F. Hodsman

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THE first primary standard of mass to be produced commercially in Britain for many years, the ten-tola primary standard for the Karachi Mint, Pakistan, has recently been completed by L. Oertling, Ltd., in conjunction with Johnson, Matthey and Co., Ltd. (see *Nature*, August 14, p. 206). The standard of mass has been prepared to an exacting specification for the Pakistan Government, and its manufacture involved a number of special problems which are of general interest, especially to those concerned with precision weighing.

In order that a self-consistent system of weights can be established throughout the world, weights must be related through individual manufacturers' standards to some recognized ultimate standard of mass. It is not yet possible to rely on any natural phenomenon for such a standard, as is possible, for example, with length, which can be related to wavelengths of light. Recourse must of necessity be made to the mass of an actual piece of material, which in the case of metric weights is the International Kilogramme, located at the Bureau International des Poids et Mesures at Sèvres, near Paris. Most countries, including Britain, have primary standards of mass, which form the basis of their own weight system, the primary standard in Britain being the Imperial Pound. The weight system in Pakistan is based on the tola, which is defined as 180 grains (7,000 grains equals one imperial pound); the recently completed primary standard of 10 tolas thus has a mass of 1,800 grains (about 120 gm.).

A satisfactory primary standard must fulfil a number of requirements, the most important of which is stability, and its construction must be such as to ensure constancy and reliability of mass over a period of many years. The Imperial Pound, for example, is believed to have remained constant within one part in five million during the past seventy years. It is the achieving of this stability which presents the manufacturer with some of his most difficult problems.

The primary standard should be as near its nominal mass as is reasonably possible in order to avoid the difficulties surrounding the use of small 'make-weights' when comparing the standard with sub-standards. The standard should also be of reasonable size in relation to the sub-multiples and multiples in common use. For this reason, the 10 tola has been chosen as the primary standard as being a better intermediate value than 1 tola, which would involve difficulties in standardizing large multiples.

The Pakistan standard is made from an alloy containing 90 per cent platinum and 10 per cent iridium—an alloy which experience has shown to be exceptionally stable and durable. Since both these metals have a high density, the weight occupies a small volume and consequently has a small surface area, which also enhances stability. The density of the weight must not be less than 21·50 gm./ml. at 20° C. to ensure that it is sufficiently free from cavities and inclusions, which might affect its stability.

The alloy billet was forged by the firm of Johnson, Matthey and Co., Ltd., in Hatton Garden, London, and was subjected to gamma-ray examination to reveal any major internal defect. It was then roughly turned and polished and subjected to a density determination by the National Physical Laboratory at Teddington. The billet used for the weight was free from all inclusions and achieved a density of 21·54 gm./ml., which indicates a high degree of freedom from inclusions.

The shape of the final weight is a simple cylinder with a height and diameter of approximately one inch, the under-surface being relieved over its central portion, to provide an annular seating for the weight and to minimize the risk of foreign matter adhering to the under-surface when the weight is in use.

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