16. COMMISSION POUR LES OBSERVATIONS PHYSIQUES DES PLANÈTES, DES COMÈTES ET DES SATELLITES

PRÉSIDENT: Rev. T. E. R. PHILLIPS.

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The following works embodying researches coming within the scope of this Commission have been published since the last meeting of the Union:

1. "Recherches sur la polarisation de la lumière des planètes et de quelques substances terrestres," by B. Lyot, *Annales de l'Observatoire de Paris, Section de Meudon*, **3**, Fasc. 1. Characteristic curves are found representing the fraction of light polarized in the case of the Moon and several of the planets for the angles Sun-Moon or planet-Earth and compared with curves obtained in the laboratory for light reflected by a number of terrestrial substances. Some of the conclusions arrived at are referred to in the notes below.

2. *La Planète Mars* 1656–1929, by E. M. Antoniadi. This is based mainly on the author's own telescopic observations with the 0·83 m. Meudon refractor in 1909 and the following years, and contains the author's conclusions therefrom. The work of numerous earlier and contemporary observers is also summarized and compared with the Meudon observations.

3. *The Moon*, by W. Goodacre. Contains a description of the lunar surface formations, numerous drawings, charts and photographs, and the author's revised Map of the Moon in 25 sections.

4. "Ricerche Polarigrafiche sui Pianeti. La Polarizzazione sul Disco di Giove," by M. Maggini, *Mem. della Soc. Astron. Italiana*, **4**.

5. *La Constitution des Comètes*, by F. Baldet. Paris, Hermann et Cie. 1930.

6. "Halley's Comet in its Apparition of 1909–1911," by Nicholas T. Bobrovnikoff, *Pub. of the Lick Observatory*, **17**, pt II, 1931.

7. "Absorptionsspektren und Atmosphären der grossen Planeten," by R. Wildt, *Nach. von der Gesellschaft der Wissenschaften zu Göttingen*, Math.-Phys. Klasse, 1932.

THE MAJOR PLANETS

Pluto. The outstanding event under this heading has been the discovery at the Lowell Observatory of a Trans-Neptunian planet to which the name Pluto has been given. The discovery telegram read: "Systematic search begun years ago supplementing Lowell's investigations for Trans-Neptunian planet has revealed object which since seven weeks has in rate of motion and path consistently conformed to Trans-Neptunian body at approximate distance he assigned. Fifteenth magnitude. Position March twelve days three hours G.M.T. was seven seconds of time West from Delta Geminorum, agreeing with Lowell's predicted longitude." The discovery was announced by the Lowell Observatory on 1930 March 13, the anniversary both of Lowell's birth, and of the discovery of Uranus by Herschel in 1781.

The discovery of Pluto was a direct result of the search programme set going in 1905 by the late Dr Percival Lowell in connection with his theoretical work on the dynamical evidence of a planet beyond Neptune. The existence and orbit of such a planet had been predicted in 1915 by Lowell, who died in 1916, from a rigorous mathematical investigation of the discordances between the tabular and observed

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longitudes of Uranus (*Lowell Obs. Memoirs*, **1**, "A Trans-Neptunian Planet"). A position and magnitude for the planet which proved to be more accurate had also been derived by a semi-graphical method by Professor W. H. Pickering, who had utilized the residuals of Neptune instead of those of Uranus, in 1919. Eventually it was with the Lawrence Lowell Camera of 13-inch aperture designed by the Lowell staff specially for the purpose and constructed by C. A. R. Lundin at the Alvan Clark Corporation's works at Cambridge, Mass. that the looked-for photographic images were detected by C. W. Tombaugh on plates taken on 1930 Jan. 21, 23, and 29.

At first the real nature of the object appeared somewhat uncertain, but the detection by E. Delporte of an image on a plate taken at Uccle in 1927 Jan. followed by the discovery of similar images on plates taken at Mt Wilson for that purpose in 1919, at Yerkes in 1921 and 1927, and at Königstuhl in 1914 enabled the planetary character of its orbit to be established. It must, however, be remarked that despite the very close agreement between the predicted and actual orbits it is maintained by several astronomers that the outstanding discordances on which the predictions of Pluto's existence were based by Lowell cannot be attributed to perturbations by that planet—see e.g. Prof. E. W. Brown's paper in *Proc. Nat. Acad. Sci.* **16**, 364 and "On a criterion for the prediction of an unknown Planet," *M.N.R.A.S.* **92**, 101.

Reference may also be made here to Dr A. C. D. Crommelin's note on "The Discovery of Pluto" in the *Annual Report* of the Council of the Royal Astronomical Society, and his address on the award of the Jackson-Gwilt Medal to C. W. Tombaugh, in *M.N.R.A.S.* **91**, 380 and 434.

It seems unlikely that the diameter and mass of Pluto exceed 0·7 and 0·4 those of the Earth respectively.

Two determinations of its photographic magnitude give 15·76 (W. Baade, *A.N.* 5804) and 16·04 (W. Münch, *Vierteljahrsschrift Astr. Gesellschaft*, **66**, 266). The visual values are approximately one magnitude brighter.

Mercury. In addition to visual observations (*Trans. I.A.U.* **3**, 108) much photographic work on this planet has been carried out in recent years.

At Flagstaff numerous daylight photographs have been taken in yellow light between 1921 and 1931, supplemented by some in blue and red light in 1927 and 1928. Unmistakable markings were first detected on plates taken in 1925 July (*P.A.* **37**, 129, 327, 1929).

At Juvisy F. Quenisset, who had been the first to obtain photographs of the markings on Venus, secured with the Viennet photographic objective on 1931 April 11 plates showing very definitely surface features on Mercury consisting mainly of a bright region with dusky areas on its N. and S. sides, that on the S. being especially dark (*P.A.* **39**, 430, 1931, and *M.N.R.A.S.* **91**, 94). These markings were also observed visually on the same evening with the 0·24 m. equatorial.

Attempts have been made by N. Donitch to find evidence of absorption by a possible gaseous layer surrounding Mercury at the time of its transit across the Sun's face on 1907 Nov. 14 (at Assouan), and on 1924 May 7 and 1927 Nov. 10 (at Starya Dubossary). On these occasions spectrograms were secured of the region of the "black ligament" formed at the moments of the interior contacts showing almost the whole of the visible portion of the spectrum. Calculation and laboratory experiments had led to the belief that, assuming favourable conditions, new absorption lines would be found on the plates if the depth of the atmosphere producing them were 15 km. and their intensity from 8 to 10 on Rowland's scale. The spectrograms of 1907 yielded an entirely negative result. On the two later occasions the linear dispersion employed was three times as great as before, but the results obtained were again negative (*Bull. de l'Acad. Imp. des Sciences de St Pétersbourg*, 1908, p. 233 and 1912, p. 1011; and *Mémoires de la Section Scientifique de l'Acad. Roumaine*, Série 3, T. **6**, Mém. 3, pp. 81–3).

The polarimeter observations of B. Lyot appear to indicate that if the planet has an atmosphere similar to that of the Earth its effective thickness cannot exceed 2·1 per cent. of the latter: and that if the white patches sometimes recorded are clouds they must be composed of dust and not water (*Annales de l'Obs. de Paris*, Section Meudon, **3**, 1). The surface of Mercury is found to give polarization results remarkably similar to those derived from observations of the Moon and Mars, the three curves resembling that yielded by volcanic ash.

Venus. It will be recalled that photographs by F. E. Ross in 1927 showed belt-like markings suggesting a rotation in a considerably shorter period than that of the planet's revolution (*P.A.* **35**, 492). A long series of ultra-violet photographs secured at Flagstaff in 1927–8 show bright and dark markings of variable character which frequently appeared and disappeared between the daily observations. These would also seem to suggest a relatively quick rotation and are significant in connection with the results of radiometric measures.

Parts I and II of a study of the recorded observations of surface markings in 1927 in relation to the rotation axis and period of 68 hours suggested by W. H. Pickering have been published by H. McEwen in *B.A.A.J.* **40–42**.

From observations made at Setif in 1913, 1920 and 1922 by M. G. Fournier, it is concluded that the rotation period is $22^h 21^m$, and that the planet's north pole is in longitude 317°·5, latitude + 41°·5 (*C.R.* **187**, 1928).

In "Further Studies in Terrestrial Radiation" (*Mem. Roy. Met. Soc.* III, no. 21) G. C. Simpson has suggested an interesting explanation of the cloudiness of Venus and the clearness of the Martian atmosphere as compared with that of the Earth. See also a paper on "The radiation of the Planet Earth to Space," by C. G. Abbot (*Smithsonian Miscellaneous Collections*, **82**, no. 3, 1929).

The Meudon polarimeter observations give reason for believing that the light of Venus is reflected from minute droplets of which the refractive index is near that of water, and the diameters only slightly greater than 2 microns. Drops as large as those which form terrestrial clouds appear to be ruled out.

Mars. Photographs in light of various colours by W. H. Wright at Lick have proved the Martian atmosphere to be more extensive than was at one time believed, and to possess absorbing properties similar to those of the Earth's atmosphere (*M.N.* **88**, 709). In addition the prolonged series of colour-filter photographs at Flagstaff show that seasonal, diurnal, and secular changes are constantly taking place, and that, in general, conditions are largely similar to those at the surface of the Earth. Radiometric measures indicating day temperatures considerably above the freezing point of water were referred to in the last report (*P.A.S.P.* **43**, 241).

Very interesting polarimeter results have been obtained at Meudon. Normally the curve is strikingly similar to those of Mercury, the Moon and volcanic ash, but sudden and violent changes in the direction of diminished polarization are liable to occur, as happened in 1922 and 1924. There are grounds for believing such variations to be caused by certain changes in the state of the Martian atmosphere.

The orientation of the dark region of *Solis Lacus*, which had shown so remarkable a change in 1926, was found in 1930 to be again about normal. An intermediate orientation had been observed in 1928 (various published drawings).

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Jupiter. The period under review has furnished some outstanding phenomena.

(*a*) In the summer and autumn of 1928 there was a remarkable revival of activity in the planet's S. hemisphere. From a centre of disturbance at the S. edge of the S. equatorial belt a number of dark spots travelled in a *following* direction with such rapidity that the rotation period showed the unprecedented large value of $9^h 59^m \pm$! At the same time a region of extraordinary turbulence developed in the same belt in a slightly lower latitude and since its *p* end travelled approximately at the rate of system I (rotation period $9^h 50\frac{1}{2}^m$) the two ends of the disturbed area overlapped in longitude in about 7 weeks. An account of this development and associated phenomena, including remarkable colour changes and the eruption of white spots appearing as projections at the limb like those observed in 1919, is given in a paper by F. J. Hargreaves, B. M. Peek, and T. E. R. Phillips in *M.N. R.A.S.* **89**, 209. In response to a request from these observers to the Lick Observatory, a number of photographs of the planet were taken by J. H. Moore in ultra-violet, violet, and extreme red light. These were discussed by W. H. Wright in *M.N.R.A.S.* **89**, 703. They supplement and confirm very satisfactorily many of the visual observations above mentioned and supply valuable information concerning the large white cloud, a portion of which appears to have been responsible for the irradiating objects seen at the planet's limbs.

It is also fortunate that during the height of the great disturbance in 1928 several photographs were secured at Flagstaff which can be compared with visual observations and drawings of about the same dates. The accordance is most satisfactory even in the more delicate details.

A discussion of the visual observations of the planet made in 1928–9 by L. Taffara at the Royal Observatory, Catania, has been published in *Mem. della Soc. Astron. Italiana*, **4**.

(*b*) In the autumn and winter of 1929 a phenomenon of a somewhat different character was observed in the N. hemisphere, viz. the outbreak of very rapidly moving spots at the S. edge of the N. temperate belt. A discussion of the observations by various observers is published by B. M. Peek in *M.N.R.A.S.* **91**, 94. The mean rotation period was found to be only $9^h 49\frac{1}{4}^m$, a value closely similar to that shown by spots in the same latitude in 1880, 1891–2, and (one object) in 1926. It is remarkable that so swift a current should be found so far from the equatorial regions and within a few degrees of the slowest of the permanent currents known. Another remarkable circumstance is that in 1928 and again at the time of writing (1932 Jan.) objects in the S. portion of the belt have been found to exhibit an intermediate period of $9^h 53^m +$. Some dark spots on the N. temperate zone in 1929–30 were also found by F. J. Hargreaves to possess a very short rotation period for the latitude (*B.A.A.J.* **40**, 160). It is clear that the N. and N.N. temperate regions of the planet's surface call for close observation.

(*c*) While these notes have been in preparation another phenomenon of special importance has been detected: viz. the existence of a circulatory motion of certain objects in the planet's S. hemisphere. A number of humps or projections drifting rapidly along the S. edge of the S. equatorial belt in the direction of increasing longitude have been found on reaching the preceding end of the S. tropical disturbance to have their direction of motion reversed. They are apparently whirled round the end of the disturbance to the S. portion of the zone, where they appear as short streaks or detached spots close to the N. edge of the S. temperate belt. Further details cannot be given at the time of writing. (Jupiter section, Interim Report, *B.A.A.J.* **42**, 205; *Observatory*, **55**, 112, 1932, and 22nd Report of the

Jupiter section, *B.A.A. Memoirs*, relating to the apparition of 1919–20 and *B.A.A.J.* **37**, no. 2, 62.)

Further radiometric measures of Jupiter have been made at Flagstaff. One result is the confirmation of a water-cell transmission higher than that observed for direct solar radiation. Also the water-cell transmission in connection with those of several other screens appears to indicate the presence of long-wave absorption bands in the planet's atmosphere and at shorter wave-lengths than the cut-off limit of the water-cell near $1{\cdot}4\mu$. Differences have also been found in the radiation from different parts of the disc (see *Publications of the American Astron. Soc.* 39th meeting).

The polarigraphic observations carried out at the Royal Observatory, Collurania-Teramo, show the polarization to vary sensibly with the particular markings observed. From this it is concluded that the particles of vapour giving rise to the dark markings are much smaller than those causing the light patches, and that the latter accordingly represent a more advanced stage of gaseous condensation.

The Meudon polarimeter observations reveal a curious phenomenon. Not only do the measures indicate a greater degree of polarization at the E. and W. limbs than at the centre of the disc, but there is a systematic difference between that at the two limbs. As the difference is always the same in sign it would appear that the Sun's rays have a definite effect in modifying the condition of the planet's atmosphere during the 5 hours of the Jovian day.

Two papers that merit consideration are: 1. A photometric discussion by N. Barabascheff of photographs of Jupiter taken by Shajn at Simeis (*Pub. Kharkov Ast. Obs.* **3**, 1931); 2. On the Cause of Jupiter's belts by W. A. Luby (*P.A.* **37**, 1929).

Saturn. Photographs of Saturn at Flagstaff have shown that the dark band about the equator which was present in the violet photographs of 1929, 1928, 1927, and earlier ones by R. W. Wood in 1916, was absent in the like photographs in 1930, and 1931, when the ball appeared much the same in violet as in yellow and red light. This change was apparently due to variation in the colour of the ball. The observation is important in connection with the interpretation of colour-filter photographs of planets (*P.A.S.P.* **43**, 241, 1931).

Owing to the distance of the planet the angle Sun-Saturn-Earth has so small a range that it is difficult to obtain satisfactory polarization curves. Nevertheless the Meudon observations give definite results as regards the rings. Thus the curve for ring B is similar to that given by various unpulverized substances such as fragments of lavas. The suggestion is that ring B is not formed of particles as small as dust but contains fragments of considerably larger size. The remarkable fact disclosed by the observations of ring A is that the two ansae show a systematic asymmetry.

H. Slouka of Prague has found the mass of Saturn's rings to be 1/1,000,000 mass of Saturn (*Scientia*, Aug. 1931).

Planetary Spectroscopy. Further observations at Flagstaff of the red and infra-red of the spectra of the planets, using plates sensitized with Neocyanine, Kryptocyanine, etc. have reached still longer wave-lengths and have given additional bands to those previously found. The following are rough wave-lengths of the stronger absorptions as measured on low dispersion plates of Jupiter.

7015	wide and weak
7195	very strong
7265	very strong, wide and blends with preceding
7735	wide and weak
7910	very wide

8150 weak
8395 narrow, strong
8630 very intense, well delimited
8820 very intense, sharp-terminated spectrum.

In Saturn these bands are much the same as in Jupiter. They are not evident in spectra of the ring system. The much greater strength of the atmospheric absorption bands in Uranus and Neptune gives these planets their familiar greenish-blue colour.

Rupert Wildt has found (*Veröffentl. Göttingen*, 19 and 22) that the bands at 6470, 7700–8100 and 8780–9011 in the spectrum of Jupiter are due to the existence of ammonia in the planet's atmosphere.

At the Mt Wilson Observatory Adams and Dunham have studied the infra-red spectrum of Venus and found three new bands which are almost certainly due to carbon dioxide. This investigation confirms the conclusion that no appreciable amounts of oxygen or water-vapour occur in the atmosphere of the planet above the level from which light is received (*P.A.S.P.* **44**, 243, 1932).

Planetary Photometry. Photographic photometry of planetary surfaces of a differential character to determine the albedos of particular areas of planetary surfaces (i.e. polar caps, temporary bright areas, desert areas, and the grosser dark markings on Mars; and the various belts and parts of Jupiter, Saturn, etc.) appears especially desirable. The same or similar observations should furnish a colorimetry of planetary surfaces. Some work of this character has been undertaken at Flagstaff and already photographic material dating back several years has been secured.

THE MINOR PLANETS

Eros. It is well known that the light changes of Eros show marked irregularities in amplitude and are sometimes associated with variations of form. Such variations had been reported in 1924 by Innes and Wood from observations with the 9-in. refractor at the Union Observatory, Johannesburg. On 1931 Feb. 8, W. H. van den Bos and W. S. Finsen, using the 26-in. refractor of the same Observatory and a power of 1070, found that the planet presented the appearance of a figure of eight or a notched double star of about $0''\cdot18$ separation. Subsequent observations showed the period of a complete revolution to be 5^h17^m (*A.N.* 5780, **241**). An elongation of the planet was observed by Nakamura at the Kwasan Observatory, Kyoto, Japan in 1931 Jan. and Feb. with the 30-in. Cooke refractor (*Bulletin* 197).

From a detailed study of the observations of Eros extending over 30 years L. Campbell at Harvard has derived as the period of the planet's rotation $0^d\cdot2195942$, or $5^h16^m12^s\cdot94$ (*Harvard Bulletin* 881).

Both photographic and photovisual studies of the changes in light and colour-index have been made by E. Delporte and P. Bourgeois at the Royal Observatory, Uccle, the comparison stars being taken from the list prepared by F. E. Ross and R. S. Zug (*A.N.* **239**, 289). At the Maria Mitchell Observatory, Nantucket, a very extensive programme of photographic work on Eros was carried through by Miss M. Harwood. The results so far published relate to the Phase Coefficient (*Harvard Bulletin* 880) and the Photographic Light-curve (*American Astron. Soc. Pub.* **7**, no. 1, 5). In addition the very large amount of photometric work done at the Astronomical Institute of the University of Brussels, Harvard, La Plata, Potsdam, Bergedorf, Tapada, Catania, Leningrad, Marseilles, Kyoto, and elsewhere has provided valuable material for the discussion of the planet's physical peculiarities during the 1930–31 apparition.

A rapidly moving object was detected by E. Delporte at Uccle on 1932 March 12. It proved to be a new Minor Planet 1932 EA, which revolving in an orbit of high eccentricity approaches the Earth more closely than Eros, its minimum distance being about 10 million miles. Its period is about $2\frac{3}{4}$ years. Five weeks later, on April 27, a still more remarkable asteroid, 1932 HA, was discovered by Reinmuth at Heidelberg. Its orbit passes inside of the orbits of both the Earth and Venus. Its period is 1·8 years (*B.A.A.J.* **42**, nos. 7 and 8; *B.A.A.C.* 123; *A.N.* 5878).

An object discovered by Reinmuth at Heidelberg on 1931 Dec. 31 and at first supposed to be a Comet was found to be a tenth member of the Trojan Group of Minor Planets. Three members of this group were discovered in 1930.

It is noteworthy that as many as 200 Minor Planets were discovered in 1931.

An investigation of the spectra of the Minor Planets has been made at the Lick Observatory by N. T. Bobrovnikoff (*L.O.B.* 407, 1929).

SATELLITES

The Moon. Much has been done in recent years in studying the nature of the lunar surface by (*a*) a comparison of the reflectivity of its features in different spectral regions with that of a number of terrestrial rocks, (*b*) polarimeter observations, and (*c*) measurements of its surface temperature with the rate of change of the latter during eclipse.

In a paper on the measurement of lunar colour-differences in *P.A.S.P.* **43**, 203, P. C. Keenan gives details of results obtained at the Steward Observatory, discusses what has been done since the work of Wilsing and Scheiner by various observers down to the results derived from extreme red and ultra-violet photographs by W. H. Wright in 1929, and emphasizes as desiderata (1) measurements of surface brightness extending beyond the visible spectrum at both ends, and (2) a homogeneous set of data for terrestrial rocks.

Wright and others have shown the general uniformity in brightness of most parts of the surface in all colours, but that a number of individual features show variations. In particular R. W. Wood's spot near Aristarchus is 20 per cent. brighter relatively to its surroundings in infra-red than in ultra-violet light.

A photographic study of the lunar surface is being made by H. G. Tomkins at Dedham, England, with his 24-in. reflector.

Lyot's polarimeter measures show that the characteristic curve for the Moon closely resembles that of volcanic ash, but is quite unlike that of lava.

A series of papers on the numbers, dimensions and forms of certain lunar features has been published in *B.A.A.J.* **41** and **42** under the title "Studies in Lunar Statistics," by T. L. Macdonald.

Two papers have been published on the "Photometry of the Moon" by Fessenkopf and others (*Pub. Inst. Astroph. Russie*, IV, 1; *Russian Ast. Journal*, **6**, 279).

Comparative studies of the effect produced by lunar and terrestrial surface materials on reflected sunlight with respect both to relative spectral intensities and to polarization, have been made since 1925 by a Committee of the Carnegie Institution of Washington for the study of the surface features of the Moon. The rapid chilling of the Moon's surface during an eclipse indicates that the lunar surface materials are of the nature of volcanic pumice or ash. The small amount of the polarization in the reflected light indicates that the substances are not dark coloured, like basalt and other rocks low in silica, but are light coloured, like rhyolitic and trachytic rocks, high in silica. Several new methods and instruments have been developed for the measurement of the properties of the reflected light in the ultra-violet, visible, and infra-red parts of the spectrum. These methods are directly applicable to the study of the planets. A series of photographic maps represented on the standard plane of projection is being prepared. Annual reports of progress of the work of this committee are contained in the Year Books of the Carnegie Institution.

Neptune's Satellite. A preliminary determination of the mass of Neptune's Satellite has been derived by S. B. Nicholson, A. van Maanen, and H. C. Willis from a photographic study of its perturbing effect on Neptune. The conclusion is that the mass is probably not greater than 0·1 or less than 0·04 that of the Earth.

Satellite Rotations. E. M. Antoniadi has discussed the general question of the rotation of the satellites in the Solar System in *Bulletin Société Astron. de France*, **43**, 385. It has long been known that several of these bodies have identical periods of rotation and revolution like the Moon (see *Lowell Observatory Bulletins* 59 and 64; *A.N.* **198**, 233; *L.O.B.* 385), and more recent observations of the physical features of Jupiter's third satellite have shown the same to be true of that object (*L'Astronomie*, 1927, Dec.; *M.N.R.A.S.* **82**, 96). Antoniadi, in the paper mentioned, has shown that apart from the remoter bodies revolving round Jupiter and Saturn the same thing must be true of the satellites of the Solar System in general.

On the other hand an extensive series of interferometer measures of the four great Satellites of Jupiter has been made at the Collurania Observatory, Teramo, from which it is concluded that rapid variations in the discs take place similar to the oscillations recorded by W. H. Pickering (*P.A.S.P.* **37**, 191) in the case of J I and J III (*Mem. ed Osservazioni*, **1**).

COMETS

Observations of the nuclei of two comets which have made specially close approaches to the Earth have now been obtained by F. Baldet with the 0·83 m. refractor at the Meudon Observatory. That of comet Pons-Winnecke (1927 *c*) was referred to in the last report. Comet Schwassmann-Wachmann (1930 *d*) has since been examined and its nucleus found like that of the former comet to be exceedingly small. Its diameter can hardly have exceeded 400 metres. (*C.R.* **190**, 1382.)

In view of the suggested identity of bands given by the gases immediately surrounding the nuclei of comets with the Raffety bands in the flame of the Mecker burner, Baldet has compared the latter bands as obtained by M. Grenat in the Astrophysical Laboratory at Meudon in the oxyacetylene blow-pipe flame with the bands in the spectra of comets which he has studied. (*C.R.* **192**, 1553.) His conclusion is that the suggested identification is not possible. (*C.R.* **192**, 1531.)

Extensive investigations of the behaviour of matter in comets' tails have been made by N. T. Bobrovnikoff by studying a large number of photographs and spectrograms taken at Lick and elsewhere. These include Morehouse's Comet (1908 III) (*L.O.B.* 398) and Halley's Comet at its 1910 return (*P.A.S.P.* **42**, 309; **43**, 61 and *Pub. L.O.* **17**). For the former, repulsive forces equal to 88 and 151 times gravity were derived, and for certain condensations and deformations in the latter, values very considerably greater. It is concluded that as the hyperbolic orbits of the condensations do not all intersect the orbit of the nucleus, such condensations may be formed anywhere and are not necessarily ejected from the nucleus.

In a paper in *L.O.B.* 408, on the disintegration of comets, Bobrovnikoff has concluded from the losses sustained when in the Sun's neighbourhood that comets cannot have been in the solar system for anything so long a period as the planets. He tentatively suggests that they were captured about a million years ago when the Sun was passing through a nebulous region in space. A recently published research on Halley's Comet at its last return, by the same author, is mentioned at the beginning of this report.

S. V. Orlov and others have published papers at the Astrophysical Institute of Russia embracing every aspect of the physical observation of comets.

Suggestions. A number of proposals and recommendations relating to future work have been made. These are being circulated to members of the Commission and will be considered by them at the forthcoming meeting of the Union. It is very gratifying that so much attention is being devoted at an increasing number of Observatories to departments of work coming within the scope of this Commission by means of the more recently devised methods of physical research. A recent addition to the list is the McMath-Hulbert Observatory of Lake Angelus, Michigan (*Pub. of the Observatory of the University of Michigan*, **4**, no. 4).

THEODORE E. R. PHILLIPS
President of the Commission

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