scintillation, observed through a slit covering the objective, on the position-angle of the slit; and the degree of coherence between scintillation in selected frequency-ranges observed in two neighbouring apertures. Dr. W. H. Steavenson (Cambridge) discussed the effects which can be distinguished visually in extrafocal images or when the eye is placed at the focus of the telescope. The 'high seeing' appears as shadow patterns blown at high speed across the aperture, and defocusing experiments indicate an average height of origin of about 10 km. Slower shadow bands originating within a few hundred feet of the telescope can be seen to move with the surface wind. Local dome and tube effects are recognizable by their geometry. In large reflectors, the cooling of the mirror causes disturbances in the thin layer of air at the face of the mirror; these are much more serious than the well-known changes in mirror asphericity and can often be the dominant cause of image spread. Dr. A. Hynek (Ohio State University, Columbus) reported studies of image motion made by Dr. A. G. Wilson at Flagstaff, Arizona. Star-trails recorded on fast-moving film showed the amount of movement, the proportion of the time that the image is sharp, and the occurrence of multiple images. These studies were made with special reference to the design of methods of photographing Mars, and an important conclusion is that at Flagstaff the instantaneous image movement is nearly the same over the whole disk of the planet. Dr. Hynek also reported some very recent work at Ohio State University which included measures of image movement in two colours. If image-spread were an effect of rapid image motion, this might provide a further test of the remark of Hewish and Keller that the red images may be expected sometimes to have a sharper 'core' than the blue.

Dr. B. H. Briggs (Cavendish Laboratory), describing radio observations of the scintillation at neighbouring wave-lengths, said that in the ray-interference approximation the correlation across the spectrum is simply related to the spread in the ray path-lengths between the source and observer. Rapid frequency-change experiments yield records similar to the spectrum-scintillation photographs of Zwicky, and the problems of interpretation are also similar. Dr. E. H. Linfoot (Cambridge Observatories) took up the question of measuring the harm done by bad seeing. Seeing effects reduce the rate at which a given telescope can record information about the sky. The loss can be estimated in terms of the mean transmission factors (sine-wave response factors), which are essentially equal to the mean autocorrelation function of the complex displacement across the aperture. Dr. Linfoot showed how the reduction in information capacity (in Shannon's sense) can be calculated from the statistics of seeing; generally speaking, the loss is of second order when the phase-errors are small. Dr. R. Goody (Imperial College of Science and Technology, London) presented meteorological data on turbulence and convection in the atmosphere. By day, in clear weather, convection is most intense near the ground and falls rapidly throughout the first 1,000 ft. Convection is enhanced over large mountains and islands. A small island should have good daytime seeing, and even a few feet of height above the ground could be beneficial. Aircraft results show inhomogeneities at various heights. A few accelerometer records from balloon flights show increased turbulence near the tropopause, but it is not known whether this is typical. The

northern edge of the jet stream in the northern hemisphere is sometimes very turbulent. Generally, however, the atmosphere is non-adiabatic and is continually being mixed, so that the causes of seeing effects are unlikely to be confined to any narrow range of height.

In the discussion, widely different opinions were expressed about the usefulness of the ray approximation to the Huyghens wave treatment. One view is that ray theory is adequate under suitable conditions for small phase perturbations. It was urged in reply that ray theory is essentially the limit of wave theory as the wave-length becomes very small compared with the relevant geometrical path-differences, so that it is expected to be valid (as in aberration calculations) only for large phase-changes. It was the general opinion that the phase-changes corresponding to good seeing could be of the order of a few radians, but the lack of any specific measurements of this fundamental quantity illustrates how much is still to be learnt. It was pointed out that the combined effect of spatial smoothing by the objective aperture, and temporal smoothing in the electrical filters, would in general make the amount of scintillation recorded photoelectrically dependent on the transverse speed of the shadow bands. Until this is allowed for, it cannot be said whether the observed wind-scintillation correlation represents an actual physical connexion between wind-speed and optical inhomogeneities in the air. Non-isotropic inhomogeneities would necessarily give rise to telescopic images that are not radially symmetrical, although this effect might be masked by disturbances originating at another height. It was suggested that the height of origin of scintillation could be found in principle from the cross-over wave-length in the colour scintillation; from the ratio of phase to brightness-scintillation at different wave-lengths; and by the analogue of the spaced-receiver experiments of Briggs *et al.*, the linear transverse velocity being found from the correlation of scintillation in two apertures and the angular velocity by observations of two neighbouring stars. A plea was made for observations in narrower wave-length ranges.

HUNGARIAN-CZECHOSLOVAK POLAROGRAPHIC CONFERENCE

FOR the first Hungarian-Czechoslovak Polarographic Conference held in Veszprém, Hungary, during August 11-14, seventeen Czechoslovak polarographers, mostly from the Polarographic Institute of the Czechoslovak Academy of Science, were guests of the modern Chemical University in Veszprém at the meeting arranged jointly by the University, the Hungarian Chemical Society and the Hungarian Academy of Science. Prof. J. Heyrovský was the leader of the Czechoslovak delegation; from the Hungarian side, Dr. Polinszky (dean), Dr. Preissich (secretary of the Chemical Society), Dr. Cielešky (chairman of its Polarographic Section), and Prof. Bognár (general secretary of the Hungarian Academy) organized the Conference extremely successfully. The Minister of Education, Prof. Erdely-Grúz, a prominent physico-chemist, was in the chair. At the opening of the Congress, a diploma of honorary fellowship of the Hungarian Academy of Science was presented to Prof. J. Heyrovský, who then delivered an address on the "New Trends in Polarography". Prof. L.

Erdey addressed the general assembly on the "Development of Polarography in Hungary".

The forty-six communications that followed were divided into two parallel sections, one for applications in inorganic analysis, the other for biochemistry and biology. Lectures and discussions were in German, English, French, Hungarian and Slovak. General oscillographic polarography was discussed at a conjoint meeting by J. Heyrovský and quantitative oscillography by R. Kalvoda, who demonstrated their specially constructed cathode-ray oscillographs. As innovations may be mentioned: polarographic estimations of chromatograms (J. Prosz and J. Kis), automatic polarographic analysers of long duration (J. V. A. Novák), streaming of electrolytes induced by alternating currents (J. Dévay), derivative currents obtained by electromagnetic induction (J. Prosz and J. Paulik), deposition of magnesium at the streaming electrode (K. Györbiró, L. Poós and J. Prosz). In the biological section, several communications concerned Brdička's protein test, the determinations of vitamins, oxygen in tissues, alkaloids and many applications in pharmacy and food production, and the study of macromolecules by means of suppression of maxima.

The communications will be published in full in German by the Hungarian Academy of Science in a special volume. Brief abstracts of the papers may be obtained through Dr. E. Bodor, Chemical University, Veszprém, Hungary.

It should be added that Veszprém lies close to the famous Lake Balaton, on the banks of which the delegates enjoyed discussions for several days after the Congress.

J. HEYROVSKÝ

NATIONAL PHYSICAL LABORATORY, TEDDINGTON

REPORT FOR 1954

THE annual report for 1954 of the National Physical Laboratory, Teddington*, consists of the report of the Executive Committee which was presented to the General Board at its meeting during the afternoon of May 20, 1955, the annual open day of the Laboratory (see *Nature*, 175, 1102; 1955), and detailed reports, prepared by the respective superintendents, of the work of the nine divisions and Test House of the Laboratory.

The Executive Committee refers with particular pleasure to the visits of Their Majesties the King and Queen of Sweden on June 29, and of the members of the Royal Commission on the Civil Service on May 12. Other visitors during the year included parties from the Royal Naval College, Greenwich, and delegates from the joint spring meeting of the Institute of Metals with the Société Française de Metallurgie, and from the General Assembly of the International Union of Pure and Applied Physics. A thirty-minute television outside-broadcast directly from the Laboratory took place on June 2, and the work of the Laboratory, with special reference to aerodynamics research, was also described in a schools' broadcast on October 27. In addition, the director of the Laboratory, Sir Edward Bullard, took the leading part in a studio programme, entitled "Power from the Sun", which was broadcast on October 11.

* Department of Scientific and Industrial Research. National Physical Laboratory: Report for the Year 1954. Pp. viii+98+7 plates. (London: H.M.S.O., 1955.) 4s. net.

At the beginning of the annual report, the names of the members of the General Board, the Executive Committee, the Promotions Sub-Committee, the Froude Ship-Research Sub-Committee, and a newly constituted body, the N.P.L. Advisory Committee on Radioactive Standards, are listed. The new Committee formerly existed as an informal body, consisting of representatives of the Atomic Energy Research Establishment, the Radiotherapeutic Research Unit of the Medical Research Council, the Royal Cancer Hospital and the National Physical Laboratory; Dr. B. W. Robinson, superintendent of the Physics Division of the Laboratory, was appointed chairman of the Committee. In order to make the work of the Laboratory better known to industry, two liaison officers were appointed during the year for a three-year period, and it is reported that they have visited thirty-two research associations and have made direct contact with a number of industrial firms. The new building for the Metallurgy Division, which contains the refractories section, the X-ray section and laboratories for work on radioactive tracers, was formally opened by Sir Lawrence Bragg on April 6, and in June a new Division, that of Control Mechanisms and Electronics, was formed by amalgamating the control mechanisms section of the Metrology Division with the Electronics Division. The field of work to be covered by the new Division is a wide and important one, dealing with the automatic control of experimental, industrial and administrative operations and the development techniques and equipment for data-processing and computation; but, at present, work is to be restricted to a continuation of that previously carried out by the two original sections.

The Laboratory took part in several exhibitions of scientific apparatus, including the Physical Society annual exhibition, the Royal Society soirées and a conversation arranged by the Institution of Civil Engineers. Two international symposia were held during the year at the Laboratory, one in May on "Creep and Fracture of Metals at High Temperatures" and the other in November on "Precision Electrical Measurements". The proceedings of the symposium on "Automatic Digital Computers", held in March 1953, and four new booklets, Nos. 5-8, in the series "Notes on Applied Science" were published during the year. In addition, one hundred and forty-six scientific papers were contributed by members of the staff of the Laboratory to various journals and periodicals; lists of these are appended to each detailed divisional report.

The individual reports of the various divisions of the Laboratory indicate the wide range of scientific subjects covered. The Laboratory has, in addition to an extensive research programme, part of which is paid for by other government departments, certain specific responsibilities, including the maintenance of standards and routine test work. It would appear that the programme contains more items than are really desirable, and a reduction in the number in order to enable more rapid progress to be made with the remainder, and perhaps also to commence on a few new urgent items specially appropriate to the Laboratory, is being considered. The Aerodynamics Division has carried out important work on the application of boundary-layer control to the reduction of drag and the increase of lift. Helicopters appeared on the research programme of the Division for the first time, and a twin-rotor model for wind-tunnel tests was being made. Some fundamental work con-