saw Mercury on Friday and Saturday, without, and on Sunday evening through a telescope, when it showed as a crescent. I have not looked for it since, but my sister observed it on Monday evening. It will be visible till the 10th proximo, but you will now be getting a young and waxing Moon in the early evening. I should *think* we saw Mercury about 12° to 16° above the horizon ; but I am *not* sure of the altitudes.

I have not looked for Mira which is now very much in the western sky.

Yours sincerely,
W. J. SIMMONS.

C. V. RAMAN, Esq.

Note by Mr. Raman.

Mr. Mitchell writes from Bankura on date, 22nd February, "Mercury is now easily visible ½ Moon." I saw Mercury myself very easily a little after sunset on the 25th, and it seemed to me that it was brighter than Polaris which was just visible at the time. My 2¼″ telescope showed the disc clearly, but the image was very unsteady.

C. V. R.

Extracts from Publications.

Jupiter.

Mr. Phillips replied that it was June and July 1913. The weather, fortunately, during the latter part of the summer, was unusually favourable, so that, although the planet was badly placed, they were able at Ashtead to get a large number of observations of these dark protuberances and white egg-shaped markings. He found that the equatorial current, or at least its northern part, was this year (1913) drifting at an unusually rapid rate. It was interesting to compare the velocity in 1913 with that of former years, and he had made a slide showing the rotation periods of equatorial spots from 1879 to 1913.

The number of spots made use of in some of the earlier determinations was rather small, but he thought the main results were reliable. From the slide it was seen that whereas the rotation period in 1879 was 9 hours 49 minutes 59 seconds, during the next ten years the velocity steadily diminished. By 1889 the period was fully half a minute longer, or 9 hours 50 minutes 30 seconds +, and throughout the next 20 years or so it oscillated between certain limits about this value with a slight diminution about 1900. He had no reliable results so far for 1912, but in 1913 the north equatorial spots before described showed an accelerated motion which was quite extraordinary. In fact, the value of the rotation period dropped to about 9 hours 50 minutes 12 seconds, practically what it was 30 years ago, and from the middle of August to the beginning of November it still further diminished to 9 hours 50 minutes 10 seconds. It was unfortunate that he had not got any results for the southern part of the current in 1913, but they might assume, perhaps, that the movement of the north equatorial spots represented more or less accurately the equatorial current as a whole in 1913. It would be interesting to see whether the accleration was maintained, and also whether the curve repeated itself. He supposed he could hardly expect to see it repeated in his lifetime, but he would like to see it fairly on its way.

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

Silvering Mirrors.

There is no lack of formulæ for the silvering of glass; but the technical difficulties which require to be overcome in the production of a silver coating of good quality, permanence, and adherence are as a rule very considerable. Many years' experience with the various recipes has shown that it is an easy matter to obtain perfect silvering on blown glass; but that the difficulties are encountered when dealing with surfaces of polished glass, particularly when these latter are silvered again and again. This is especially the case when the silvered surface is required to reflect satisfactorily from the coated side. Moreover, difficulties are likewise met with in polishing coatings of metallic silver, which are obtained in the chemical way without the required degree of reflective surface. The film of silver is extremely soft, and it is scarcely ever possible to subject it to after-polishing without scratching it. Therefore, it is highly necessary that a process of silvering should be used which yields a highly-reflecting surface without any after-treatment, or, at any rate, reduces such after-treatment to the minimum. Modern methods of silvering, especially those with formaldehyde, yield fine, even, and reflective surfaces; but the processes are most unreliable, particularly in the case of surfaces which have been frequently polished. For these they are practically useless, and altogether so when regard has to be paid to the even absorption by the silver film, as when preparing filters for ultra-violet light. Such silver coatings are invariably cloudy, as also are those prepared with Rochelle salt.

In attempts to prepare silver surfaces of satisfactory quality and permanence I have employed a process which I have worked out from the data of Professor Gehrke in conjunction with Dr. B. Seegert. It is one which is allied to the old Martin process, and providing that certain precautions are observed, yields excellent results. The method is exceedingly simple to carry. It does not call for any scrupulous purity of the chemicals, particularly of the caustic alkali and ammonia, whilst its results, as regards good reflective power, adherence, and permanence, are excellent even under unfavourable conditions. Moreover, the cleaning of the glass when this process is used, is not of such immense importance as it is in others, and there is not the necessity to keep the surface to be silvered under water, thereby increasing the difficulty of manipulation, and at the same time injuring the surface polish. The process in the form in which it is at present used is described below.

Cleaning the Glass Surface.

Any silver coating perviously on the glass is cleaned off with dilute nitric acid with aid of cotton-wool. The glass is then rinsed, and any traces of nitric acid removed with weak ammonia. The slightest trace of nitric acid on the surface or edges of the glass gives rise subsequently in the process to the most serious difficulties, *e.g.*, the silver film is liable to undergo partial solution locally. The glass, after this preparation, is dried with a linen cloth, and the cleaning process proper then carried out. This is done very simply as follows:— Equal parts of spirit of wine and commercial strong ammonia are mixed together and enough powdered inpalpable precipitated chalk added to form a thick mixture on shaking up. A few drops of this mixture are poured on to the glass, and rubbed over the whole surface quickly and evenly with cotton-wool free from grease. Before the mixture has quite dried off, a second tuft of cotton-wool is used with a quick, circular movement to remove the residue of the cleaning mixture, and as soon as the last trace has disappeared further rubbing is discontinued. Long rubbing with cotton-wool which has become dry tends to unevenness of the silver deposit. In the above manipulation it is important to use cotton-wool which is perfectly free from any trace of fat or grease, and the fingers should be in the same condition, for which purpose they are rubbed over, before commencing the work, with a little of a mixture of spirit and ammonia. The glass surface is now ready for silvering, and should not be dusted, nor, of course, touched. The silvering is best done immediately, or after an hour or so; plates which are kept for a longer time after cleaning are found to silver badly.

Preparing the Silvering Mixture.

The silvering solution is prepared from the following two stock solutions:—

A.	Silver nitrate	30 gm. ...	... 1 oz.
	Water ...	900 c.c. ...	... 30 oz.
B.	Caustic potash	20 gm. ...	... ⅔ oz.—90 gr.
	Water ...	900 c.c. ...	... 30 oz.

To prepare the mixture 750 cc. (26¼ oz.) of solution A is placed in a capacious bottle, and ammonia added to it until it is just decolourised. It is most important to avoid any excess of ammonia. It is best to ascertain the strength of the ammonia, and from this to add straight away nine-tenths of the whole, adding the remaining tenth drop by drop, with constant shaking until the exact condition is secured. This colourless solution having been prepared, the whole of solution No. 2 is now added very slowly, with constant shaking in order to avoid the formation of a coarse precipitate. There results a deep brown opalescent liquid, which is constantly shaken while further adding amonia drop by drop, until the point is reached at which a bright solution is temporarily obtained. Here also any excess must be carefully guarded against. The solution should be perfectly clear, but without excess of ammonia, and there is now added to it, with constant stirring, the remaining 150 cc. (5¼ oz.) of solution A, the addition of which produces a strongly opalescent brownish or yellowish liquid, which is at once filtered, and is then ready for use in silvering.

It is inadvisable to make up larger quantities of the silver solution than that given above. After an hour or two small quantities of a black metallic-looking precipitate begin to deposit, first forming as a crust on the surface, and then falling to the bottom. They do not affect the silvering so long as the solution is drawn off free from deposit, and old solutions work just as well as fresh. Experience has, however, shown that the storage of the silver solution is not without danger. In one instance we experienced a somewhat violent explosion of some litres of the mixture, which broke the containing bottle into small fragments. In other cases, where attempts were made to ascertain the properties of the silver solution, it was not found possible to provoke the explosion by artificial means. Even the black precipitate was found non-explosive; but, nevertheless, it is well to observe due care in its use.

As a reducing agent one can use either the usual inverted cane-sugar or grape-sugar solution prepared from pure grape-sugar. The inverted cane-sugar solution is prepared as follows :—

C.	Lump sugar ...	... 25 gm.,	385 gr.
	Tartaric acid ...	... 3 gm,	45 gr.

These are dissolved in 250 cc. (8¾ oz.) of water, and kept at boiling point for about 10 or 15 minutes until inverted, cooled, and 50 cc. (1¾ oz.) of alcohol added. The solution is then diluted with water to 500 cc. (17½ oz.). In place of it, a 5 per cent. solution of grape-sugar may be used with exactly the same effect.

The quantity of solution of the reducing agent in comparison with the silver solution is of some effect upon the result. If we use 10 parts of silver solution to 1 part of reducing solution, the process proceeds quickly, but the mirror is not of clean bright surface, and the deposit adheres badly. Larger quantities of reducing agent (about 30 per cent. of the silver solution) yield the best, most permanent, and brightest coatings. If the proportion of reducing agent be made still greater, the silvering then proceeds slowly; the coating is not such a fine surface, but extremely even by transmitted light. This last form of the process is very suitable when making filters for ultra-violet light; but the one given above is the best when silvering glass for use as a reflector.

Manipulation in Silvering.

The temperature of the silvering mixture is not of very great effect in the process; but the glass to be coated should not be colder than the solution. If it is warmer, all the better. The silvering takes place best when the surface to be coated is flooded with the silvering mixture immediately the latter has been compounded. Placing the surface to be silvered downwards gives bad results. It is best to use glass dishes in which the glass to be silvered is simply laid or is fastened to the bottom with two or three bits of wax. The silvering solution must cover the surface to be silvered to the depth of at least 8 mm. to 10 mm. (1-3rd to 2-5ths of an inch).

During the silvering process (which should not be carried out in sunlight) the dish is vigorously rocked continuously. The silvering solution speedily becomes golden yellow in colour, and after from 20 seconds to 30 seconds begins to deposit silver. If all has been done correctly, one sees then that the clean surface of the glass first assumes a beautiful sky colour, quickly assuming a silver grey tone and then a metallic surface. The silvering is allowed to proceed with constant rocking, until there deposit on the silvered coating tiny silver bodules of about the size of a pin's head, which grow from second to second and finally cover the surface with a grey coating resembling leather. But before this point is reached, the operation must be instantly stopped. The correct point requires to be learnt by experience. Silvering for too short a time gives a coating which is readily injured, whilst if carried out for too long a time the surface is dirty and of poor reflecting power. The silvering process is stopped by pouring off the solution quickly, and cleaning the silvered surface with distilled water, which can be sprinkled over it in a fairly strong stream. The silver adhering to the surface is thus removed as far as possible by sprinkling with distilled water, and the plate is then immersed in distilled water, removed without touching the surface, and a large tuft of cotton-wool wetted with distilled water carefully used over the silvered surface with light but gradually increasing pressure. The cotton-wool must on no account be too dry. It will be found after using it for a few minutes that the water is repelled by the silver surface, and as soon as this is the case over the whole of the plate from end to end, the plate is laid film upwards on a solid support, and the last traces of water removed by means of a sheet of filter-paper gently applied with the hand. The excellent adherence of the film enables all these operations to be carried out without risk.

After drying off the last traces of water, the surface should be perfectly uniform, and of fine reflecting power. For most purposes, it is ready for use without further treatment. As a rule, there is a delicate film of a bluish colour adhering to the surface. It appears to consist of finely-divided silver, but is of no disadvantage for most purposes. To remove it, which is necessary only when the silvered surface is to be used from the front, a clean tampon of mocha leather is taken and fastened over a pad of cotton-wool. The leather should be absolutely free from grease. After a few passages of the leather-across the surface, with fair pressure, the silver coating becomes perfect, and obtains the maximum of reflecting power. It is very seldom that small fractures are produced by this operation ; but they are never of such depth that they can be seen in diffused daylight, but are observable only in sunlight.

Mirrors prepared by the above described process retain their properties in pure air for an astonishing length of time longer than those prepared by most other processes. They are, of course, extremely sensitive to hydrogen sulphide ; but they can be kept protected for months against the action of this gas if they are wrapped in paper impregnated with lead acetate, or stored in a box with the lid covered with lead-acetate paper. When in course of time the mirror becomes tarnished by sulphade vapour, it is best to silver it afresh. It is difficult to clean up the tarnished surface. Mocha leather so used removes a part of the discolouration, but is apt to impair the mirror surface. An attempt to clean up the surface by use of a tuft of wood soaked in potassium cyanide solution was found to have the drawback of dissolving the silver deposits in parts. Dust which falls on the surface can, however, always be removed without danger with the leather.—(*Dr. A. Miethe.*)

[*English Mechanic and World of Science—January 9, 1914.*]

The Study of the Stars.

There is no department of Astronomy which is now receiving greater attention than the study of the spectra of the stars. Dr. Henry Draper was the first to photograph the lines in a stellar spectrum, although Sir William Huggins had already obtained a mark from the spectrum of Sirius, and later was the first to publish his results in successfully photographing steller spectra. The untimely death of Dr. Draper, in the midst of his work, led to the establishment at Harvard of the Henry Draper Memorial. For nearly thirty years Mrs. Draper has maintained an active interest in this work. By placing a large prism over the objective of a telescope, the light of all the brighter stars in the field is spread out into spectra, so that instead of photographing the spectrum of one star at a time, as with a slit spectroscope, as many as a thousand have sometimes been taken on a single plate. Such photographs, covering the entire sky, have been taken with the two 8-inch doublets already mentioned. A study of the spectra thus obtained enabled Mrs. Fleming to discover many hundred objects whose spectra are peculiar. Among them may be mentioned 10 of the 19 new stars known to have appeared during the years in which she was engaged in this work, while 5 of the others were also found at Harvard by other observers. She discovered more than 200 variable stars, 91 out of the 108 stars of the very peculiar fifth type, and showed that these objects occurred only very near the central line of the Milky Way. During the last two or three years a great demand has arisen for the class of spectrum of large numbers of stars. The Harvard photographs show the class of spectrum of nearly two hundred thousand stars. Miss Cannon has, accordingly, undertaken to prepare a catalogue of these objects, with the result that she has already classified about one hundred and fifteen thousand spectra, covering more than one half of the sky. The work is progressing at the rate of five thousand stars monthly, and the results will fill seven of the large quarto Annals of the Harvard Observatory. The organization of this work has required the most careful application of the principles of "scientific management."

[*Popular Astronomy—February 1914.*]

Jupiter 1913.

Red spot.

The red spot was seen here first on April 6, already well advanced in the dark region of the S. Tropical Disturbance. Its shape has been strikingly like a dirigible balloon with pointed ends. Its length (probably on account of the pointed extremities showing to greater advantage against their present dark background) has been somewhat longer than during the former apparition. The mean of measures on seven nights is 35°.60 $\pm$ 2° as against 26°·3 last year. Its color has been white, scarcely distinguishable from the color of the zone bounding (p and F) the disturbance. Up to the latter part of June the surface of the disturbed area has been almost uniformly dark whenever seen, except a faint brightening, with vague configuration following the RS. This, early in July, became concentrated in a small white spot nf the RS. which with the white portions immediately following streamed out in a sf direction, suggesting very strongly a drift from the more central regions toward a narrow channel between the RS. and the equatorial zone bordering it on the north. I could never be sure of any passage of material through the channel. The configuration was first sketched June 17 as removed some little distance from the RS., again July 3 as having advanced considerably, and being involved in the space between the RS. and the zone to the N. Its color had become quite brilliant. At first it showed an unbroken line with its front brightest and quite conspicuous, but by August 25 it had broken up into at least four separate little spots that continued in the same line. The front spot at this time was almost abreast the centre of the spot. It is this steady advance that causes us to suspect that in some quiet way the material has been conveyed to the preceding side of the RS., as the general material of the belt drifts past. The above described appearance was seen every night with one curious exception. On the 5th of August between 10 and 11, occurs the following entry. "The white spot just f the RS. cannot be seen : it seems to have disappeared." The RS. was then in full view with a quality of seeing rated 9-8 on a scale of 10. A peculiarity in the shape of the RS was seen in the shape of a very slight concavity on the nf side where it came into contiguity with the white mass just mentioned.

[*Popular Astronomy—February 1914.*]

A Wrong Attitude in Amateur Astronomy.

No doubt all amateurs, in taking up astronomy, take it up originally and primarily for pleasure, recreation and interest. This is natural and to be expected. Astronomy should not, however, even if studied at first for any of the aforesaid reasons, remain to the amateur who is sufficiently advanced and experienced, merely a means of obtaining personal pleasure; it should contain, even for him, a greater and more dignified signification. Yet how many amateurs are there who are content simply to entertain themselves and their friends with the telescope? I regret to say that there are too many. Just recently I had an experience with an amateur that may be of interest to relate here. I had occasion, upon knowing previously, that the gentlemen in question was one who might be called an amateur astronomer, and was provided with both a telescopic and a photographic outfit, to invite him to join the Society for Practical Astronomy, and particularly our Photographic Section (inasmuch as he was in a position to do photographic work so well). He replied rather dryly to my invitation that he was one of those persons who do not care to join scientific societies, as he did not have the time to contribute anything in the way of written articles, but he would feel, if he joined the S.P.A., as though it were his duty to do something in that line. I endeavoured to explain to him that such would not be expected if he did not have the time, and if he would send in the results of his work to the Director of the Photographic Section, the Director would gladly attend to the proper utilization and publication of them for him. He told me that he would consider the matter, and the result of the conversation was, as might be expected from the beginning, that he preferred to remain alone and cultivate astronomy for his own pleasure and amusement. Upon inquiry, I learned that this gentleman has a 4-inch refractor, permanently mounted under a revolving dome, and in addition to this, a 4-inch photographic lens by Brashear an outfit which any amateur might prize and justly be proud of, and which if, in the proper hands, could yield results of almost unlimited worth in more than one branch of observation. I cite this case merely as one typical of many that I have personally encountered since I began, some years ago, to do my part in the movement to unite amateur astronomers and incite them to work and to observe systematically. I may state that the gentleman alluded to is not by himself, but is representative of a singularly large number of amateur astronomers all over this country who, though they are able and willing to take the pains and spend the money required to build up a rare astronomical equipment, yet, at the same time, are unwilling to use that outfit in such way that it shall be of utility for anything outside of their own personal entertainment. I know of several such cases in one city, and know of a certain amateur who has a fine observatory, a magnificent large refractor with a varied stock of eye-pieces and other accessories, a micrometer, a camera, a spectroscope, in short, everything that one could want an equipment that would indeed be a credit to any college or university, who probably has never made or published a single observation of scientific value, although he has been interested in astronomy, I understand, most of his life !

[*Popular Astronomy—February 1914.*]

Memoranda for Observers.

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

For the month of May 1914.

Sidereal time at 8 p.m.

	H.	M.	S.
May 1st	10	34	41
,, *8th*	11	2	17
,, *15th*	11	29	53
,, *22nd*	11	57	29
,, *29th*	12	25	5

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

Phases of the Moon.

	H.	M.	
May 3rd First Quarter ...	11	59	A.M.
,, *10th* Full Moon ...	3	1	,,
,, *17th* Last Quarter ...	3	42	,,
,, *25th* New Moon ...	8	5	,,

Meteors.

	Radiant. R.A. Dec.	Character.
May 1st—8th	338°—2°	Swift ; streaks ; brilliant.
,, *2nd—13th*	245° + 3°	Slow ; bright.
,, *18th—26th*	246° +29°	Swift ; white.
,, *29th—June 4th*	333° +27°	Swift ; streaks.
May-June	353° +39°	Swift ; streaks.
May-June-July	252°—21°	Slow ; trains.