clear that in the particular region of the sky there was no extension of the Milky Way which could have been mistaken for the Gegenschien.

However this may be, there is no doubt that for us in India, we have in the Zodiacal Light and allied phenomena, a splendid field for serious work by amateur astronomers who are situated away from the smoke and glare of the Calcutta sky, and the purpose of this note will be fulfilled if it encourages others to take up the subject. It would, no doubt, be possible to arrange for photometric observation, etc., of the Zodiacal Light.

Lord Rayleigh has shown that a cloud of small particles whose dimensions are small compared with the wave-length of light scatters twice as much light towards the direction of the Sun as in a direction at right angles to it. It seems possible that on the meteoric swarm theory, this result of mathematical theory may explain the special brightness of the Zodiacal band of light in a direction opposite to that of the Sun. If we assume that the greater portion of the cloud of matter outside the Earth's orbit is situated within two or three hundred thousand miles of the Earth, we should see a circular hole in the patch of light corresponding to the shadow of the Earth cast by the Sun. It does not appear that this has ever been observed and possibly the entire illumination is so faint that no detail can be distinguished.

Extracts from Publications.

Snow.

When first observed no snow could be detected upon the planet (Mars), but the north polar zone was enveloped in cloud, as indicated by its bright yellow color, and the pole itself was turned away from us, as shown by the table, at an angle of 10°. The south polar zone was distinctly reddish, as far as the pole itself, and was apparently clear of cloud. August 14 a greenish white spot was seen in the extreme north, extending along the limb some 20°. It was whitish for about 20° farther, and then faded into yellow. The greenish white is probably a contrast effect, and quite different from the greenish grey due to vegetation, which will be noted later. This seems to have been the first appearance of snow. Its diameter was 1,300 miles, assuming it to continue

past the terminator in the same direction to the limb. This would indicate that the snow cap had at this time reached as far south as mean latitude 72°. At the next observation the pole was enveloped in cloud, but by September 2 a slight greenish tint was again seen, and the border was sharply defined against the reddish yellow of the soil. Diameter 1,800 miles. Latitude 65°. On September 13 and 17 small areas of snow were visible through the clouds at the north, and on the latter date it was suspected through the clouds at the south pole as well. The centre of the south polar cap does not coincide with the geographical pole, and the cap itself is more or less permanent. At the time of this observation it would be turned towards us as much as possible.

September 30 the snow was clearly seen at the north as a white patch, measuring 1,700 miles in diameter. Latitude 67°. Vegetation beginning to spring up along its edge or else marshy dark soil, forms a narrow irregular grey band, but not of the blue-black intensity which is seen later in the season as the result of melting. October 12 the north polar regions were again of a yellowish color indicating cloud, but the grey border was more uniform and pronounced than before. Diameter of the snow 2,300 miles. Latitude 58°. October 19, clouds at the limb yellow; over the snow whitish yellow. Diameter of snow 2,100 miles. Latitude 61°. October 30, the northern white spot was at first described as greenish, but an hour later as drab or yellow, and not particularly bright, less bright in fact than a small area near the south pole, which was perhaps really snow. Diameter 2,600 miles. Latitude 53°.

[*Popular Astronomy—January 1914.*]

Crepuscular Rays in the West at Sunrise.

By Capt. A. Lucke, F.R.A.S.

A remarkable display of this not uncommon phenomenon could be witnessed this morning between the hours of 6-30 and 7-30 (mean time, Long. 30° E.). The Sun rose behind a low bank of filmy clouds and its rising presented no abnormal features. In the west the Moon was some 10° above the horizon, setting in a clear sky, except for a quantity of white cirrus clouds from above the Moon to the Zenith. The mirage effects were stronger than usual on the Suez Canal; the air was keen and dry, wind being light from south.

The fan-like rays were suddenly seen below the Moon, spreading out from a point considerably below the horizon to a distance of approximately 17° above it (sextant angles), the dark spaces between the pearly rays distinctly darkening the clouds above mentioned. The rays were irregular in positions and numbers, and their upper edges indistinct in form, the lower being, on the contrary, sharply defined. The general hue of the clear sky in the vicinity appeared a shade between the bright ray and the dark separations, as if, indeed, the dark and the light rays were real and not comparative.

The Moon being full and well up above the horizon, its position marked the centre of the fan, whose rays at 7 hours 10 minutes numbered 14, eight being easily counted to the left, including one of nearly 2° width and a doubtful six to the right, all these last being narrow rays much less bright than the others.

The Sun rose clear, and did not throw any rays in the east, which he frequently does; and these westerly rays, although I have seen them faintly on other occasions, were so strong and persistent that I judge the record of the phenomenon to be of possible interest to the members. The rays were first seen at 6-30 and were lost to view at 7-22.

PORT SAID, EGYPT,

1913, November 15.

[*Journal of the British Astronomical Association for November 1913.*]

Sir Robert Stawell Ball was born in Dublin on July 1, 1840. He was sent to school in England, and became a student of Trinity College, Dublin, in 1857. His university career was one of exceptional brilliancy, and he graduated as gold medallist both in Mathematics and in Experimental Physics. He subsequently worked for some years at Lord Rosse's Observatory at Birr, King's County, where he studied the configurations of nebulæ with the great 6-ft. telescope. In 1867 he became Professor of Applied Mathematics at the Royal College of Science, Dublin, and in 1874 was appointed Andrews Professor of Astronomy in the University of Dublin

and Royal Astronomer of Ireland. This appointment carried with it the Directorship of the Dunsink Observatory, and Ball utilised his opportunities for contributing to the needs of practical astronomy by determinations of stellar parallax (by visual methods of measurement of course, in those days) on a somewhat extensive scale. He also published a series of memoirs on the "Theory of Screws," which brought him a considerable reputation as a mathematician. He was elected a Fellow of the Royal Society in 1873, and was knighted by the Lord Lieutenant of Ireland in 1886. In 1892 he was selected to succeed Adams as Lowdean Professor of Astronomy and Director of the Observatory at Cambridge. On taking up his residence at Cambridge he joined King's College where he was given a Professorial Fellowship. He applied himself with diligence to his professorial duties, and to the organization of the astronomical researches which have been so successfully carried on at the Observatory. But Sir Robert Ball is best known to "the man in the street" as a popular lecturer on astronomy and as a writer of popular books. He was quite one of the pioneers of popular lecturing and even before the days of lantern slides, was able to interest and amuse his audience by the extraordinary charm of his manner and the attractiveness of his wit. His popular books such as "The Story of the Heavens" and companion volumes were remarkably successful and brought him into touch with people of varying grades of intellectual culture. The versatility of the man was one of his great charms. Whether he was officiating as President of the Royal Astronomical Society (which office he held during the years 1897–1899) or was presiding over a dinner of the "T. C. D." Dining Club, he appeared to be equally the right man in the right place. In the same way his formal text-book on "Spherical Astronomy" was as successful in one direction as his "In Starry Realms" was in another. All who knew him (and who did not, either directly or indirectly ?) will feel that they have lost a genial friend, and that by his death a remarkable personality has been withdrawn from our midst. He died at Cambridge on 25th November after a lingering illness.

This Association (of which the deceased had been a member since 1892) was represented at the funeral by Mr. E. B. Knobbel.

[*Journal of the British Astronomical Association for November 1913.*]

Planetary Nebulæ.

By Arthur Prahl, Milwaukee, Wis.

In what follows, short descriptions of some interesting planetary nebulæ are given as they appear in a reflector of 14-in. aperture.

In the first place, the word 'planetary' is a misnomer; it would seem to imply that some of the nebulæ being more condensed than others, are assuming the nature of planets; this certainly is not the case. Indeed some of the so-called planetaries are not even nebulæ, but remote star-clusters. The nebula in Hercules, N.G.C. 6210, may be taken as representative of this class. A power of 700 shows it as a globe floating in space, the edges hazy, and the northern edge brighter than the rest.

The object N.G.C. 6229, in the same constellation, is given as a "large, round, but faint" planetary, discovered by W. Herschel. Whether he saw it so or otherwise, I do not know, but it certainly is not a nebula. With low powers it appears as one, and such I believed it to be for sometime until recently when I observed it several times with powers 450 and 700. The former showed indications of resolution, while the latter power revealed it as a beautiful star-cluster, very dense, with stars of less than the fourteenth magnitude. Had Herschel seen it thus, he would undoubtedly have called it the "richest and most condensed mass of stars in the firmament," an honour which he conferred upon M.80 in Scorpio.

N.G.C. 7027 in Cygnus is described in Webb as being "like an 8·5 magnitude star, about 4″." Schmidt gives it 8″ to 10″, and his estimation is correct. It appears as a double nebula or pair of nebulæ, one about 4″ in diameter, the other about 3″, with about 4″ from centre to centre. Both are clean cut, with no haze, and appear as a double star in the process of evolution.

N.G.C. 6826, in the same constellation, is seen as a nebulous star, or star projected on a nebula which appears as a circular disc of even light superposed upon another larger and fainter disc. A most interesting object.

Another object, N.G.C. 6818 in Sagittarius, is described by Herschel as being of uniform brightness; Rosse and D'Arrest saw in it a darker centre. Under careful observation, the disc is seen to be round; but the darker part is found not to be central, but situated in the preceding half,

of crescent form, and concentric with the edge. The nebula is situated nearly between two stars of about the eleventh magnitude.

N.G.C. 7662 in Andromeda appears as a bright star out of focus with low powers. The higher powers show it as a beautiful annular nebula, round, but with the vacuity eccentric; no trace of Lassell's nucleus and two oval rings. A faint star, 13 magnitude, follows the nebula at about 1′.

The planetary in Aquarius (N.G.C. 7009) is very large, bright, and elliptical, and is a most remarkable object. Lassell saw in it a bright, well-defined ring, while Buffham saw an opening (Webb "Cel. Ob. for Com. Tel," Vol. II, page 24), and Vogel two openings. Such detail is beyond the power of my glass; but at times I have seen the nebula to be of uneven brightness thus faintly indicating the existence of these details. My telescope does, however, show clearly the Saturn-like aspect given the object by the two small attendant nebulæ, of which the preceding is seen to be the smaller, more diffuse, and connected with the large nebula by a faint haze. The following one is the brighter, more definite, and does not seem to be attached like the other.

A small nebula, N.G.C. 2438 in Argo, is situated in the cluster M.46. This appears of even light with low powers; but with a suitable power it is seen to be annular, perfectly formed, with a double star in the centre.

N.G.C. 2022 in Orion presents an even disc of light with no detail.

The large planetary, N.G.C. 3242 in Hydra, appears annular, with two nuclei on opposite sides of the ring. No stars can be seen such as Sesshi thought he saw.

Thus it will be seen that, instead of appearing "planetary," these nebulæ reveal extraordinary details which, instead of tending to solve the problem of their nature, serve to make it more complicated, leaving the observer in deep perplexity, with no hope of a solution.

[*English Mechanic and World of Science—December 19, 1913.*]

Specula-Making.

Amateurs who devote their time to the increasing pursuit of specula-making may like to know of a little device I employ which I have never seen described in "Ours," although I have been a regular reader since 1896, and have searched

through many volumes of earlier years. An ordinary table has to serve me as a workshop bench. In first starting out to make a speculum, I obtained several discs of plate glass, approximately ¾ in. thick, two of 5 in. and two of 6½ in. diameter, from a local glass-merchant at a price of about 3*s*., and this, with 1*s*. worth of carborundum, 3*d*. worth of jeweller's rogue, and sundry small quantities of knife powder, flour emery raided from the kitchen cupboard, has been all that has been required so far. I took an ordinary school slate and cemented the disc to be the tool upon it (starting upon a 5 in. speculum). One of the spare 6½ in. discs, intended to be worked up later, I cemented underneath the slate to prevent flexure. Round the edge of the tool I scratched deeply upon the slate a number of radiating lines as a guide for the eye in insuring a regular slow rotation of the tool, and I cut a groove in one corner of the slate frame so that the carborundum washings could be poured off easily into small glass jars, cementing a cotton reel to the back of the mirror as a handle. I proceeded to work by hand, rough-grinding by carborundum, and working partly by cross strokes and partly by circular. In making the cross strokes it was easy to hold the handle loosely, so that the mirror itself slowly revolved clock-wise, whilst with the left hand I slowly turned the slate with the tool upon it counter-clockwise, allowing a regular number of cross strokes to each of the radiating lines before mentioned and to each interval between them. Working in this way it was easy to swill off the carborundum washings into jars and preserve them for elutriation, and when one had finished an evening's spell, it was only to give the slate and tool a washing under the tap and put them away, leaving the table free for other work if necessary.

I had only one grade of carborundum to work with and chose the finest the local ironmonger could supply. He could not specify which it was. It proved to be a very keen cutting material indeed, quite keen enough for rough-grinding, and in a comparatively short time I had the 5-in. mirror ground to a focus of 50 in. It did not elutriate well, however, as the material seemed to "work down" very little, and the surface when one had done one's best was too coarse to start to polish upon. However, by the use of ordinary knife-powder emery, carefully washed free of grit, and then patiently graded, I was able to get a surface answering the description of being only covered "with a light milky haze, and reflecting light at an angle very well." After polishing with pitch and washed rouge, using the Foucult test in figuring,

making a rough wooden jury-rig tube and stand, and utilising a flat and eyepiece in my possession, I was able to get results on star tests that were immensely encouraging. Although hitherto I had only had experience of small refractors, the perfect achromatism and good dividing power of this first experimental unsilvered mirror made me determine at once to take up reflector construction in earnest, and a most engrossing pastime I have found it. All beginners in this study, like myself, are deeply indebted to the Rev. W. F. A. Ellison for the great generosity he has shown in communicating through the columns of "Ours" the knowledge gained by his large experience in mirror-making and telescopic work generally. Mr. Ellison may be interested to know that I looked up practically every letter he has ever written to the *English Mechanic* before starting on this pleasant pursuit. I believe it is possible for every intelligent amateur to construct for himself, at a small expense, a telescope that will open up new worlds for him, and possibly the use of a slate, as described above, may be found a handy contrivance by those of limited resources.

COVENTRY.

[*English Mechanic and World of Science—December 26, 1913.*]

Professor Turner certainly startled the Royal Astronomical Society with his paper read at this month's meeting, suggesting that sunspots are caused by periodical encounters of Saturn with the Leonid meteor stream, and that these are responsible for several other facts of astronomy which are as yet unexplained. I do not propose to go into further details of the hypothesis, but an excellent summary, by the author himself, will be found in the *Times* of December 13, and commentaries on this in the two succeeding issues of the same paper. I will only say, as a matter of fact, that the reading began with some show of scepticism on the part of the audience; but Professor Turner put his case so convincingly, and brought forward evidence in support from so many quarters, that the Fellows present could not but feel interested, and he sat down amid sincere and loud applause, although as stated in the report in last week's number, it met with criticism on essential points.

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In the Observatory Magazine for December, Mr. Stanley Williams writes about the velocity of the markings. known

as the North Equatorial current; that between the years 1879 and 1889 this current continually slowed down, or in other words, the rotation period derived from it increased from 9 hour 50 minutes 30 seconds. From 1889 to 1911 its velocity remained very nearly uniform, but that the observations of this year show that the velocity has begun to increase again. No doubt it is something of this kind that Mr. Phillips has to tell us. It will be interesting to watch whether the velocity of the current returns to its large value of the year 1879.

[*English Mechanic—December 26, 1913.*]

Memoranda for Observers.

[Standard Time of India is adopted in these Memoranda.]

For the month of April 1914.

Sidereal time at 8 p.m.

	H.	M.	S.
April 1st	8	36	25
,, *8th*	9	4	0
,, *15th*	9	31	36
,, *22nd*	9	59	12
,, *29th*	10	26	48

From this table the constellations visible during the evenings in April can be ascertained by a reference to a star chart, as the above hours of sidereal time represent the hours of Right Ascension on the meridian.

Phases of the Moon.

		H.	M.	
April 4th	First Quarter	1	11	A.M.
,, *10th*	Full Moon	6	58	P.M.
,, *17th*	Last Quarter	1	22	,,
,, *25th*	New Moon	4	52	,,

Meteors.

	Radiant. R. A.		Dec.	Character.
April 7th—22nd	210°	—	10°	Slow; fireballs.
,, *18th—23rd*	189°	—	31°	Slow; long.
,, *19th—20th*	201°	+	9°	Slow.
,, *19th—22nd*	271°	+	33°	Swift; brilliant.
,, *30th*	291°	+	59°	Rather slow.