9. COMMISSION DES INSTRUMENTS ASTRONOMIQUES

PRÉSIDENT: Dr G. E. Kron, Lick Observatory, Mount Hamilton, California, U.S.A.

MEMBRES: H. W. Babcock, J. G. Baker, Baum, Bowen, Brahde, Code, Couder, Danjon, Dimitroff, Dunham, J. W. Evans, Fellgett, Gottlieb, J. S. Hall, Hiltner, Lallemand, Linfoot, Linnik, McMath, Maksutov, Meinel, Melnikov, Monin, Platzeck, Rösch, Sisson, Sukharev, Väisälä, Walraven.

La Commission a deux Sous-Commissions: 9*a*, 9*b*

PROGRESS IN INSTRUMENTATION

Leiden Southern Station. T. Walraven reports that a new 36-inch reflecting telescope was constructed with automatic setting for rapid photo-electric work. Optics were made by Pearson at the Yerkes Observatory, mounting by Rademakers in Rotterdam, and electrical fittings by the Leiden Observatory. The telescope is fitted with an ingeniously contrived photo-electric spectrophotometer already described (Walraven, T. and J. H., *B.A.N.* **15**, 68, 1960).

Sacramento Peak Observatory. J. Evans reports that two new instruments are in use here. (1) A new 16-inch quartz coelostat with a 12-inch apochromatic lens for feeding light to any one of several instruments. (2) A 13-meter spectrograph with a double-pass optical system, in which the grating is used twice. Since the spectrograph acts as a double monochromator, scattered light is below the detection level of about 0·1%.

Astronomical Observatory of the University of Oporto. P. de Barros reports that he is building a transit instrument so designed as to be free of flexure, and free of pivot errors. The instrument also has practically constant collimation.

Mount Stromlo Observatory. T. Dunham, Jr., reports that the coudé spectrograph of his design is in service on the 74-inch telescope. The spectrograph frame, in contrast with previous conventional design, is on edge, thus giving it great stiffness in the direction of gravity flexure. At the latitude of Canberra (Mount Stromlo), this arrangement results in the cameras being mounted very conveniently on an almost horizontal optical bench. An off-axis collimating mirror, well below the level of the ground, will send a 16-inch beam to a multiple grating. At present, a shorter-focus collimator is used to send a 6·8-inch beam to a single grating. Gratings available so far are a 600 grooves per mm, blazed second order yellow grating ruled by Babcock with an area 6·0 inches × 7·5 inches, and a 6 × 8-inch Bausch and Lomb grating with similar ruling but blazed in the infra-red. Bausch and Lomb will supply a quadruple replica mosaic. Cameras are of 8, 21, 48, and 120-inch focal lengths, though not all are at present in service. The spectrograph extends from 10 feet above ground to 20 feet below. Elaborate methods, including the circulation of water in copper pipes and the use of electrical heat, have been provided for reducing temperature gradients in the coudé room.

Pic-du-Midi Observatory. J. Rösch reports on the following new equipment. (1) A high-dispersion solar spectrograph of 4 mm per Å is available fitted with a Lallemand electronic camera for increasing definition by decreasing exposure time. (2) Another Lallemand camera is fitted to the 60 cm refractor for short-exposure photographs of planets and double stars. (3) M. Hugon and J. Rösch have developed a new type of beam-splitting micrometer for measurement of lunar reference points. (4) H. Camichel and J. Rösch built equipment for measurement of the diameter of Mercury during solar transit by the photo-electric method suggested by Hertzsprung.

Tokyo Astronomical Observatory. H. Hirose reports that the 74-inch Grubb-Parsons reflector

has been erected at their new Astrophysical station, Mount Chikurin. The main aim of the instrument will be spectrographic work with a grating spectrograph at the coudé focus, and two Cassegranian spectrographs with respectively two glass and two quartz prisms. All three spectrographs are by Hilger. A 36-inch reflecting telescope by the Japan Optical Company for photo-electric photometry is also available at Mount Chikurin, and a second such telescope is under construction.

La Plata Astronomical Observatory. J. Sahade reports that La Plata will get a reflecting telescope of 84-inch aperture similar in design to the Kitt Peak telescope of this size. A site will be found at some place between latitudes approximately $-25°$ and $-35°$, and between Cordoba and the Andes. The project is being supervised by Sahade.

Kodaikanal Observatory. M. K. Vainu Bappu reports the availability of three new instruments, a 100 Å/mm (at Hγ) one prism spectrograph for the 20-inch reflector; a Hilger quartz spectrograph for ultra-violet (UV) spectra of bright stars on the 12-inch horizontal telescope; and a photo-electric scanner and monochromator for the 20-inch reflector.

Radcliffe Observatory. The coudé spectrograph is in operation with two Schmidt cameras of 48-inch and 21-inch focal lengths which give dispersions of 6·8 and 15·6 Å/mm in the second order, violet to UV. D. H. Andrews is developing a new direct intensity microphotometer and a new comparator for automatically measuring spectrograms for wavelength. A coudé spectrograph is being designed for the 48-inch telescope by E. H. Richardson. The use of a fifth mirror will permit a horizontal coudé room.

Lick Observatory. A. E. Whitford reports that the 120-inch reflecting telescope is in routine operation. A report on the mirror figure is in the literature (Mayall, N. U. and Vasilevskis, S., *Astr. J.*, **65**, 304, 1960). Mayall has found that the limiting magnitude is about 23·0 for direct photography at the prime focus. The coudé spectrograph, under Herbig's supervision, is also in use with the 20-inch and 160-inch cameras. The main frame of the spectrograph is a triangle of 24-inch I-beams resting on a three-point suspension. The frame is overhead, with the optical parts suspended. The collimated beam, $6\frac{1}{2}$ inches in diameter, feeds any one of three gratings which, with the two cameras, give a series of dispersions between 48 Å/mm and 1·3 Å/mm. At 16 Å/mm a 10th magnitude star requires an exposure of one hour in average seeing for a spectrum width of 0·5 mm. With the 160-inch camera, the practical limit of resolution seems to be set by the slit width. The 20-inch camera is fitted with a Lallemand electronic camera under the supervision of M. F. Walker. Other instruments for the 120-inch telescope in construction or design stages include (1) a prime-focus spectrograph designed to provide dispersions from 400 Å/mm to 50 Å/mm; (2) a photometer base with a provision for simultaneous monitoring of sky; (3) support mechanism for the additional mirrors of the 5-mirror coudé system. Herbig is developing a 21 Å/mm nebular spectrograph for the 36-inch Crossley reflector that uses an echelle grating. Vasilevskis has adopted a final design for the two-co-ordinate automatic plate measuring engine. Measurement is by interpolation between marks on an engraved quartz scale. P. Treanor, using the 22-inch Tauchmann reflector, experimented with wedge interference filters for narrow band multi-color determination of interstellar polarization and energy distribution. Results were promising. N. Woolf is experimenting with photo-electric spectral scanning with the 120-inch coudé spectrograph.

Institute for Astronomical Research of the Turku University. Y. Väisälä reports that the large zenith tube (400/6875) is ready for experimental observations, though the final figuring of the objective is not yet finished, and it must be stopped to 300 mm. The inclination is measured both by levels and by plumb lines, and the plumb lines have so far proved to be the more reliable. The accidental mean error of one star was $\pm 0''.10$ for a latitude observation. Declinations can be observed within the zone $+60°\ 00'$ to $+60°\ 50'$.

Mount Wilson and Palomar Observatories. H. W. Babcock reports activity in the production of diffraction gratings. Special gratings for particular application to astronomical problems have been provided to other observatories. The ruling engine is being modified to improve its precision and reliability still further.

Cambridge and Edinburgh. P. B. Fellgett writes as follows:

'A design study has been made, at Cambridge, for an automatic measuring engine for Schmidt photographs. The classical Schmidt telescope is outstanding not only in its approach to theoretical perfection but also in the extent to which the high theoretical performance can be approached in practice. Its capabilities have seldom been fully exploited. Since more than 10^4 star images may be recorded on a single plate, the only practicable way to use the whole of the information is to transform it into digital form wholly automatically and to carry out the research on an electronic computer. Emphasis is placed on the statistical aspects of the detection of star images and of their measurement for position and brightness in the presence of grain fluctuation. Application of matched filter concepts shows that the optimised settings for position and brightness cannot be separated, and must be part of a single process. A study of relevant photographic properties has been published (*M.N.R.A.S.* **118**, 224, 1958). Analysis indicates that astrometric and photometric measures can be sufficiently free from systematic error for modern needs only if they are made simultaneously, and with a large enough number of standards per isoplanatism patch that the residuals can be interpolated by correlation methods. Currently, only Schmidt systems fulfil the implied conditions as to working field, freedom from design or accidental asymmetric aberrations, and isoplanatism. There is evidence that the disadvantages of shortening the focal length, found in previous work, may be due at least in part to failure to adapt the choice of emulsion and method of interpolation to the changed conditions.

'The digitising of the Becker Iris Photometer at Edinburgh is in an advanced state. The results will be reduced on the EDSAC computer, using the AIDA programme developed by A. N. Argue. Digitisation of spectrophotometry is also under way. These projects, together with a flying spot scanner, are intended partly as pilot experiments for the fully automatic Schmidt measurer referred to above.'

Grubb Parsons. G. Sisson reports the installation of the 74-inch telescope for the Tokyo Observatory, and mentions that mechanical features to guard against earthquake damage have been incorporated into the instrument. The 98-inch $f/3$, parabolic Isaac Newton Telescope is under construction. The telescope will be mounted upon a polar disk instead of a polar axis; it is to be commissioned in 1966.

McMath-Hulbert Observatory. McMath reports that the second model of their isophotometer is a considerable success, and that time on this instrument is in such demand as to keep it in continual operation.

Observatories in the U.S.S.R. A report prepared by O. A. Melnikov and N. I. Kutcherov follows.

1. V. P. Linnik in Pulkovo developed and tested, on the 30 cm reflector, a slitless spectrograph with interference reference points used as comparison lines for the determination of the radial velocities of stars (*C.R. Acad. Sci. U.R.S.S.* **124**, 1009–10, 1959).

2. The Danjon prism astrolabe was mounted at the Poltava Gravimetrical Observatory. Regular latitude observations were started in June 1960 by means of this instrument.

3. A 700 mm transit circle APM – 10 for azimuth observations was mounted at the Poltava Observatory.

4. In the Pulkovo Observatory work connected with new astrometrical instruments and new methods was continued:

(*a*) A photo-electric method for recording circle readings has been improved and an experimental device constructed. (A. A. Efimov, Ju. M. Otreshenkov, *A.J. Moscow* **37,** 146, 1960).

(*b*) The new photographic meridian circle (M. S. Zverev) and the horizontal transit instrument, with the central optical cross-staff (A. A. Nemiro) instead of a mirror, are being developed at the Observatory and its workshops.

(*c*) An automatically controlled zenith tube (V. A. Naumov's system of control) designed for the observation of 10 stars per 1·5 hours was mounted.

(*d*) The L. A. Sukharev horizontal meridian instrument, of factory make, is being mounted.

(*e*) Solar observations with the large transit instrument and the vertical circle are systematically made using the L. A. Sukharev objective mirror filter which reduces by 50 000 times the solar brightness and thus decreases observational errors.

(*f*) The V. P. Linnik interference heliometer is used systematically for the measurement of the diameter of the Sun.

5. In the Sternberg Astronomical Institute in Moscow portable quartz clocks were built for gravimetrical measurements with pendulum devices in the sea (Grushinsky, N. P. and Epishin, N. A., *A.J. Moscow* **36,** 172, 1959).

6. At the Kharkov Institute of Measures and Measuring Machines a molecular time and frequency standard was produced, based upon the use of a molecular generator on a beam of ammonia molecules (Leikin, A. J. *A.J. Moscow* **36,** 734, 1959).

7. In the Moscow Observatory of the Sternberg Astronomical Institute a new meridian circle was mounted. Systematic catalogue observations are conducted by means of it.

8. M. D. Sopelnikov and I. V. Baulin (*A.J. Moscow* **37,** 151, 1960) described the spark chronoscope for oscillographic reception of time signals which was designed at the Kharkov Institute of Measures and Measuring Machines.

9. M. A. Istchenko, Ju. P. Platonov and V. B. Sukhov (*A.J. Moscow* **37,** 156, 1960) described the oscillographic devices for the reception, in Pulkovo, of precise time signals.

10. L. A. Panajotov (Pulkovo Observatory) suggested the use of a vacuum prism in front of an object-glass to compensate for refraction effects in astrometrical observations.

11. L. M. Kotlar (*A.J. Moscow* **37,** 469, 1960) described a new design of differential photometer for the Pulkovo solar magnetograph. In contrast to existing photometers, only one photo-electric multiplier (not two) is used and an auxiliary modulation of the light beam is accomplished by means of an electro-optic crystal modulator.

12. N. V. Jakovlev describes the use of a mirror-lens objective for the photography of artificial Earth satellites (*A.J. Moscow* **37,** 550, 1960). This objective permits photography of artificial Earth satellites down to magnitude 6 on a film with a sensitivity of about 500 (lux sec^{-1}).

13. P. V. Shcheglov (*A.J. Moscow* **37,** 586, 1960) and V. F. Essipov (*ibid.* **37,** 588, 1960) describe their photographic experiments with a contact image converting telescope on nebulae and stars in the light of the Hα line. A gain of 30-40 times is obtained.

14. The building of the 700 mm reflector with a metal (steel) mirror and an automatic electric control (D. D. Maksutov's optics, designed by B. K. Ionnissiani) is being finished in the Pulkovo workshops. The reflector is supplied with a computer to introduce a correction for mean refraction into the telescope position. (*Pulkovo Bull.* **162,** 149, 1958).

15. D. D. Maksutov published a new method for the study of the figure of mirrors of large telescopes (*Pulkovo Bull.* **160,** 5, 1957). M. A. Sosnina—a new investigation of the compensation method for the control of large spherical mirrors (*ibid.* **162,** 137, 1958). Pan-Tsiun Hua—a new investigation of the optics of mirror telescopes (*ibid.* **165,** 152, 1960).

16. N. I. Mikhelson suggested the use of beryllium as the material for reflector mirrors (*Pulkovo Bull.* **162,** 158, 1958).

17. N. F. Kuprevitch gave a detailed description of the new experimental 285 mm Cassegranian television telescope-reflector used in Pulkovo (*Pulkovo Bull.* **163,** 133, 1960). The television arrangement is designed for 625 scan lines at 50 exposures per sec. $f = 18$ and 125 cm, the electronic magnification $= 8{\cdot}5$. Photographs of the Moon and stars were obtained.

18. A. V. Markov described the optical and photometric properties of the astro-photographic mirror-lens Pulkovo camera ASP−4 of G. G. Sliusarev's system (*Pulkovo Bull.* **158,** 130, 1958). The camera consists of a spherical mirror and a mirror-lens system producing a narrowed parallel

beam inside the camera. In this beam is mounted a focusing system of lenses. The entrance aperture is 280 mm, the equivalent focus, 1503 mm, the technical constant $T = 0{\cdot}2$.

19. N. A. Dimov gave a description (*A.J. Moscow* **37,** 464, 1960) of a new type of stellar spectrophotometer of the Crimean Observatory which uses the integration principle. The observed spectrum interval of 110 Å is scanned by the exit slit.

20. L. M. Kotlar designed, built and described the Pulkovo solar magnetograph (*Pulkovo Bull.* **163,** 73, 1960) which is similar to the ones in Pasadena, Cambridge and the Crimean Observatory. It differs only in the presence of a compensator for Doppler line shifts and in their recording.

21. A. V. Merkulov created in Pulkovo and described a new "static" spectroheliograph (*Pulkovo Bull.* **162,** 1958) and a telescopic interference monochromator as a supplement to the spectroheliograph to narrow the transmission pass-band up to 0·05 Å (*ibid.* **163,** 17, 1960). He also suggested two modifications of the Fabri-Perot interferometer for astro-spectroscopical purposes (*ibid.* **163,** 35, 1960).

22. N. S. Nikulin, A. B. Severny and V. E. Stepanov described the solar magnetograph of the Crimean Observatory (*Publ. Crim. Obs.* **19,** 3, 1958), built according to Babcock's scheme, but with a radial velocity compensator. This magnetograph was improved by N. S. Nikulin in 1960 (*ibid.* **22,** 3, 1960).

23. Ju. A. Sabinin, E. N. Beliajev and V. A. Miasnikov suggested a new system for an A.C. photo-electric guider with analysing optics for small diameter instruments (*ibid.* **23,** 174, 1960). With a guiding field diameter of 100 mm, the telescope can be guided on stars down to magnitude 5. The system was tried at the Crimean Observatory on the 40 cm astrograph and on the 500 mm meniscus telescope.

24. A. V. Brunos and V. Bumba (*ibid.* **22,** 134, 1960) built at the Crimean Observatory a photo-electric comparator for measuring spectral line positions by appraising the symmetry axis of the line wings instead of the maximum blackening of the line.

25. R. E. Gershberg, V. I. Pronik and S. I. Korkin at Crimea built an oscillographic attachment to the soviet microphotometer MF−4 for recording intensities (*ibid.* **22,** 166, 1960).

26. Ju. A. Sabinin and V. P. Egorov gave a description (*ibid.* **22,** 275, 1960) of their system for automatic co-ordination of dome rotation with the motion of the equatorially mounted 40 cm astrograph and the 500 mm telescope (Crimean Obs.).

27. Kh. I. Potter and Ju. S. Streletzky describe a camera ($D = 345$ mm, $f = 3450$ mm) designed by them and built at the Pulkovo workshops for lunar observations according to the Markowitz method with a normal astrograph (*A.J. Moscow* **36,** 1047, 1959). Main design principles and photographs are given.

28. V. G. Fesenkov describes (*A.J. Moscow* **36,** 1094) a two-channel polarimeter for use in studies of atmospheric optics and astrophysics. The theory of the instrument is given along with a description of the polarimeter built in 1958 in the Alma Ata Observatory.

29. S. S. Tovtchigretchka describes an impulse-phasing device (*A.J. Moscow* **36,** 1130, 1959) of the electro-mechanical frequency divider of the quartz clocks built at the Metrology Institute in Leningrad.

30. The specialized chromosphere-photosphere telescope was mounted in the Lvov Observatory. The chromosphere combination is $D = 6$ cm, $f = 214$ and 534 cm; the photosphere combination $D = 33$ cm, $f = 908$ cm. The photo-electric high-speed solar spectrophotometer was designed and built (P. P. Kozak, *A.J. Moscow* 1960, in press).

31. In the Goloseevo Observatory of the Ukrainian Academy of Sciences (near Kiev) were mounted, the 700 cm AZT=2 reflector with a spectrograph and photometer and the 200 mm meniscus telescope for star scintillation observations ($D = 200$ mm, $f = 2$ m and $f = 10$ m).

32. M. V. Dolidze and L. M. Fishkova developed an attachment to the self-recording microphotometer MF−4 for conversion into direct intensities in the reducing of spectrograms (*Bull. Abastuman Obs.* **22,** 117, 1958).

33. L. Ksanfomaliti investigates systematic errors of the photo-electric devices used for determination of the degree of light polarization (*Bull. Abastuman Obs.* **24,** 175, 1959).

34. N. V. Merman carried out a complete calculation of a specialized meniscus telescope (Cassegrainian) for $D = 700$ mm $f/20$ for the field of $2W = 32'$ (for photographic and visual planet observations) with auxiliary optics up to $f/14$ ($f/2{\cdot}8$ $f/3{\cdot}5$) for planet photography and

cinematography. A purely mirror combination $f/20$ for radiometric observations is also available (*Pulkovo Bull.* **159,** 145, 1958). The entrance and relative aperture are selected in a manner to reduce (as far as possible) atmospheric turbulence effects and to use in planet cinematography the ordinary Agfa JSS film with short exposures.

35. V. B. Sukhov and Ju. P. Platonov (*Pulkovo Bull.* **161,** 52, 1958) gave a description of the photo-electric arrangement of the Pulkovo time service with alternating current power supply.

36. P. P. Bozhko studied in detail the Repsold meridian circle of the Nikolaiev Observatory.

PROPOSALS

Rösch points out that Commission 9, though called the Commission on Astronomical Instruments, has always dealt with both instruments and techniques. He suggests that the name of Commission 9 be modified to include the mention of techniques, thus bringing the name of the Commission into closer agreement with its function.

There is now a considerable number of coudé spectrographs in operation throughout the world. Generally, few details of these instruments have been published. Dunham suggests that an informal meeting of persons skilled in the design and use of these instruments might be timely, and might serve a useful purpose. Possibly a portion of the business session of Commission 9 in Berkeley could well be devoted to such a discussion, which, Dunham feels, should be informal and spontaneous, and not circumscribed by the preparation of papers.

G. E. KRON
President of the Commission

9*a*. SOUS-COMMISSION DES CONVERTISSEURS D'IMAGES

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MEMBRES: Duchesne, Fellgett, J. S. Hall, Hiltner, Krassovsky, Lallemand, McGee, Morton.

INTRODUCTION

During the two years since the 1958 General Assembly, work has been carried forward on all of the types of photo-electric image tubes described in the 1958 report. None of the techniques has been discontinued, and no basically new technique has been added. Some significant improvements, however, have been achieved, and the experimental use of these tubes in astronomical observations has continued to increase.

As in the 1958 report, the discussion will be divided into three parts according to the techniques involved: (1) devices employing electronography, (2) image converters with optical outputs, and (3) signal-generating systems. In a device employing electronography, electrons ejected from a photo-emissive cathode are recorded by letting them impinge directly onto an electron-sensitive emulsion. In an image converter having an optical output, the electrons strike a phosphor screen where they produce an intensified optical image which can be photographed. In a signal-generating system, the electronic image is converted into a time-based signal current, as in commercial television practice. In some tubes of the foregoing classes, the flux of primary photo-electrons is internally intensified.

DEVICES EMPLOYING ELECTRONOGRAPHY

At the Observatoire de Paris, Professor Lallemand and his colleagues have continued work