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COMET-HUNTING.

By William Reid.

"There is no royal road to learning," and my experience has taught me that the same applies to comet-searching. Occasionally a comet has been discovered by accident, but the great majority have been found by people who set out to search for them, and who kept up the search until they were successful. As I have had a little experience in comet-sweeping, it has been suggested that I should give a few details regarding what induced me to begin comet-searching, the instrument I use, my method of using it, and how I would recommend a beginner, who had determined to take up the work, to proceed.

Soon after the Cape Astronomical Association (now the Astronomical Society of South Africa) was formed, a "Comet Section" was inaugurated, and by some chance I was nominated Director. Why I was chosen for this office would be difficult to explain; I certainly had no more experience of the work than many of the other members. Upon taking office, I soon discovered that I should have to depend very much upon my own efforts if I intended making the Section a success. As I knew very little about comet-searching, I had to devise some method of search which would ultimately lead to success. The plan which I adopted was to search systematically the whole of the Southern sky at least once a month. This I soon found was rather more than I had bargained for. At first it was a very big undertaking. My knowledge of the Southern sky was very limited—it took me some time to get familiar with the many nebulæ which could be mistaken for comets, and it was only after I had mapped down hundreds of them that I was able to recognize them as old immovable friends. I must also admit that it took me some time to develop a rubber neck and back, and until I had done so I had some difficulty in explaining to unsympathetic friends the reason for my wry neck! I am afraid I did not always tell them the true cause.

After nearly three years' search without the long-looked-for new comet coming along, I almost came to the conclusion that I was never going to find one, and the idea was beginning to be forced upon me that there was something wrong with my method of search, or that a new comet, when first discovered, was so faint that it was beyond the power of my telescope. Just about this time, when visiting Mr. A. W. Long, I happened to ask him how he managed to make such a perfect job of printing the names of the constellations on his maps in the *Cape Times.* Mr. Long at once produced sheets of printed names which he had only to cut out and paste on his maps. I chanced to look over them, and, to my extraordinary surprise, I came on a column which read: "Reid's Comet," "Reid's Comet," again and again repeated. As may be guessed, this set me thinking. Here was one who had such faith in my ability to find a new comet that he had actually made provision to welcome the stranger whenever it appeared. I there and then made up my mind to continue the search until I found a new comet, or die in the attempt, and it is pleasing to state that Mr. Long was able to use the new name before the year was out.

I have somewhere seen it stated that a "comet-sweeper" is a "cheap telescope, of short focus, and a large field." I once looked through a telescope which answered this description, and I must say that there was no difficulty in seeing what looked like comets—*every star* had a tail, and the whole field was a nightmare! My advice to anyone taking up comet-searching in earnest is to buy the largest and best telescope he is able to afford, but, whatever its size, to make sure that the definition is perfect. Without perfect definition the eye soon gets tired, and there is plenty to tire the eye in comet-sweeping without instrumental defects of this kind. My own telescope is a six-inch Cooke, photo-visual, and gives very fine definition. The mounting, unfortunately, is a home-made one, equatorial, rather rough, and not very true, but it is firm, and I have managed with it so far. One cannot get everything, and for comet-sweeping it does not matter so much. With my six-inch photo-visual, sweeping is very trying owing to its abnormal length—at one end of the sweep I am on my knees, and at the other on the point of my toes. I have got accustomed to this, but I would recommend a beginner to get a telescope of shorter length, as he will find it very much easier to handle, and will not require to put in an apprenticeship as a contortionist, which might result in him giving up the work before he had well started. It is well to get a very low-power eyepiece for ordinary sweeping, and also one a little stronger, which sometimes comes in handy in resolving what looks like a hazy patch into its component points of light.

In my search for comets I restrict myself almost entirely to the Southern sky. As soon as the full moon is gone I start work in the Western sky, sweeping in declination with the Right Ascension axis fixed. I start about 30° from the South Pole, and make the sweep just long enough for the earth's rotation to bring a new field into view each time. There is always a certain amount of overlap at the Southern end, but this cannot be avoided. I find it most convenient to sweep from left to right, swinging the telescope back at the end of each sweep, but this is a point which each one will soon decide for himself. The following night I start in the East and follow the same procedure. By this method, starting each night where I left off the previous night, I used to cover the whole Southern sky once each month. For some time back (owing to various causes) I have been unable to do this, but I still manage it occasionally. Working in an office as I do all day, I had to devise some method of search which would not interfere too much with my night's rest. So I hit on the plan of sweeping until three o'clock in the morning the first Sunday when there was no moon, and working from three o'clock in the morning until dawn the following Sunday. Near the South Pole I still sweep in declination, but move the telescope in Right Ascension to get a new field, as the earth's rotation is too slow to give a new field at the end of each sweep.

I do not pretend to say that my method of work is the best—some might like an alt-azimuth mount; I certainly think it would make the search much easier—but, whatever method is adopted, my advice is to do the work thoroughly. It is better to search a part of the sky well than to run over it too quickly. A faint comet is very easily missed, and most comets, when newly discovered, are faint.

In addition to a good telescope, the comet-hunter must also have a Star Atlas. For the constellations and the brighter stars and nebulæ, Norton's Star Atlas is very good. For finding positions and star fields, there is nothing better than the photographic star charts published by the Union Observatory, Johannesburg.* I have found them exceedingly useful, and for the amateur comet-hunter they are the best maps which have yet been published. A copy of Dreyer's New General Catalogue of Nebulæ and Clusters of Stars is also very useful.

At first comet-sweeping is very wearisome, and, until one's neck, arm and back get accustomed to the unusual work, is rather painful, but this soon wears off, and before long one is able to keep up the search for hours on end without any discomfort. It then becomes very fascinating: the continual change of field,

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* Taken by the 10-inch Franklin-Adams Star Camera. The charts are enlarged, covering 30 square degrees, on a scale of 36 mm. to 1°, with equatorial co-ordinates ruled by hand, and showing stars to about 14th or 15th magnitude, between 19° South Dec. and the South Pole.—Ed.

beautiful combinations of stars, now a dark patch, then a blaze of light, where the whole field is one mass of glittering gems, with every now and then a nebulous patch which creates a flutter of excitement, as it may be a comet; and when the comet does come along the excitement and pleasure is intense. Do you remember when you caught the big trout in the pool below the waterfall, which had defied your utmost efforts for weeks? Or the "Proud Monarch of the Glen" which you had laid low, after following it on hands and knees through corries, heather and peat, for the best part of a day? If so, you have a faint glimmer of the ecstasy and pleasurable sensations which you will experience when you land your first comet. Bakie, in his work, "Through the Telescope," says: "Comet-hunting is somewhat monotonous and laborious, and seems to require special aptitude, and, above all, an enormous endowment of patience. Probably the true comet-hunter, like the poet, is born, not made." It is true that the work is laborious, and requires a tremendous amount of patience and perseverance, but it is far from monotonous. In comet-hunting one has the whole sky in which to revel, among never-ending streams of clustering gems and groups of stars, to say nothing of the thoughts which accompany the sight. I might go on enlarging upon this subject, but refrain from doing so because I know that comet-sweeping is the most absorbing and enlightening work which an amateur astronomer can take up. Compare it with the monotony of keeping a star for hours on the intersection of two spider's threads, and I think you will agree with me that comet-seeking is a pastime compared with that!

When an object which may be a comet enters the field, it is a good plan to determine its position so that you may be able to pick it up again, and also to make as correct a drawing of the field as possible. If you have noted its position with reference to the stars in the field, you may be able to detect movement within an hour or two. If movement is detected, report the find to the Director of the Comet Section *at once,* and it may also be well to report to the nearest Observatory. It should never be forgotten that *the one who reports first gets credit for the discovery.*

If possible, when selecting a site for your observatory, choose one where you can get low down in the East and West. All comets approach the Sun at one period of their course, and as they are nearly always brightest near perihelion, there is more chance of finding them near sunrise or sunset. If unable to obtain such a site you need not give up comet-hunting on that account. I am wretchedly situated for comet-sweeping, having houses and trees on all sides, with Table Mountain effectually blotting out the West. Yet I have been fairly successful, and you need not despair so long as you can see a fairly large part of the sky.

Since beginning this paper I have been asked quite a number of questions, most of which I have already answered, but, as the subject of several has not been touched upon, I will try to answer them to the best of my ability. I do not search in bright moonlight, nor do I continue the search when there are a lot of driving clouds about, or when the seeing is very bad. To give an account of the number of hours spent for every comet I have found would rather deter young astronomers from taking up the search. I think one comet per annum would be a good catch, *after* one gets familiar with the nebulæ. I work without light of any kind, but when forced to consult a chart or take a field, I use a bright electric lamp with the light shaded from my eyes. My light is at the end of a long flex, and I can move it wherever I want it. When sweeping I average from four to five hours per night. My record is from seven o'clock at night until three o'clock the next morning, with a rest of half an hour. I have often spent the night in my observatory when the seeing was particularly good, taking a short rest every now and then. On the other hand, I have often been forced to close down almost as soon as I had begun, on account of clouds or mist. If the night is good my plan is to go on as long as I possibly can.

To succeed at comet-hunting means devoting every hour you can to the search, making up your mind that you are going to succeed, searching systematically, never despairing, and, above all, never giving in. I am quite confident that if you work upon these lines your patience and perseverance will be rewarded. The prize may be some time in coming, but it will come.

JUPITER.

By A. W. Long, F.R.A.S.

(Seventh of a Series of Lectures on the Solar System by Members of the Cape Centre.)

We have now come to what may be called the second stage of our journey through the Solar System. Hitherto we have visited the Sun and its most immediate attendants, and have investigated the problem of the little army of asteroids which enclose the terrestrial planets. Beyond the region of the asteroids we come to a part of the Solar System whose members seem to belong to a different class, surpassing, as they do, in magnitude and in distance from each other, the Earth and its neighbours.

The asteroids are placed between two groups of planets which are each four in number. The members of the inner group are called terrestrial planets owing to their nearness and similarity to the Earth. They might also be called the aged planets, as they are at a greatly advanced stage in their life's history. The members of the outer group are called the major planets on account of their great size. They might also be called the young planets, as they have a long way to go before they reach the state of development attained by the Earth and its sister planets. The first of these outer planets is the mightiest giant of them all, and our surprise at its immensity is all the more striking by its contrast with the tiny little worlds which immediately precede it.

The appearance of Jupiter to the eye does not suggest to us that it is of so surpassing magnificence, as it is greatly excelled at all times by Venus, the Earth's twin in size. The fiery Mars, only one-tenth the size of the Earth, sometimes attains greater splendour than Jupiter, and even the elusive Mercury can rival it when it gets a proper chance. We find, however, that it is only on account of their comparative nearness that the inner or inferior planets show to so great advantage.

Mercury and Mars are dull objects except when they closely approach the Earth; the former comes to within 48 million miles of us, and the latter is sometimes as close as 35 million miles. Venus, whose maximum brightness does not altogether arise from a closer approach to the Earth, is never more than 160 million miles away, but Jupiter can never get closer to us than 367 million miles, and is sometimes as far away as 600 million miles. When, therefore, we see him shine so brightly, having the knowledge of his great distance, we begin to realize what an immense body he must be.

The telescope helps to increase our respect and admiration for this most lordly planet. An ordinary 3-inch telescope is sufficient to reveal to us his glowing disc; in it we behold at a glance his spheroidal form, and admire the beautiful markings that adorn his face—an enchanting vision which we are ever eager to share with our friends, and which, on account of the ever-changing aspect of the four brilliant satellites which attend him, never palls nor grows stale.

Let us look a little closer and measure the size of Jupiter. We find that this massive globe has a diameter of 88,700 miles, if measured equatorially, and 82,800 miles if taken from pole to pole. The volume of the planet is so colossal that it is sufficient to make 1,300 bodies as large as the Earth. If we could cut up this gigantic world into moons the size of our own, we would find that there would be enough to fill one-third of the sky if placed at the distance of our moon. We find on further enquiry that Jupiter is larger than all the other planets combined.

When viewing Jupiter for the first time in even a small telescope, one of the first things that strikes the observer is the shape of the disc. It is seen to be distinctly flattened at the poles. The compression is estimated at about 1/17th. This wide departure from the spherical form is due to the great rapidity of the planet's rotation, his huge size, and the powerful centrifugal force which is set up in equatorial regions. Jupiter rotates in a period of about ten hours, so that an object on the equator whirls round at the rate of about 8 miles per second.

We have evidence regarding the primitive condition of Jupiter in the nature of its rotation. All parts of the surface do not rotate in the same period. It is found that the equatorial regions complete the circuit in a shorter period than do those of higher latitude. Regions near the pole require seven minutes longer for their revolution. It is also seen that different spots in the same latitude travel with different speeds, and even the same marking has been observed under careful scrutiny to vary its speed. This all goes to show that at any rate the visible surface of Jupiter is not solid matter. A comparison of the volume and mass of Jupiter confirms this. In volume Jupiter is 1,300 times the size of the Earth, but in mass it is only equal to 316 Earths. Its density is only about one and a third times that of water. It is therefore to be assumed that for some distance from the surface it is in a gaseous or plastic state.

It is obvious, when observing Jupiter with a powerful telescope, that we are not looking upon the face of a solid world, but upon an immense sea of cloud broken here and there by visions of a dusky interior. These patches of dark shadings are not constant, but, considering that they are due to cloud formations, they show extraordinary stability. The principal markings lie in bands parallel to the equator. The most constant features are two broad bands of dark colour, one on each side of the equator. The light bands lying between and to the north and south of the dark zones are obviously clouds reflecting light highly as our clouds do. These clouds are not caused by evaporation through the sun's heat. They are not affected by night and day, but as they come round the edge of the disc they appear practically the same as when they passed from our view at the other side, that is, they are the same at sunrise, sunset and midday. A particular marking may endure for 24 hours or for as many years. It is therefore inferred that they are caused by the internal heat of the planet.

Most astronomers consider the planet's surface, as we see it, to be purely atmospheric, but there are others who believe that we are looking at the hot, pasty, semi-liquid surface of the globe itself, and that it resembles the interior of one of our active volcanoes. It is also suggested that the first thin layers of a crust are being formed around what was once an incandescent liquid sphere, and that, as the temperature in the upper strata of Jupiter's atmosphere is now probably low enough to condense water vapour, copious rains are continually falling. These rains do not reach the surface, but are evaporated in the lower strata of the atmosphere, and ascend to be recondensed. This rainy cycle is supposed to last for several centuries to come.

If Jupiter has a solid surface, it must be sunk very far below the envelope of clouds which surround the planet and at a depth to which the Sun's rays are unable to penetrate. Life, therefore, as we know it, cannot exist on Jupiter.

Jupiter's axis is nearly perpendicular to the plane of his orbit, the departure from the vertical amounting to only 3 deg. 5 min. If Jupiter were like our Earth in other respects, this very small inclination would debar him from having seasons like ours.

The Earth, as seen from Jupiter, is never very far away from the Sun, and scarcely reaches what we would call naked eye visibility, its greatest angular distance being only about 12 degrees, or half that of Mercury as seen by us. Flammarion says: "If the Jovian astronomers, present or future, observe the Sun with attention, it is in the transits of our little globe across his disc that it will be most easily discovered. It is thus that they see us from there. . . . Assuredly, if it were rumoured in Jupiter that the inhabitants of this little black point maintain that the whole universe was constructed for them, it is very probable that the good Jovian citizens would burst out into such an Homeric laugh that it would be audible from here."

That Jupiter is very far from being in a solid cool condition was noticed as far back as 1860, when G. P. Bond found that Jupiter was a much better reflector of light than our Moon. He computed their relative albedos to be in the ratio of 14 to 1. As the Moon reflects 17 per cent. of the light received from the Sun, it appeared to Bond that Jupiter gave out more light than he received. Others have claimed to have detected proofs of internal luminosity.

Later estimates of Jupiter's light-reflecting power place it at from 62 to 75 per cent. The albedo of white paper is 0.70, and that of freshly fallen snow is 0.75. The disc of Jupiter is not by any means as white as snow or white paper. It is covered with dusky markings, and the general ground is yellowish. If, therefore, it reflects light almost or quite as much as white paper, there is reason for the suggestion that the planet must have at any rate a small amount of inherent light.

If this be true, then this planet may be looked upon as a miniature sun getting towards the dark stage. The disc of Jupiter, like that of the Sun, is brightest towards the centre, whereas the terrestrial planets are brighter towards the edge. This may indicate that Jupiter sends out light of his own, but, if so, the amount of it must be very small, as it is not sufficient to light up his satellites when Jupiter shuts off from them the light of the Sun. Another proof of the feebleness of Jupiter's inherent light is observed when a satellite is in transit. The shadow of the satellite on the planet's surface is very black, which shows that the inherent light of Jupiter is a pretty negligible quantity.

On the other hand, the rapidity of some of the changes which we observe on the surface of the planet implies the expenditure of a great amount of heat, and, seeing that the Sun's rays, coming as they do from so great a distance, cannot account for this, it is certain it must come from within the planet. Zollner says that in all probability the temperature of Jupiter cannot fall very far short of incandescence. Owing to its enormous distance, the heat Jupiter derives from the Sun is only sufficient to leave water on the surface of the planet at 500 deg. below freezing-point. The clouds which we see must, therefore, arise from internal heat. We can understand this condition of Jupiter if we assume that the Earth and it had their origin in the same nebula, in which case Jupiter would retain its heat for many ages after the Earth had cooled down.

All movements of the Earth's atmosphere are solar heat rays transformed into motion, but the Sun's rays at the distance of Jupiter are only 1/27th as powerful as at the Earth's distance. Therefore, as Miss Clerke says, speaking of both Jupiter and Saturn, "The large amount of energy, then, obviously exerted in these remote firmaments must have some other source, to be found nowhere else than in their own active all-pervading fires, not yet banked in with a thick solid crust."

There is evidence in Jupiter's spectrum of the presence of inherent light. Vogel has noted a strong band in the red which agrees with a dark band in the spectrum of red stars. Proctor concludes: "It would seem that the inherent light of Jupiter, which probably forms but a small portion of the light we receive from the planet, is closely akin to the light of those red stars which have been regarded as far advanced in stellar old age, and that, were it not for the light, almost white, which Jupiter reflects, he would shine with a well-marked red colour."

Proctor demonstrates that the small density of Jupiter is explainable only on the assumption that Jupiter is heated sufficiently "to emit through a non-luminous cloud-laden atmosphere some small portion of inherent light." He goes on to say: "But the theory that Jupiter is intensely hot by no means requires that he should give out a large proportion of light. His real solid or liquid globe (if he have any) might, for instance, be at a white heat, and yet so completely cloud-enwrapped that none of its light would reach us. Or, again, his real surface might be like red-hot iron, giving out much heat but very little light."

The idea of the globe of Jupiter being in a semi-liquid condition is based on the assumption that the disc we see represents the actual body of the planet. Sir Geo. Darwin, however, has shown that if the real dimensions of Jupiter were so great, there would be perturbations among the satellite system which we know have no real existence. He concludes that the real globe of the planet lies far within the circumference we see and measure.

In a paper published in 1923 in the Monthly Notices of the Royal Astronomical Society, Dr. Jeffreys suggests that the evidence hitherto advanced in support of the theory that Jupiter and the other great outer planets are very hot, and that a large proportion of their volume is occupied by gas, is very inadequate. He contends "that the data are more easily reconcilable with the hypothesis that these planets are cold and solid, their materials being of low density in comparison with terrestrial rocks." He considers that the amount of heat that Jupiter would have lost by radiation, if its interior were in complete thermal communication with its surface, would, on any reasonable assumption of its original temperature, be sufficent to solidify the planet, "and, if it solidified, the hypothesis that there is free thermal communication from the interior to the surface breaks down." "Thus the surface would cool down until it was much cooler than the interior, and heat would only slowly be conducted out."

Because the density of Jupiter is comparable with that of water, it has been assumed that a large portion of its volume is gaseous. Dr. Jeffreys says this argument is open to suspicion, and holds that the low density affords as good an argument for the assumption that Jupiter is solid as against it. He points out that, although their densities are nearly equal, Jupiter's mass is 21 times that of Uranus, and "it is very unlikely that, if much the larger portions of their volumes were in the gaseous state, the ratio of the volumes occupied by matter in the gaseous and solid or liquid states would in all cases be just great enough to make all four planets of roughly similar density."

Dr. Jeffreys' theory implies that the outer planets are all composed of matter very different from the chief constituents of the Earth. This would not be inconsistent with the tidal theory of the origin of the Solar System, as "the inner planets would, on account of their low mass, have lost most of their lighter materials, whereas the outer planets would have retained them."

(*To be continued.*)

THE STORY OF THE SOUTHERN CONSTELLATIONS.

By Theodore Mackenzie.

The stars were originally grouped into constellations about B.C. 2700 by an unknown race living in a latitude about 40 degrees North. The constellation designers paid little or no attention to shapes suggested by stars in any particular neighbourhood but requiring, probably for religious purposes, a dragon in one part of the sky or an eagle in another, they named the stars in those parts accordingly. It is possible that this race lived to the east of the Caspian Sea, as recent excavations have revealed a similarity of culture between that locality and the earliest civilization of Sumer and Akkad. It is through the latter peoples and the Greeks that the original constellations have come down to us practically unaltered.

The oldest complete catalogue of these star-groups which we possess is that of Ptolemy of Alexandria who flourished in the second century A.D. This catalogue contains 48 constellations, of which the fifteen South of the Ecliptic are Cetus, Orion, Eridanus, Lepus, Canis Major, Canis Minor, Argo, Hydra, Crater, Corvus, Centaurus, Lupus, Ara, Corona Australis and Piscis Australis. Twelve of these were recognised at a much earlier date, but Hipparchus added to the twelve Fera, afterwards called Lupus, which he took from the stars forming Centaurus, and Ptolemy added Corona Australis, while he divided the original Canis into Canis Major and Minor. Eridanus was called by Aratos, a Greek poet, and Ptolemy simply the River (Gr. Potamos) but the name Eridanus (the River Po) was subsequently added.

At the time when the constellations were designed the South Pole of the Equator was in Hydrus, about half-way between Alpha and Delta of that group, and the whole region South of 50 degrees South Latitude was invisible to the designers and of course could not be divided into groups of stars. By Ptolemy's time the Precession of the Equinoxes had changed the position of the South Pole; new stars appeared to the watchers in Northern latitudes and others with which they were familiar disappeared but no new designs were added to the Southern skies.

The stars of the Southern Cross were visible to the designers of the constellations but made no special appeal to them and were only included as a part of the Centaur. No surprise need be felt that Ptolemy did not create the constellation of the Cross; it would make no appeal to him but it is certainly remarkable that Marco Polo the Venetian (1271-1295), whose travels in the East included Java and other islands of the East Indies and who reached ten degrees of South Latitude and must often have seen it, never even mentions it as a striking object of the heavens

He, however, took no interest in astronomy, his almost solitary reference to the stars being "The North Star is not visible here nor even the stars of the Wain." Those that believe Dante's Four Stars refer to Crux ascribe his knowledge of them to stories brought home by Marco Polo but if they had impressed the latter he would surely have mentioned them in his writings.

In the fifteenth century A.D. the Portuguese in successive expeditions explored the West Coast of Africa further and further South until in 1488 Bartolomeo Dias rounded the Cape. During the latter half of that century the wonderful Cross in the South became a well-known object to these navigators and in 1500 or 1501 we find Maitre Joao, physician and astronomer to King Manoel, writing of the stars "of the Cross" as an accepted asterism. Ludovico de Varthema who was in Java in 1503 also refers to the wonderful Cross revolving round the South Pole at a distance of about 30 degrees. Amerigo Vespucci was the first to identify the Cross with Dante's four stars, a still unsettled controversy which there is no space to discuss here. He also claimed to have been the first to see them since the Fall of Man, a claim as absurd as most of his others.

Andrew Corsali whose narrative was written between 1515 and 1517 is another who refers to the Cross and there are many others. Camoens is strangely silent about it. The English navigators called it "The Croziers" and the "Guards of the Pole." Seamen of all nations used Alpha Crucis to determine their latitude from its accepted South Polar distance. The duplicity of this star was discovered at the Cape by Father Tachard. When therefore the authorities unite in saying that the Southern Cross was added by Royer in 1679 they are only telling a part of the truth.

I do not know whether the native navigators of the Indian Ocean used the Cross for latitude. They travelled far and wide and were acquainted with the Eastern Coast of Africa as far South as Cape Correntes. *Vide passim* the narrative of Sindbad the Sailor, a curious mixture of fact and imagination. Sixteenth-century travellers in the East Indies speak of the navigators of the seas South of Sumatra and Java using it as a guide, and in a recent number of the *B.A.A.J.* it is stated that the Maoris used it in their voyage across the Pacific to New Zealand. Two of Vasco da Gama's pilots about 1506 made use of it not only for latitude but for determining the variation of the compass and as a timepiece.

If this article comes into the hands of readers who have never seen the Cross such may be glad to know that a very fine picture of it and the surrounding region is to be found in Professor Forbes' "David Gill, Man and Astronomer." The "Coal-Sack" is however incorrectly shown as penetrating into the Cross near Beta.

The first additions to Ptolemy's list of Southern Constellations were made (if we except the Cross) in Bayer's Atlas in 1603. These were Apis (now known as Musca), Avis Indica or Apus, Chamæleon, Xiphias or Dorado, Grus, Hydrus, Indus, Pavo, Phœnix, Piscis Volans, Tucana and Triangulum Australe. The name Apus came to be preferred to Avis Indica and as it was likely to be confused with Apis the latter was changed to Musca.

The origin of these groups is explained in the following note by W. T. Lynn: ". . . A reference to Bayer will show that he truly stated the matter in this way; that various navigators had given names to some of the constellations in the extreme Southern part of the Heavens, but that the first clearly to define and locate them was Petrus Theodori, whom he calls 'nauclerus peritissimus.' The real name of this skilful pilot, who accompanied the Dutch expedition of four ships which sailed to the East Indies in 1595, was Pieter Dirck Keyser. As might be expected, due reference to his name, as practically the author of the nomenclature in question, is given in that well-known and highly valued repertory, M. Houzeau's 'Vade Mecum de l'Astronomie.' But in this reference there is an error respecting Keyser himself which it may be well to point out for correction in future editions. It is said of him that he, in 1597 'revint d'un voyage aux Indes.' As a matter of fact he never returned as he died off Bantam in Java on the 11th (not the 1st as stated by Wolf in his 'Geschichte der Astronomie') of September, 1596. . . .

"Soon after Plancius, whose pupil Keyser had formerly been, obtained possession of his observations of the Southern stars, by which means the constellations formed by him were afterwards inserted on celestial globes and charts. Bayer gave at the end of his Uranometria (published it will be remembered in 1603) a map containing these twelve constellations, but without attempting to affix letters to the stars in them, as he had done in his maps of the ancient groups."

For a criticism of the accuracy of these maps I must refer the reader to my translation of Father Tachard. In the "Studio" of 1924, May 15, there is a very interesting reproduction of an engraving of 1592 called "Plancius Taking a Sight." The picture is of a ship on the poop of which Plancius is seated with a compass before him. Attached to the compass is a quadrant through which is passing a ray of light from the sun. There are two legends, one being "Orbis longitudines repertæ e magnetis a Polo declinatione" and the other "Magnete paulum utrinque sæpe devia dat invenire portum ubique Plancius." The first means "Longitudes found by means of the declination of the needle from the Pole" and the second "By means of the needle, oft varying a little from one side to the other, Plancius enables us everywhere to find a harbour."

Jacobus Bartschius added Monoceros and Columba Noachi about 1624, the former apparently at the expense of some of the classical constellations, and Hevelius named the "Cape Clouds," as they were called by the mariners, after Magellan. These, known to astronomers as Nubecula Major and Nubecula Minor, are of course not constellations in the strict sense of the word but they are mentioned here in order to complete the history of the Southern Skies. Hevelius also added Sextans in 1624.

Halley was at St. Helena in 1677. He compiled a catalogue but omitted Indus and Crux. His fervent loyalty led him to name a new constellation of his own Robur Carolinum (King Charles' Oak). This is not to be found among the present constellations for a reason which will presently be explained.

In 1751-2 the Abbé de la Caille sojourned at the Cape and did an almost incredible amount of astronomical work. He found that in the heavens there still remained large spaces strewn with lucid stars not represented on the charts and accordingly formed new constellations. He disliked the idea of imitating the ancients in assigning to these "names of animals unknown in Europe" and disliked still more the idea of pandering to royalty as Halley had done; so he "formed figures of the principal instruments of the fine arts." His constellations are Sculptor (the studio of the sculptor), Fornax (the chemical furnace), Horologium (the clock), Reticulum (the rhomboidal net which he used as a micrometer), Cælum (the engraving tool), Pictor (the painter's easel), Pyxis (the mariner's compass), Antlia (the air-pump), Octans (the octant, or quadrant of reflection used by navigators), Circinus (the geometrical compasses), Norma (the set-square and rule), telescopium (the telescope), Microscopium (the microscope), and Mons Mensæ (our own Table Mountain). The pseudo-classical titles are here given in their shortened form. I must point out that the English names are not necessarily translations of the titles. The titles in brackets are taken from La Caille's own description of what he intended to represent. Mons Mensæ or Mensa as it is now known was a very happy choice as at its upper culmination the Greater Cloud of Magellan is correctly placed to represent the south-easter cloud descending on Table Mountain. It must be admitted that some of the Abbé's Latin titles "would have made Quintilian stare and gasp."

La Caille says: "In imitation of Bayer I assigned Greek and Latin letters to all the visible stars of the new constellations and to all those of the ancient ones which did not possess them. The alphabetical order of the Greek letters is approximately that of the brilliancy and magnitude of the stars. I was compelled to alter the letters which Bayer had assigned to the constellations of the Ship, the Centaur, the Altar, the

Southern Fish and the Wolf, both because they were very badly distributed, and because many of the brighter stars had no letter at all. It was often impossible for me to recognise in the sky a star to which one of these letters had been assigned, which arises without doubt from the fact that Bayer constructed his planispheres of this part of the heavens from the ancient catalogue of Ptolemy and the rough observations of Portuguese pilots. I was also compelled to give Latin letters to the stars in the southernmost portions of Eridanus, the Great Dog, the female Hydra and the Archer, in which constellations I have retained Bayer's Greek letters.

"The constellation of the Ship is composed of more than one hundred and sixty stars very easily distinguished by the eye. I first assigned Greek and Latin letters to all the brightest stars composing it and then divided it into three parts, viz., the Stern, the Hull and the Sails. The Stern is separated from the body of the vessel by the rudder and I called the Sails all the part above the vessel between its deck and the horizontal mast or yard on which the sail is furled. To each of these parts I asigned Latin letters, capital and small. . . .

"You will not find here the new constellation which Mr. Halley inserted into his planisphere in 1677 under the name of Robur Carolinum since I have restored to the Ship those bright stars which that astronomer, then aged twenty-one, took away from it that he might pay court to the King of England. However laudable was the motive I cannot approve of the method adopted by Mr. Halley in fashioning his constellation, for in order to make it appear isolated he has left uncharted fairly bright stars between the Ship and his tree, and to make people believe that the stars composing his tree were new or had not hitherto been observed he made no comparison of their position with those of the ancient catalogues as he always did with regard to the stars of other constellations. However, of the twelve stars of which Mr. Halley's tree is composed nine are in the ancient catalogues and are designated by their proper letters in the planispheres of Bayer in the constellation of the Ship. Finally, there is no doubt but that all the fifteenth and sixteenth century observers of southern stars, making new constellations from them, always assigned to the Ship all the stars composing Mr. Halley's tree. But is it conceivable that while they formed the constellations of the Flying Fish and Chameleon, near neighbours of the Ship, and composed of stars, the brightest of which are of the fifth magnitude, they should have left between the Centaur and the Ship a large space full of stars of the first, second, third and fourth magnitudes so well grouped with those of the Ship?" So ended Robur Carolinum!

The following criticism of Halley and La Caille is by W. T. Lynn. He says: "Halley adopted these names [Bayer's.—T. M.] of constellations in his southern catalogue, including also those named by Royer and as I remarked above, his own asterism detached from Argo and called by him Robur Carolinum. The stars in these constellations he indicates entirely by their positions in the figures, and as all astronomers are aware, Flamsteed took care to give similar positions, in addition to affixing Bayer's letters, to most of the stars in the British Catalogue. It was reserved for Lacaille to give letters to the stars in the constellations near the South Pole. He endeavoured, unlike Bayer, to make the order of letters follow strictly that of the brightnesses of the stars. . . . Yet as Dr. Gould remarks in his 'Uranometria Argentina' this object was by no means accurately carried out, there being many exceptions to this intended correspondence, the cause of which, as Dr. Gould points out (p. 54), is not far to seek. Very few of the 9766 stars contained in the 'Cœlum Australe' were observed more than once, so that the estimates of their magnitude were necessarily hasty and often affected by atmospheric influences. Moreover the notation seems to have been adjusted after Lacaille's return to France, when there was no means of referring to the sky in doubtful cases; and he also appears to have modified his observed magnitudes in some instances so as to produce a better accordance with those assigned by Halley when observing at St. Helena."

The last statement is pure conjecture and sounds incredible to one who has read La Caille's own account of his work. It appears to me that some other reason must be found for apparent mistakes in La Caille's estimates of magnitude. Here is his own statement of his method: "The magnitudes of the stars were determined by comparing them with one another with the naked eye with all possible care. Every star of this catalogue is at least of the magnitude assigned to it, for whenever I had any doubt, for instance, if I were not certain if the star I was examining was of the third or fourth magnitude I relegated it to the fourth magnitude. Stars of the sixth magnitude however, which are not distinguished in the catalogue by a letter were only estimated at their magnitude when in the telescopic field, and it may be that some are below the sixth magnitude because at the moment of observation the small stars appeared more or less bright in the telescope according to different circumstances, for instance according to whether the eye was more or less affected by other light, whether the sky was more or less clear and whether it was affected by the moon or by darkness."

It will have been noticed that La Caille is quite definite about dividing Argo into three constellations, Carina, Vela and Puppis. In modern atlases such as Proctor's and Norton's Argo is divided into four, Malus being added. In these atlases there is no Pyxis. Bailly is, I believe, responsible for the substitution.

Admiral Smyth, in his "Cycle of Celestial Objects," 2nd ed., 1881, refers to the anachronism of La Caille's providing the ship Argo with a compass but I submit that there is not a scrap of evidence that La Caille did anything of the sort. Pyxis Nautica is merely one of the scientific instruments pictured by him and its proximity to Argo is no more significant than that of Antlia. Regarding the objections raised to his choice of objects suitable to be represented in the heavens I should like to quote his own reasons but lack of space forbids.

La Caille's catalogue of 9766 stars of the Southern Hemisphere was edited by Sir John Herschel and published in 1847. In his Preface Sir John says: "Lacaille as is well known to astronomers made the zone observations of his Cœlum Australe Stelliferum in 1751 and 1752 with a small telescope 26¼ French inches in focal length and half an inch in aperture, magnifying about eight times, attached parallel to the telescope of his mural quadrant, which continued firmly clamped to the limb during the whole of each night's observations. The principle of observation in these zones consisted in noticing the moments of ingress and egress of each star which presented itself in the field of view, into and out of a rhomboidal area bounded by parallel edges of brass (filed out of one piece) exactly adjusted in the focus of the object glass. The mean of the times thus noted (to the nearest integer second) in the case of any object gave the time of its transit over the imaginary vertical diagonal of this rhomboid; while their difference, or the interval between the moments of ingress and egress reduced into arc by the approximate polar distance, gave the length of the horizontal chord of the rhomboid traversed by the object, whence by an easy calculation its distance from the upper or lower vertex (according as the transit took place in the superior or inferior half of the rhomboidal area) or its difference of declination from that vertex, or from the horizontal diagonal of the rhomboid could be obtained. . . . It is true that with an instrument so defective in optical power as that used, and with no greater exactness in noting the moment of ingress and egress, much precision was not to be expected, and Lacaille himself considers 30 seconds in arc as an amount of error to which the observations are liable."

It almost savours of impiety to question a deliberate statement of Sir John Herschel's but one could wish that he had given his authority for the statement regarding the size of the telescope. An aperture of 0.5238 British inches and a focal length of nearly 28 inches seems almost incredible. A piece of ordinary tubing used to carry electric lighting wires resembles it almost exactly. La Caille's own version reads as follows: "Failing a mural instrument which is so handy for this kind of observation I had recourse to a method which I had tried at Paris. . . . I portioned out the sky between the South Pole and the Tropic of Capricorn into twenty-five very nearly equal zones. I attached to my quadrant a telescope of 28 inches in length, the eyepiece of which being very weak gave me a field of nearly three degrees. In the focus of this telescope I placed a kind of rhomboidal reticule which embraced the whole field, so that directing my quadrant to a given altitude in the plane of the meridian or nearly so I was able to determine by means of the clock and the reticule the positions of all the stars which crossed the telescopic field which by the diurnal motion of the sky disclosed one of the twenty-five zones easily distinguished by the divisions of the quadrant. This method has two great advantages: it is infallible for not allowing a single star to pass without being observed and it is practicable during the greatest fury of the wind, for in order to observe the occultation of a star by an opaque body, it is not at all essential that the telescope should magnify the objects; it is sufficient that it renders them more distinct. . . . It took at least one hundred uninterrupted nights, or watches of more than six consecutive hours each. . . . Moreover to secure great precision it was necessary that the stars observed during each watch should all be compared with two bright stars, one of which passed the top of the reticule and the other the bottom. After that the position of these stars was determined by other observations made expressly for that purpose by the same method as used for the principal stars."

The International Astronomical Union at its meeting at Rome in 1922 adopted a list of eighty-nine constellations, forty-eight of which, being those South of the Ecliptic, have been mentioned in this article. If readers possessing Proctor's or Norton's atlases change Malus to Pyxis and add the northern constellation Scutum (Scutum Sobieskii) which comprises the south-western portion of Aquila they will have the complete official list.

I do not know by whom Xiphias was changed to Dorado. Lord Frederick Hamilton speaks of catching in an Argentine river a great golden carp (*dorado* in Spanish).

AUTHORITIES.

For the origin of the constellations the reader is strongly recommended to read Mr. Walter Maunder's "Astronomy of the Bible." Much interesting information about the Southern Cross is given by Fr. Oom in an article in French in the *Astronomische Nachrichten*, Jubilee Number, September, 1921. A translation of Father Tachard's astronomical work at the Cape appeared in the *S.A. Quarterly*, September, 1920. The quotations from Lynn are from *The Observatory*, July, 1886, and those from La Caille are from the "Histoire de l'Académie Royale des Sciences," 1751. I have to acknowledge my indebtedness to Mr. Pilling, Secretary of the Cape Observatory, for valuable help.

THE ECLIPSE OF THE MOON, 14TH AUGUST, 1924.

Reports by Members.

(N.B.—South African Standard Time—2 hours East of Greenwich—is used throughout. Positions from latest Railway Map.)

The eclipse of the moon, which took place on August 14th, 1924, was well observed in many parts of the Union. Unfortunately for Cape Town observers, the moon disappeared behind thick clouds shortly after it rose, and remained invisible throughout the whole evening. Glimpses of the early phases of the eclipse were obtained at Sea Point. Towards the South the sky was somewhat clearer, and at Muizenberg the total phase was observed. Captain Cameron-Swan reports as follows:—

"The eclipse of the moon on the 14th inst. was visible at Kalk Bay (18° 30′ East Long., 34° 18′ South Lat.) almost in its entirety, though a light haze and occasional drifting clouds prevented good definition being attained at any time for more than a few minutes.

"The moon was under observation from 7.15 p.m. to 11.20 p.m. through a 3-inch refracting telescope, using a magnification of 40 diameters, and occasionally through a pair of prismatic binoculars $\times$ 8.

"At 7.40 a slight darkening of the limb entering the penumbra was noticed, like grey smoke, and one observed the gradual spreading of the darkness, the advancing shadow edge appearing softly graduated from the uneclipsed brilliance of the Moon, through a smoky twilight, to the darker tone.

"When the moon entered the umbra at 8.31 a very dense shadow crept slowly over the limb, which seemed completely to obliterate the hitherto fairly distinct lunar features.

"When a quarter of the moon's surface was covered by the umbra one could discern faintly the outline of the obscured limb, but no details in the eclipsed portion were visible.

"At 9 p.m. the outline of the totally eclipsed half of the moon was plainly seen, but the only feature which could be clearly distinguished at that time was the crater Tycho, which shone faintly through the darkness.

"As the shadow crept over the remainder of the lunar surface details of its features became faintly visible; the colour of the eclipsed part varied between copper-colour and reddish brown, shading off into a pale blue near the edge of the umbra.

"When the total phase began, at 9.31, the colour of the moon was better seen, and its features became more distinct, though none of them was specially prominent. The general effect during totality was of a copper-coloured central portion merging into blue-grey towards the circumference.

"The occultation of a 9th magnitude star (B.D.—13° 6002) was clearly seen, its seeming approach to the moon being watched at intervals during half an hour until, at 10.20 p.m. exactly, it disappeared behind the moon's limb.

"About 11 o'clock clouds grew denser, and drifted across the moon, frequently completely obscuring it; this condition continuing until 11.15, so that the termination of the total phase could not be observed."

Observed at Cape Town (18° 25′ East Long., 33° 55′ South Lat.) by H. E. Houghton with 3½-inch refractor, power 40, and finder, power 5. Weather conditions: Fine from midday; at 6 p.m. clouds gathered, with slight breeze from S.W. or W.

h. m.

8 00 Clouds thinning.

8 23 Moon seen through clouds and haze; trace of penumbra on east (following) limb.

8 31 Hazy, with corona; east limb just obscured by shadow.

8 50 Edge of shadow indistinct; no sign of markings on obscured area, no colour in shadow or edge, smooth curve.

9 00 Moon quite hidden by clouds.

9 15 Moon seen through thick haze, S.W. limb brighter than N.W.

9 18 Haze thinning; outline of moon distinct except at E. point.

9 22 Moon invisible through thick haze.

10 30 Sky overcast.

Observed at Plumstead, Cape (18° 30′ East Long., 34° South Lat.) by W. H. Smith with 3-inch Cooke refractor, power 30 throughout. 100 tried, but found impossible.

h. m.

7 31 Moon in fine cloud. Seeing very bad; moon's limb "boiling," almost impossible to focus correctly.

7 31 to 8 30 Looked for penumbra; suspected at times, but very uncertain.

8 30 Distinct darkening on eastern edge of moon.

8 32 Shadow distinctly seen encroaching on limb.

8 36 Edge of shadow fairly sharp to naked eye; in telescope not easy to define; a tendency to shade off towards centre of moon.

8 40 Limb clearly visible through shadow.

8 50 Eclipsed portion of moon easier seen.

8 56 Eclipsed portion nearer limb brighter in comparison with inner part of shadow. Colour now assuming faint coppery tinge.

h. m.
9 12 Dark markings easily visible through shadow. Edge of shadow not sharp, perhaps due to bad seeing. Uneclipsed limb still "boiling."
9 18 Edge of shadow slaty grey, changing gradually through orange to coppery colour towards limb of eclipsed portion.
9 30 Tycho and rays easily visible.
9 59 to 10 10 Western edge always much brighter than eastern, colour never as deep as eastern edge.
10 10 Clouds stopped further observation.

Note.—Seeing all through eclipse was very poor, haze and sometimes fairly heavy cloud interfering with observations, although at times faint stars, about 9th magnitude, became easily visible.

OBSERVED AT BEAUFORT WEST (22° 40′ East Long., 32° 25′ South Lat.) by R. WATSON. Times approximate.

h. m.
8 33 First observed. Umbra visible.
8 39 Umbra greenish; penumbra smoky. Grimaldi easy.
8 45 Ditto; smokiness precedes centre of arc, possibly radially streaked.
8 46 Copper tints coming. Grimaldi still visible.
8 47 Decided difference in lustre between centre and bright limb of moon.
8 50 Umbra on Tycho. Grimaldi still visible. Aristarchus easy, colour green and copper blend.
8 54 Definite copper margin coming.
8 58 Aristarchus and Grimaldi easy. Copper seems patchy.
9 6 Pico enters umbra.
9 7 Copper about two-thirds depth of umbra, rest green, but no definite boundary.
9 11 Conspicuous craters entering umbra. ? Manilius and Menelaus.
9 13 Aristarchus easy; Grimaldi not so easy.
9 18 Seas, Plato, Tycho, etc., easy.
9 42 Aristarchus getting less bright, Grimaldi faint.
10 15 (about) Fainter than Mars and much more red.

Note.—General impression that it was a bright eclipse, with no unusual features.

OBSERVED AT IDUTYWA (28° 15′ East Long., 32° 5′ South Lat.) by G. COWEN.

"The shadow was first noticed here about 7.40 p.m.; was darkest and covered all the moon, though the shadow was densest from centre to top (*i.e.*, South) of moon at about 9 p.m.; had passed completely at 10.20 p.m. Times are approximate."

OBSERVED AT PRETORIA (28° 20′ East Long., 25° 40′ South Lat.) by H. N. CROWTHER, B.A., who states:—

". . . I was not free until after 10 p.m. The usual copper colour was well in evidence, very similar to that of Mars, allowing for the latter's greater luminosity. Visibility was perfect."

h. m.

11 30 Detail on illuminated portion of moon seemed to me poor, considerably inferior to normal full moon. Colour: Broad blue-grey band within the umbra, on illuminated border, perhaps one-eighth or one-tenth of moon's diameter, shading gradually into the copper tint.

11 55 Umbra (about one-fourth) all dirty grey.

"I noted no other marked phenomena, *e.g.*, multiple edge of shadow, or bulges of shadow, other colour on edge, etc. Times are approximate."

OBSERVED AT PRETORIA, Transvaal University College Observatory (28° 20′ East Long., 25° 40′ South Lat.), by PROF. P. G. GUNDRY, Ph.D., and Messrs. G. E. ENSOR, CLAASENS, and ROBERTS with 5½-inch Zeiss Equatorial, power 120; 2¼-inch Watson, power 40; Binoculars, power 6; and Prismatics, power 8.

"No clouds present, but sky hazy after a hot and dusty day.

"The penumbra was carefully watched for, but first contact could not be detected by any of the observers; but just before contact of the shadow a faint coppery tint could be seen.

"The first contact of the shadow was to time. As far as could be seen the edge was not multiple. The colour was slaty grey, deepening to reddish brown.

"The more prominent landmarks were plainly visible through the shadow; Aristarchus in particular was clearly seen throughout the eclipse. Copernicus and Tycho were also noticeable.

"Two stars were seen occulted; the first about 157 degrees from N.P., and the second about 112 degrees from N.P. The first occultation was instantaneous, but the second seemed to hang on the moon's limb in a very curious manner.

"Unfortunately the notes of times of contact and occultations were mislaid and cannot be given at present. The end of the eclipse was not observed, as the time was too late to permit the observers to catch the last train to town."—G. E. ENSOR, M.S.R.

OBSERVED AT ROSBOOM, LADYSMITH (29° 50′ East Long., 28° 40′ South Lat.) by MISS H. L. TROUGHTON.

"Penumbra: Observable to naked eye as intensification of moon's darker features. Seen with field-glasses as faint smoke--tinted veil.

"Umbra: Edge pale grey, degraded, no sharp outline.

"Dark band clearly visible within the edge, and double the width of the grey edge: shaded off more gradually towards the limb. Limb showed clear, pale yellow throughout eclipse.

"Variation of outline: At each stage of eclipse shown by accompanying diagrams I, II, III [not reproduced] the shadow seemed to be spilled forward over a large surface (marked by shading), which showed up darker than the darkest part of the umbra.

"Red colour: First visible at half eclipse. Deep smoky red at limb, shading off to clear pale yellow. Moon's dark features visible throughout. Dark border of umbra showed grey on entering eclipse, but disappeared on emerging.

"Distribution of colour: Diagram IV [not reproduced] shows first change after mid-eclipse. Shaded part deep red, inner circle golden, crescent pale yellow. Limb darkest from C to D, very bright from A to B."

OBSERVED AT DURBAN (31° 5′ East Long., 29° 45′ South Lat.) by D. L. FORBES and OTHERS.

"I did not follow the moon's eclipse carefully, for we had a large attendance at the Observatory [8-inch refractor], and my attention was divided between Luna, Mars, and various enquiring members. But the general opinion was that the total eclipse was an unusual one. . . . The most outstanding feature was the dense shadow, which about 10 o'clock was low upon the northern limb, and at 11 had moved to high upon the eastern limb. It was like a dense smoke cloud, and obscured about one-half of the orb considerably. The remainder was patchy and streaky in the extreme, and this state of affairs continued throughout.

"The eclipse of 1917 was a beautiful one, the entire face of the moon being very equally coloured copper. The recent eclipse was noted for unequal colouring—one side as if under a cloud of smoke through which the moon was visible, and the other side toned down to a copper hue, but with many light streaks thereon."

The following official weather reports are added:

"Weather forecast for 24 hours ending 11 a.m. 15th August, for South Africa: Cloudy and unsettled over N.E. Transvaal, but clearing later. Fine and bright elsewhere, with haze and mist in places. Winds easterly to northerly, variable in force, but fresh at times over interior, where local dust storms. Cool to cold in Centre and East, mild in West and South."

"Weather conditions over South Africa yesterday [15th August] at 8.30 a.m. were: Pressure normal on South Coast, high over East. Dull, cloudy and misty over West and South-West Cape. Fine elsewhere. Winds variable and light, cool; sea slight."

PARTIAL ECLIPSE OF THE MOON, 8TH FEBRUARY, 1925.

OBSERVED at PRETORIA by G. E. ENSOR, with 2⅛ inch refractor.

"The sky was practically the whole time obscured by a light smoky cloud drift, which interfered considerably with observations. The first contact with the umbra occurred at 10.8 p.m. near Schickard and Mare Humorum. Colour dark smoky grey, quickly obscuring all lunar details. At 10.45 the shadow reached and covered Aristarchus, and at 10.53 Copernicus was obscured. For some time Aristarchus was visible through the darkness, growing fainter and fainter, and finally disappearing completely at 11 p.m. At this time the shadow was very dark: the colour a dull smoky grey with occasionally a brown tinge. This was in sharp contrast with the total eclipse of August, 1924, in which the colour was reddish brown, and sufficiently transparent to allow a distinct view of lunar details. It is quite possible that the presence of the light smoky cloud drift altered the colour and density of the umbra, since during clearer intervals a distinct brown tinge was apparent. At 11.30 the shadow began to leave the N.W. region, and Aristarchus reappeared. At 11.45 the Mare Crisium was partly obscured. After this time heavy clouds obscured the moon, and observations were discontinued."

The Editor acknowledges the receipt of the following:—

"Die Himmelswelt," published by Die Vereinigung von Freunden der Astronomie und kosmischen Physik (E.V.), Berlin, September, 1924-*May,* 1925; *"Gazette Astronomique," published by the Société d'Astronomie d'Anvers (Antwerp), October,* 1924-*May,* 1925, *also Report for* 1924 *and Publication No.* 1 *of the Bureau Central Météorique; Publications of Tartu (Dorpat) Observatory, Esthonia, Tome XXV, No. 6, "Statistical Studies of Double Stars," and Index; Tome XXVI, No.* 1, *"Photometric Measures on the Moon and Earth-Shine"; No.* 2, *"Stellar Distribution and the Law of Chance"; No.* 3, *"Determination of the Colour-equivalents of Stars"; Astronomical Almanac for* 1925 *from the National Observatory of the Czecho-Slovak Republic, Prague; Harvard College Observatory Reprints* 16-20, *Circulars* 261-273, *Bulletins* 800-818; *Monthly Reports of the American Association of Variable Star Observers,* 1924; *Circulars issued by the New Zealand Astronomical Society.*

NOVA PICTORIS (1925).

Mr. R. Watson, Beaufort West, discovered a new star in Pictor, near the Alpha of that constellation, on Monday, May 25, at 5.50 a.m.

The importance of Mr. Watson's discovery may be appreciated when we remember that in the course of history there are only about twenty authenticated accounts of the discovery of bright novæ. The first was the star of Hipparchus in Scorpio, which appeared in 134 B.C., and which suggested to Hipparchus the necessity for cataloguing the stars.

Examination of photographs of the region of the nova indicate that prior to its sudden outburst it could not have been brighter than the 15th magnitude. This means that the star has risen to more than 160,000 times its original brightness. This stupendous increase appears to have occurred in a very short time, as Mr. W. Reid was observing in the region four days previous to the discovery, and is confident that the star could not then have been visible to the naked eye.

From the estimates of the brightness of the nova as received from Mr. Watson, it appears that it was discovered just before maximum, when its magnitude was 2.3.

The nova is easily found, as it is close to the star Alpha Pictoris, and the two objects are in the early evening in the direction from Canopus known as 10 o'clock. The nova is the lower of the two, and, at the time of writing, the brighter.

Readers will remember that it was Mr. Watson who discovered the famous nova in Aquila in 1918. The only other astronomer who has two bright novæ to his credit is Dr. Thomas Anderson, of Edinburgh. Thus Mr. Watson shares with Dr. Anderson a unique place in the annals of astronomy.

Mr. Watson has written the following note describing his discovery:—

"In 1918, after the discovery of Nova Aquilæ, a resident of Beaufort West said to me, 'How did you do it? have you got all the apparatus?' Others have asked me, 'Do you know all the stars in the sky?' Well, the only apparatus used was a pair of spectacles; whilst my knowledge of the sky had to be very considerably assisted by reference to Norton's Atlas.

"The subject of astronomy has appealed to me a great deal since Mr. Long introduced me to it in 1910. I found it both interesting and instructive to read what facts had been discovered about the solar and stellar systems, and, incidentally, I found the knowledge gained of some use to me in my own line of work. Naturally my reading had to be supplemented by visual observation of the sky. Not that I could actually see very much, but a little thought and imagination make a lot of difference. Where my neighbours see only innumerable points of light I can recognize—here, a giant red sun of very low density which would dwarf our sun as our sun dwarfs the earth; there, in that misty spot, a beautiful and mysterious spiral nebula; or, in another direction, a world not unlike our own, and possibly inhabited by some strange form of life. This is a great comfort to a resident in a country district. When night falls one merely exchanges the sights of this world for visions of other worlds, and in course of time one becomes familiar with the face of the sky in the same sense that a student of geography becomes familiar with a terrestrial map. As the latter gazes at Northern Africa, a picture of camels and burning sands may present itself to his mind; whilst the small patches marked London and New York bring up somewhat different visions of hurry and bustle.

"Now and again, however, one notices a star or a peculiar arrangement of stars that one had not noticed before. On such occasions it is my custom to refer to an atlas—not so much to find out the name of the star, or with any expectation of finding a new star, but rather to confirm and retain the impression of the unfamiliar apparition. I had had such experiences so often that when Nova Aquilæ appeared I expected to find it on the map. I was a little better prepared for Nova Pictoris.

"It happened like this: I had to be at my work at 6 a.m. on Monday, the 25th May, and, having to walk about half a mile southwards, I left my house at 5.45 a.m. Upon opening my door I saw a glorious vision of the planet Mercury. I knew it at once, but its brilliance astonished me. The zodiacal light was there, too, heralding the dawn. My sleepy head began to wake up and take notice. Turning down the street, Canopus first caught my eye, low down in the south-east, with the larger Magellanic cloud above it. In the South-West appeared the Southern Cross, and due south I noted Beta Carinæ practically on a level with Alpha Crucis. Then the unfamiliar spectacle presented itself: further to the eastward, in line with Alpha Crucis and Beta Carinæ, and at the same interval from the latter, I noted a pair of stars. I regarded them carefully, and noted their position with respect to Canopus and the Magellanic cloud. My thought was, 'I am sure there was no pair of stars there before.' I almost returned to consult my atlas, but I did not care to keep an officer who had been on duty all night waiting, and I also realized that the news would be of no use to anyone before evening, so I proceeded on my way, making as careful a note of the position as I could. At breakfast time I was able to ascertain from Norton's Atlas that the fainter star must be Alpha Pictoris and—well, the unmarked star must be a nova. I then took its approximate Right Ascension and Declination from the atlas, and telegraphed the information to the Royal Observatory.

I was conscious that I was acting rather hastily, but it was a public holiday, and I was afraid the Observatory staff might be absent if I deferred wiring till evening. It is also very important, too, that a nova should have its spectrum photographed at an early stage.

"That is my story; some people are astonished at my making this discovery. My astonishment is that all the Australian astronomers seem to have overlooked it.

"I have seen the star on a good many evenings, but conditions have been very poor for estimates of its brilliance.

"It was approximately 2.3 magnitude at discovery, rose next day to about 1.7, then dropped to magnitude 3 towards the end of May. Since then it has been steadily increasing in lustre, until this morning (Monday, 8th June), when I estimated its magnitude at 1.6 (the brightest I have seen it).

"R. Watson."

Reviews.

"Modern Astrophysics," by H. Dingle. London: Collins' Sons, 1924. 420 pp. Price 30s.

Professor Dingle's book is a most comprehensive work, and supplies a vast amount of new knowledge bearing on the problems of astronomy which the general reader could hardly obtain elsewhere. The book appears to have been designed for the amateur astronomer: it treats its various subjects descriptively and not mathematically, but requires careful and thoughtful reading.

The first portion is a short treatise on spectroscopy. A very clear account is given of the theory of atomic radiation, according to which the jumping of an electron from one orbit to another is associated with the emission or absorption of light of a particular wave-length. The main portion of the book deals in a most complete way with the characteristics of the stars, their type of spectrum, masses, motions, volumes, densities and distances. Here the reader will find all the ascertained facts which must be taken into account in the development of theories of the evolution of stars and the general structure of the Universe. The later parts of the book are devoted to such theories and speculations. In reading these chapters it will be realized how difficult it is to formulate any general theory of the Universe which will be consistent with all the known facts. It seems to be quite certain that there is a gradual evolution of stars from the giant red star, of large dimensions and very low density, through intermediate stages of higher temperature and gradually increasing density to the final stage of the cool dwarf reddish star of very high density, but it is not so clear what happens at the two ends of this process. It is possible that in the spiral nebulæ we see stars in process of birth, but it is a very difficult matter to fit in the irregular gaseous nebulæ with any general evolutionary scheme. The lover of astronomy will find these speculatory chapters most fascinating, and will be grateful to Professor Dingle for having written such a comprehensive and overwhelmingly interesting book.

"The Earth: Its Origin, History and Physical Constitution," by H. Jeffreys, M.A., D.Sc. University Press, Cambridge. 16s.

The main idea of this book is that any theory, *e.g.*, a theory of the origin of the solar system, must stand the test of a quantitative mathematical investigation. The most interesting part of the book is that dealing with the origin of the solar system. Laplace's theory of the origin of the planets as due to the breaking off of successive outer shells of a contracting nebula does not stand the test of mathematical analysis, and is discarded. In order to produce our solar system, the influence of another external body, more massive than our sun, has been found to be necessary. Thus it is considered that the origin of the solar system is rather the result of the accidental encounter of two stellar bodies than the natural development of a single nebula. When our sun was much larger than it is now, and had a diameter of about 26 million miles, a more massive star must have made a close approach to it. Tidal protuberances were raised on the sun as a result. Much of this raised matter would ultimately fall back into the sun and give rise to its movement of rotation, but a portion of the protuberance on the side of the disturbing body would become detached from the sun and produce a family of planets moving round the sun in the direction of the solar rotation. As the lighter materials of the sun would naturally be ejected first, so the outer planets are of much lower density than the inner planets. The planetary satellites were similarly torn off the newly born planets by the tidal forces due to the sun. Our moon is an unusually large satellite: the breaking off of such a large portion of the earth was due to the fact that the solar tides coincided with the natural period of oscillation of the liquid earth. This happened when the earth was about 10,000 years old and rotated in about four hours.

The age of the solar system, estimated from considerations of the shape of the orbit of the planet Mercury, is not greater than 10,000 million years. The earth probably formed its solid crust 15,000 years after its birth, but the oceans would not appear until very much later, when the sun had cooled down considerably. There are various methods of estimating how long ago this was—*e.g.*, by comparing the total amount of salt in the ocean with the rate of transfer of salt to it by rivers, or by comparing the total quantity of the sedimentary rocks with the rate of disintegration of igneous rocks—but the most reliable method is that based on the determination of the ratio of uranium to lead in the oldest igneous rocks. The age of the ocean is considered to be about 1,340 million years.

As regards the life of the sun itself, Lord Kelvin's theory that the condensation of the sun maintained its output of energy did not indicate a sufficiently long life to accord with other known facts. More recent sources of information indicate a very much longer period of activity for the sun, and suggest that the union of hydrogen atoms to form heavier elements supplies most of the energy. Actually, the sun is reducing its mass at the rate of four million tons a second, but this amount, large as it may seem, is a very minute fraction of the whole mass of the sun. In fact, the life of the sun is estimated at millions of millions of years.

Astronomical Society of South Africa.

New Members.

Beusch, A., Gobabis, S.-W. Africa.

Forrest, A., 38, Garden Road, Orchards, Johannesburg.

Fraser, J., 233, Longmarket Street, Pietermaritzburg.

Nel, O. L., Middleton, P.O. Greytown, Natal.

Roux, C. H. de la Rey, Actuarial Dept., S.A. Mutual, P.O. Box 66, Cape Town.

The addresses of the following are now as stated below:

Cox, W. H., "Iolaire," Palmyra Road, Newlands.

Davis, J. B., 46, Grey Street, Queenstown.

Granger, J., 17, Church Square, Cape Town.

MacDonald, H., "Camelot," Morpeth Road, Plumstead.

Mason, H. C., Roslin Hotel, New Church Street, Cape Town.

Pierce, Rev. T., P.O. Box 99, Graaff-Reinet.

Roberts, Rev. N., Potchefstroom.

Schonegevel, H. W., 4, Morley Road, Observatory.

Troughton, Miss H. L., G.D.A. Hostel, Cottesloe, Johannesburg.

Wallis, A. H., C.E., J.P., F.R.Met.S., S.A. Railways, Windhoek.

Any changes of address should be notified to the Secretary, P.O. Box 2061, Cape Town.