occurred intermittently, it was difficult to define the duration of the ablation season.

Daily measurements of ablation and accumulation are of greater interest to the meteorologist, and the usual methods of measurement are subject to many errors. The ablation is frequently measured by the lowering of the surface relative to a stake sunk in the snow, and the change in level is multiplied by a density to give the ablation in, say, inches of water. But the surface can settle for a variety of reasons. Compaction can occur without ablation, melt water descending through subsurface snow can cause compaction beneath a frozen snow surface and radiation can cause melting below the surface. Furthermore, the snow density varies irregularly with depth. Constant watching of the snow and the weather cannot eliminate all sources of error. In the accumulation area of a glacier during the melting season, the total mass of ice and water can be measured by sampling every snow layer from a pit dug to a suitable reference level. The density of each sample and the thickness of each layer are measured and their products summed up. That task may easily take a full day's work. The water content of all the samples can be measured by calorimetry, but it is an impossible task in a deep profile.

These are the methods of measurement available at present, and there is a pressing need to develop a simple field-method of recording separately the total masses of water and ice in a melting snow profile.

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TESTING OF METALS BY OPTICAL METHODS

ON January 13 a symposium, at which there were some sixty participants, was held at the Institute of Physics, London, on "The Possible Uses of Surface Methods as a Means of Testing Metals (with Special Reference to Optical Methods)". This was sponsored by the Non-Destructive Testing Group of the Institute of Physics, and it was to be understood that only non-destructive methods were to be discussed. The symposium was opened by Prof. S. Tolansky, of the Royal Holloway College, University of London, Dr. O. S. Heavens, of the University of Reading, and Dr. R. W. B. Stephens, of the Imperial College of Science and Technology, University of London, who each in turn gave a half-hour discourse on selected topics, after which the meeting was thrown open to general discussion. The chair was occupied by Dr. J. Thewlis.

In an introductory survey, illustrated by some forty slides, Prof. Tolansky selected as typical subjects for examination some of his own studies on the optical testing of surface finish, of microtopography in general, the examination of micro-hardness and directional hardness, the character of electrodeposits and the examination of machined metal surfaces. Attention was devoted to five different methods of approach which he uses for the study of surface structure. There is first two-beam interferometry, which is capable of extensive application; then, for increased precision, indeed reaching down to structural features the heights of which approach crystal lattice dimensions, there is multiple-beam interferometry in a variety of forms, examples of which were shown. It was stressed that the great resolutions attainable are only in the height–depth dimension and not in extension across the surface. Experiments revealing the perfection of contour of the silver layers used in multiple-beam interferometry were described. The light-profile microscope was then illustrated, and it was emphasized that this has very obvious metallurgical applications, some of which were shown. The advantage of this system is that it is capable of resolving an elementary cube of side (roughly) half a light-wave. Thus in effect a useful magnification of about a thousand is available in three dimensions, and this is of much value in many problems. A simple optical shadow-casting technique was then described and possible applications discussed.

Finally, a review was included of a critical experimental examination intended to test the validity of the method of total reflexion advocated for the exploration of engineering bearing surfaces. In this, a hypotenuse of a right-angled prism is pressed on to the surface and at the points of contact total reflexion is interfered with, revealing thus a dark pattern. Some difficulties in interpretation were discussed.

Dr. Heavens then reviewed the development of recent studies of surface reflectivity and of the assessment of surface films and oxide films on metals. He pointed out that electromagnetic theory enables the optical constants of a material to be deduced from observations on light reflected from a surface. The theory is simple for the ideal theoretical case of a plane boundary separating homogeneous, isotropic regions. Thus accurate experiments can yield information on the nature of a real surface from the difference between such observations and the computations of the theory for the ideal case. In the case of transparent materials, the presence of a transition layer at the surface is revealed by a gradual, rather than abrupt, differential phase-change in the light reflected from the surface. For heavily absorbing materials, the optical constants are easily deduced from polarimetric observations. Since the depth of penetration in these cases is a small fraction of a light-wave, then these observations yield information about the surface layers only and cannot easily be adapted to the problem of examining the bulk properties. Simple criteria exist, however, enabling the homogeneity of the surface layers to be checked.

The problem of examining surface roughness was then discussed by Dr. Heavens. He indicated that this may be tackled by a number of different reflexion methods, according to the scale of the roughness involved. For very rough surfaces (irregularities of many wave-lengths) he described scattering methods as useful. By judicious selection of the wave-length a wide range of roughnesses may be covered. Irregularities of the order of a wave-length may be examined by two-beam interference methods, such as are widely used in the optical industry. Under this heading, the interference microscope, coupled with replica techniques, was mentioned. It was then stressed that for surface roughnesses much smaller than a wave-length there are two notable methods, namely, multiple-beam interferometry which can be applied to a wide range of surfaces, both transparent and absorbing, and, for specialized applications, phase-contrast methods. Both these methods enable a very high resolution normal to the surface to be attained.

Although much information may be obtained by a detailed analysis of the state of light reflected from a surface, methods suitable for non-destructive testing tend to be restricted to those which are reasonably simple to make and to interpret.

The third formal contribution, by Dr. Stephens, was devoted mainly to suggesting future possible extensions of techniques. It was pointed out that, as a general assessment, the application of optical reflexion methods is mainly dependent on the provision of good reflecting surfaces. Since for opaque materials the light-wave penetrates only to depths of the order of a few hundred angstroms, considerable care is necessary to avoid any treatment of the surface which might alter appreciably its physical characteristics as compared with the bulk material. The use of obliquely incident light minimizes the effect of small surface blemishes, and radiation wave-length is another factor at our choice. In testing for a high surface polish, it would be desirable to use the shorter ultra-violet wave-lengths; but when the object is to standardize the material itself, then longer wave-lengths are to be preferred. Dr. Stephens then directed attention to the recent advances in infra-red detectors—the photoconductive cells with their very small time-constants which provide new possibilities in non-destructive testing. Moving farther along the electromagnetic spectrum to the microwave region, the use of these centimetre waves offers an advantage in reflectivity measurements from the aspect of less exacting requirements in surface smoothness, and furthermore, by changing the frequency, the effective depth of penetration can be conveniently varied. Dr. Stephens here emphasized the advantage of such studies over methods using visible light, which are confined effectively to surface layers.

Recent work on the fundamental properties of surface electromagnetic waves has indicated another possible line of approach to the investigation of surface properties. These, Sommerfeld or Zeeneck waves, are attenuated both in the direction of propagation and normally to the surface to an extent dependent on the reactance of the surface, and are thus sensitive to geometrical irregularities and surface composition. Another approach in surface testing which Dr. Stephens thinks may merit attention is to investigate optically the effect of applying a second physical agency to the specimen, for example, a magnetic field, as in the Kerr magneto-optic rotation effect.

The three formal surveys were succeeded by a lively discussion to which many of the audience contributed. An appreciable fraction of the available time was taken up with a discussion of the reliability of replication methods, contributions being made by Dr. J. Thewlis, Miss K. B. Day and also Prof. Tolansky, who expressed the view that he has experimentally established that some materials can be used for making replicates with very high fidelity in extension, but yet simultaneously with appreciable uncertainty in depth. Mr. J. C. Kelly raised the issue of the relative perfection of contour of vacuum-deposited silver and vacuum-deposited dielectric multilayers. This matter received appreciable discussion.

The novel surface-penetrating methods proposed by Dr. Stephens aroused much interest and several queries about such procedures were posed.

Several members present were surprised at the extreme sensitivity of the polarization methods advocated by Dr. Heavens.

It was clear from the vigour of the discussion that the symposium had justified itself and focused attention in a practical way on a wide variety of techniques available to those who must needs examine metals in a non-destructive fashion.

PHOSPHOLIPIDS IN FOODS

A CONFERENCE on recent advances in the knowledge and uses of phospholipids in foods, arranged jointly by the Food Group and the Oils and Fats Group of the Society of Chemical Industry, was held in London during February 9–10 at the Wellcome Research Institution. The opening session, under the chairmanship of Prof. T. P. Hilditch, was concerned with the chemistry and physical chemistry of phospholipids. Papers were presented by Prof. T. Malkin and Dr. B. A. Pethica. The afternoon session, at which Dr. K. A. Williams took the chair, was devoted to consideration of methods of separation. Dr. June Olley described methods of counter-current distribution, and Mr. D. N. Rhodes chromatography. A third paper, on deteriorative changes in food phospholipids, was presented by Dr. C. H. Lea. During the first half of the second day, two papers were presented: one by Dr. J. A. Lovern on phospholipids in fish, and the other by Dr. F. Aylward on plant phospholipids, the chairman being Dr. A. J. Amos. The final session, under the chairmanship of Prof. A. C. Frazer, was also introduced by two papers: Dr. J. N. Hawthorne spoke on animal phospholipids, and Mr. H. H. Hutt on the large-scale production and industrial uses of phospholipids.

The papers were full of interesting information and covered a wide range, from relatively abstruse and detailed chemistry and physical chemistry to technical points concerned with large-scale production. Discussion was lively and varied in each session. It was apparent that things are moving on the chemical side. A wider range of pure synthetic phospholipids is likely to be available in the near future. This should lead to greater and more accurate knowledge of the physical chemical properties of this group of substances. Once this information begins to become available, many fascinating problems in the biological field, especially those associated with the structure and functions of lipoproteins, are likely to open up. The importance of close co-operation between chemists, pharmacologists, biochemists and nutritionalists in this field cannot be over-emphasized.

Work on phospholipids in foods is still in a formative stage, but methods of isolation and identification are rapidly developing. The importance of phospholipids in relation to deteriorative changes in food is well recognized. They may also play an important part in relation to some of the attractive properties of foods that technologists may wish to retain or enhance. This conference concerned itself mainly with the chemical and physical chemical background, with the occurrence of phospholipid in natural