Vol. 3. No. 1

The Journal
of the
Astronomical Society of South Africa.

EDITED BY
H. SPENCER JONES, M.A., Sc.D., F.R.S.

Contents.

Published by the Society, P.O. Box 2061, Cape Town.
Price to Members and Associates, One Shilling.
Price to Non-Members, Two Shillings.

NOVEMBER, 1931.

The Journal
of the
Astronomical Society of South Africa.

VOL. III. NOVEMBER, 1931. No. 1.

THE REV. FEARON FALLOWS, M.A., F.R.S., F.R.A.S.

By CAPT. D. CAMERON-SWAN, F.R.A.S., F.R.P.S., F.S.A.(SCOT.).

(PRESIDENTIAL ADDRESS, SESSION 1930-31.)

In the days of ancient Rome, it was the custom of gladiators on entering the arena to address the Emperor in the following terms:—

"Ave, Caesar; morituri te salutant!"

("Hail, Caesar; those about to die salute thee!")

The President of this Society stands in a similar position to that of the gladiators. He makes no official appearance before the members until the hour in which he delivers his Address to the Society, after which he introduces his successor.

Before proceeding with my address, I wish to express on this—the first occasion on which I have appeared before the Society as their President—my thanks to the Members of Council who unanimously proposed me, and to the members of the Society, who elected me *in absentio* to that high office; an honour which I was reluctant to accept when I remembered the qualifications of the eminent and distinguished astronomers who had preceded me in the Chair.

The invariable kindness and support which I have received from the Members of Council at our meetings have made my position less exacting than I had anticipated, and I shall crave the same consideration for my successor.

The subject of my address is one which was suggested to me by members who felt that on the occasion of the centenary of his death some account of the life and labours of the first of His Majesty's Astronomers at the Cape would prove of general interest.

THE REV. FEARON FALLOWS, M.A., F.R.S., F.R.A.S.
(The first of His Majesty's Astronomers at the Cape.)

From a silhouette at the Cape Royal Observatory.

The chief sources of information on this subject are: Sir George Airy's historical introduction to the "Results of the Observations made by the Rev. Fearon Fallows at the Royal Observatory, Cape of Good Hope, in the years 1829-31," and the "History and Description of the Royal Observatory, Cape of Good Hope," by Sir David Gill, from which many parts of this biographical sketch are quoted *verbatim*.

My hearty thanks for assistance in this research are given to Dr. Spencer Jones, who has accorded me most willingly every facility for investigation of the records at the Royal Observatory; to Mr. Lloyd, the Librarian of the Public Library, Cape Town (of which institution Mr. Fallows was a trustee); to Mr. Ribbink, Librarian at the Parliamentary Library; and to Mr. Donald G. MacIntyre for many valuable suggestions.

Without further introduction I will read my address.

One hundred years ago (on the 28th of this month), all that was mortal of the "first of His Majesty's Astronomers at the Cape" was buried in a grave dug out of the sandy soil opposite the main entrance to the Royal Observatory.

He was still a young man, being only 42 years of age when death came as a welcome relief to his sufferings.

If a "post-mortem" had been held, the doctor would have reported that incurable dropsy, following a dangerous attack of scarlatina, was the cause of death—which, from a purely medical and physical point of view, would have been a correct verdict.

But if a coroner's jury of astronomers, acquainted with his heroic struggle to do what was expected of him in face of a thousand irritating and unnecessary difficulties, had "sat on the body," their verdict would have been that he was "strangled with red tape, and finally killed by a mural circle!"

Both verdicts would have been true, but the latter one explains the reason for the physical powers of the brave little man being so reduced that these serious maladies fatally affected him.

FEARON FALLOWS was born at Cockermouth, Cumberland, on the fourth of July, 1789—the year in which Washington was elected first President of the United States, and in which the fall of the Bastille heralded the commencement of the French Revolution. In the same town, nineteen years previously, William Wordsworth, poet laureate, first saw the light.

Brought up to his father's trade of weaving, young Fallows devoted, from childhood, every spare moment to study; and a book on mathematics was his constant companion at the loom.

If I may refer to a boyish memory in this connection, I would like to say that I remember, very clearly, seeing the last of the hand-loom weavers in the market town of Brampton, only 30 miles from the place where Fallows and his father lived and worked. There were only a few old men left, and these were between 70 and 80 years of age: they had worked at those hand-looms since childhood, and, as my visit was in the year 1876, these industrious veterans must have been weaving during the latter part of Fallows's lifetime. There they sat, almost automatically sending the shuttle flying, with a click, from side to side of the heavy wooden frames, whilst depressing alternate pedals to cause new avenues for the shuttle through the warp of the fabric.

It may be queried whether the effect of the regularity of motion of the various parts of the hand-loom, the precision in arrangement of the threads forming the warp, and the habit of counting, stimulated the cultivation of a mathematical order of mind.

The father of young Fallows was a man of considerable information and studious habits, devoting much of his spare time to the education of his child, especially in arithmetic and geometry, in which his son chiefly delighted.

The Rev. H. A. Hervey, vicar of the neighbouring parish of Bridekirk, to whom Fallows's father acted as parish clerk, was much struck by the acquirements and originality of the lad, and on his recommendation Fallows was engaged, at the age of nineteen, as an assistant to the headmaster of Plumbland Grammar School, some six miles to the north of Cockermouth.

Whilst engaged in that new and more congenial occupation, Fallows was enabled in the year 1809, through the influence of some gentlemen of fortune, to enter St. John's College, Cambridge, whence he graduated as third Wrangler in 1813, in which year Sir John Herschel was Senior Wrangler.

Having already referred to the fact that Fallows was a native of the same town as the poet Wordsworth, it is interesting to find that both entered and graduated at the same College, though their respective years of residence there did not coincide.

Fallows was an admirer of poetry—the natural beauty of the Psalms specially appealed to him; whilst Wordsworth was an admirer of astronomy—as proved by his having written nine poems about the moon, two addressed to the planet Venus, and four concerning stars.

But, so far as I can ascertain, the astronomer and poet never met!

Having taken Holy Orders, Fallows held a mathematical lectureship in Corpus Christi College for two years, and was then elected to a fellowship in his own College. He proceeded M.A. in 1816.

He was Moderator, or principal examiner, in the University of Cambridge in the year 1818, and, during the two years following, the Fates were shaping his destiny, as will be seen from the ensuing extracts:—

"At a meeting of the Commissioners appointed by Act of Parliament for more effectually discovering the longitude at sea, held at the Admiralty, on the 3rd February, 1820:—

Present,—Viscount Melville (First Lord of the Admiralty), the Right Hon. Sir Joseph Banks, Bart. (President of the Royal Society), Messrs. Croker and Barrow (Secretaries to the Admiralty), Davies Gilbert, M.P., John Pond (Astronomer Royal), Rev. Dr. Robertson (Savilian Professor of Astronomy), S. P. Rigaud (Savilian Professor of Geometry), Very Rev. Dean Milner (Lucasian Professor), Rev. W. Lax (Lowndean Professor), and others:

Mr. Gilbert proposed that the Board should take into consideration the propriety of the establishment of an observatory at the Cape of Good Hope, which, he observed, was likely to be highly conducive to the improvement of astronomy.

The motion was seconded by Sir Joseph Banks, who gave it as his opinion that nothing could more essentially promote the glory of this country than to be foremost in such an undertaking.

The Committee of Instruments and Proposals, with the addition of Sir Joseph Banks, Mr. Gilbert, and Mr. Pond, was desired to draw up a statement of the most eligible plan for such an observatory, with an estimate of the probable expense."

On the 6th of April, 1820, the following Report was brought up from the Committee:—

"Resolved that, since a considerable time will be required for the establishment of a complete observatory at the Cape, on account of the difficulties arising from the abundance of sand in most parts of the country, and from other local circumstances, the Committee therefore recommend the appointment of an astronomer at the Cape, as soon as a proper person can be found, and that he be sent out with portable instruments, in order to enable the Committee to form a better judgment of the arrangements that will be required; but that, in the meantime, the principal instruments be ordered to be put in hand for the observatory, on the same scale as those at Greenwich, and as much as possible on the same construction."

Three weeks later, the following estimates were received from Messrs. Troughton, Dollond and Jones, for the instruments required at the proposed Cape Observatory:—

Mr. Troughton—						
A 25-foot Zenith telescope ..	£300	0	0			
Object-glass by Dollond ..	100	0	0			
Ironwork by Jessop & Donkin	300	0	0			
				£700	0	0
Mr. Dollond—						
A transit	£500	0	0			
A Newtonian 7-foot telescope, 9-inch aperture	210	0	0			
Two 46-inch achromatics, with various improved micrometers, and extensive fields of view	315	0	0			
				£1,025	0	0
Mr. Jones—						
A 6-foot mural circle	£787	10	0			
				£787	10	0
Total				£2,512	10	0

Mr. Pond (Astronomer Royal) observed that the equatorial sector now at Greenwich might be spared for the Cape, as well as a 6-foot Newtonian telescope by Short, which would supersede the necessity of a new reflecting telescope, and reduce the estimates to £2,300

It was ordered "that the respective artists should be desired to proceed in their undertakings."

On the 9th of October, 1820, Earl Bathurst, Colonial Secretary, fully concurring in the view which the Board of Admiralty had taken of the expediency of erecting an observatory at the Cape of Good Hope, had instructed the Governor of the Cape to allot a suitable piece of ground for the purpose, at the expense of the Colonial Government, and in such a situation as the astronomer whom their Lordships might send out may think fit and eligible, and, moreover, to lend every possible assistance towards carrying into effect the object in view.

At the Court at Carlton House, on 20th October, 1820, the observatory was established by Order in Council, for "the improvement of practical astronomy and navigation," the cost of instruments being about £2,300, "besides the expense of the building itself, which cannot be estimated in this country"; and it was proposed that the establishment should consist of the persons with the salaries following, viz.:—

One astronomer	£600	per annum.
One assistant	250	,, ,,
One labourer	100	,, ,,

On the 26th October, 1820, the Reverend Fearon Fallows, M.A., Fellow of St. John's College, Cambridge, was appointed His Majesty's Astronomer at the Cape.

Fallows at once took steps to further prepare himself for the important duties which he had undertaken. During the months which intervened between the date of his appointment and that of his departure for the Cape, he visited the public and private observatories of England, studied the instruments and their use, and spent much time in the principal workshops where astronomical instruments were made.

The general plan of the Observatory was agreed on by Mr. Fallows in consultation with Mr. Rennie—the eminent civil engineer—by the end of November, 1820.

On the 1st of January, 1821, Fallows was married to Miss Mary Anne Hervey, eldest daughter of his early friend and patron, the Rev. Mr. Hervey, vicar of Bridekirk; and on the 4th of May, accompanied by his wife, he sailed from England, arriving at the Cape on the 12th August—a voyage of 100 days.

Four days after his arrival, the Acting Governor of the Cape, Sir Rufane Donkin, wrote to Mr. Goulburn (Colonial Under-Secretary), informing him that "The Astronomer Royal has arrived here, but I hear without funds or letter of credit to build his observatory." Whilst he hunted for a site in conformity with Admiralty requirements, Fallows obtained from the local Government a settler's wooden hut, which he converted into a temporary observatory for his portable instruments, erecting it on the site in Cape Town whence Mason and Dixon had observed the transit of Venus in 1761.

The instructions regarding his duties, which he had received from the Board of Longitude, were defined as follows:—

"(1) In the choice of the situation for the observatory he is to bear in mind the necessity of avoiding the sandy dust which pervades many parts of the colony, and the advantage of having a bright star within a minute or two of the zenith, if possible.

(2) Before the completion of the observatory, he is to employ himself in making an approximate catalogue of the southern stars with the portable transit-instrument and equatorial which have been provided for him: and to take measures for determining the latitude of La Caille's observatory.

(3) When the observatory is completed and the instruments fixed, he is to make his observations as much as possible of the same kind and in the same manner as the Greenwich observations have been usually made; to employ the same stars where it can be done conveniently; and to draw up the register in the same form, in order that the whole may constitute two corresponding series capable of comparison in all their parts.

(4) He is to pay particular attention to the rediscovery of the comet of 1819, according to the places calculated by Professor Encke for 1822.

(5) He is to neglect no opportunity of making any observations capable of improving the theory of refraction.

(6) He is to send to the Secretary of the Board of Longitude every six months a correct copy of all his observations, prepared for publication."

In the course of the remaining part of the year 1821, Mr. Fallows examined the ground in the vicinity of Cape Town to a considerable extent. He entertained the question of utilising the house in which La Caille's observations were made, or the neighbouring house, as a site for the observatory, but ultimately decided against this location (as the view was much interrupted), and explored other sites in the country. Tiger Berg seemed to him the most suitable spot, but it was finally abandoned because of prevalent sand drift, and the impossibility of securing a water supply.

Eventually, with considerable misgivings as to the effect of sand drift, he selected the present site, then called "Slang Kop" or Snake Hill—a barren, rocky, rising ground, covered with wild thistles, and as inhospitable in its aspect as it is possible to imagine.

Gill says that, in his opinion, Fallows's choice was absolutely the best possible, having regard to the fact that before the days of electric telegraphy it was essential in the interests of navigation that the observatory should be so situated that its time signals might be visible from the Port.

In July, 1822, the site selected by Fallows was formally approved, but it was not until December, 1824, that the plans for the Observatory, with the necessary authority to carry them out, reached the Cape.

Meanwhile Fallows's position was not an agreeable one. He was living in a hired house but poorly constructed, with his workshop and instruments in outhouses. He had asked for additional instruments, and after many delays met with a refusal. With such small instruments as he had originally, namely, an altitude and azimuth instrument by Ramsden (30-inch vertical circle), and a transit instrument by Dollond (1.62 inches aperture and 19½ inches focal length), Fallows had made, during the latter half of 1821 and the early part of 1822, the observations from which he derived the approximate places of 273 stars between the Zenith of Cape Town and the South Pole. These were published in the *Philosophical Transactions* of the Royal Society in 1824.

No sooner was Fallows in possession of the necessary authority, than he set about preparations for building the new observatory, with much judgment and using every precaution to ensure its stability. Tenders were called for by advertisement in the *Cape Town Gazette* on 28th of January, 1825, and that of Mr. Cannon was accepted. In February of that year Mr. Skirrow, an Admiralty Clerk of Works, arrived to aid Mr. Fallows in this unaccustomed work, and the building was so far advanced by the end of 1827 as to be ready for the fixing of piers for the instruments.

The Whigs came into power in 1827, and, in a fit of ill-advised economy, cut off £10,000 from the estimates for completing the buildings and grounds. Though the main building was almost finished externally, it was a mere block of masonry on an exposed rocky hill, without enclosure, without roads, without proper water supply, and without stabling or outdoor accommodation of any kind. In answer to an application for a small grant of money for planting trees to afford protection from wind and sand, Fallows was informed by letter from the Secretary of the Admiralty that His Royal Highness the Lord High Admiral had commanded him to say that "if you have any desire to *beautify* the ground it must be done at your own expense!"

The Observatory was almost cut off from civilisation by a surrounding marsh, and a guard of soldiers had to be established to protect the property from theft. The slight hill on which it stood was rocky and bare of any vegetation save thistles: it was infested by snakes, and jackals howled dismally at night. Even such necessities as coals and candles were disallowed by the authorities. In a letter from the Admiralty dated 21st November, 1828, Fallows was informed that "their Lordships have disallowed £8 12s. 8½d. for coals and candles" for Captain Ronald, the Assistant Astronomer.

In a plaintive letter to the Board of Longitude, a copy of which I have seen, Fallows says:—

> "Let the Honourable Board for a moment consider that we are situated at four miles distance from Cape Town; that the Leesbeek's River flows between us, and that every artificer must wade through the water before his arrival and after his departure each day: the consequence is that it becomes a matter of great difficulty to procure good hands at any price; so much so, indeed, that I have, myself (assisted by Mr. Fayrer), repaired the chares* for the approaching winter."

It was against difficulties such as these that Fallows had to contend; vexatious delays in sending plans and instruments, misfortunes with unsuitable assistants (he was left without any assistant between 1824 and 1826), and difficulties in obtaining skilled labour for erecting the piers and then the instruments; so that though Captain Ronald, the latest of his assistants, arrived at the Cape towards the end of 1826 with the instruments for the Observatory, it was not until the beginning of 1829 that they were mounted ready for work.

It was of this period that the following story was related by Sir David Gill:—

> "After the Observatory building had been nearly completed, but before the scaffolding and ladders had been removed, Fallows went into the mural circle room, after the workmen had gone, to test the opening of the shutters. He had prided himself on the design of these shutters and the ease with which any particular shutter could be opened. But on pulling the rope to open the shutter for observing Zenith stars, he found that the shutter would not move. He ran up the staircase leading to the roof, peeped out of the door at the top, and there, comfortably seated on the central trap-door of the meridian opening, was a large leopard (the so-called Cape tiger). The astronomer and the leopard both rapidly disappeared in different directions!"

The astronomical work of the Observatory commenced in earnest in 1829, but during that year Captain Ronald, his excellent assistant, fell sick, and in the following year had to return to England, leaving Fallows alone to do the best he could with the transit instrument and mural circle. In this endeavour to do unaided the work of four men he was ably assisted by his wife, whose aptitude and intelligence were such that with

---

* A North-country word, probably referring to the water channels through which the Liesbeek River flowed.—D.C.-S.

very little instruction she was soon competent to make observations with the mural circle, whilst Fallows himself observed with the transit instrument. So, the Cape Astronomer had, like Hevelius, the pleasure of finding his best assistant in the partner of his affections.

The cares and anxieties he had endured enfeebled his constitution. The task was too great for the strength that remained to him. He had left his comfortable Fellowship at St. John's, full of zeal to found exact astronomy in the southern hemisphere, full of strength and energy which it was his ambition to devote to the great scientific task he had undertaken. His strength and energy were frittered away by no fault of his, but by continued disappointments and heart-wearing delays. All of his children died in infancy. When, after having taken infinite pains in the erection of the permanent instruments, he was in a position to commence their use, he was left without assistants.

But his main trouble was over the great mural circle which had been sent out in an imperfect condition; the worry and perplexity which this caused him by apparently anomalous results (which fortunately affected his observations only in detail, but not sensibly in their mean result), are stated, on high authority, to have been the means of shortening his life. This mural circle—to the use of which he had looked forward with so much pleasure and interest, proved to be a source of bitter uneasiness to him. Fallows found that the index-error of two opposite microscopes was ever variable for different circle readings.

It was not until nine years after his death that the cause of these discrepancies was discovered. In 1840 this circle was sent to Greenwich Observatory, in reference to which Sir George Airy, the Astronomer Royal, wrote that " after some examination of its large pivot, which was evidently deformed, Mr. Simms proceeded, under my direction, to re-turn it, when, to our great astonishment, the steel collar of the pivot was found quite loose, having been attached merely by *soft solder!*" Sir George Airy had a new collar mounted in the usual way, by heating on, and very carefully turned, after which the instrument was adjusted for use, but observations with it were not made until 1848, when Airy remarks that these " show how great are the errors of division, as freed from sensible error in the form of the pivot."

In the summer of 1830, Fallows experienced a severe attack of scarlet fever, from which his enfeebled condition never rallied.

In November, 1830, Fallows transmitted some observations he had made with the mural circle, together with observations of the planet Uranus, and of Mars for parallax. In January, 1831, he forwarded moon culminating observations, requesting that they might be placed in the hands of Captain Beaufort.

At last, incurable dropsy set in, but Fallows still struggled to perform his duties, and during the early part of 1831 he was carried, daily, in a blanket, by his servants, from his sick-room to the Observatory, for the purpose of winding up his clocks and chronometers. Towards the end of March he was taken to Simonstown, but the rest and change came too late, and he died on the 25th July, 1831, three weeks after his 42nd birthday.

At his own request his remains were buried in the Observatory grounds, on the border of the lawn due south of the entrance to the main building. A flat slab of Robben Island stone covers his grave. The inscription on the stone is as follows:—

SACRED
To the Memory of
THE REVD. FEARON FALLOWS, M.A., F.R.S.,
Late Fellow of St. Johns College,
Cambridge,
His Majesty's Astronomer
at the Cape of Good Hope.
Died 25th July, 1831.
Aged 43 years.

In the *South African Commercial Advertiser* of Wednesday, 27th July, 1831, appeared the following notice:—

"DEATH OF THE REV. MR. FALLOWS.

The Reverend Fearon Fallows, A.M., Astronomer Royal in this Colony, expired in Cape Town on Monday afternoon the 25th inst., aged 43 years.

We understand that his remains will be interred at the Royal Observatory on Thursday afternoon at three o'clock, at which hour the procession will leave that place. A large concourse of mourners is expected to attend the funeral."

The same paper, on Wednesday, 3rd August, 1831, published a letter from a correspondent, from which I have made the following extracts:—

"If almost universal regret can in any case afford comfort to survivors, the immediate friends of our late astronomer may lay full claim to this source of consolation. His funeral was at once an affecting and an imposing scene: men of every rank, of every persuasion, almost of every shade of character, here

met to deplore the death of one whose place will not easily be filled, and they united not only in the service of the lip, but in the deep and unseen feeling of the heart; and many of them, in all the bitterness of undissembled sorrow.

The remains of Mr. Fallows were deposited in a grave, sunk at his own request, to the depth of 12 feet, in an elevated spot of ground which he had destined for his sun dial.

The impressive service of the Church of England was read by the Colonial Chaplain; and at intervals, two of his favourite Psalms (the 90th and 67th) were sung by a choir which he had himself formed. This also was in compliance with his special request.

. . . . . .

His chapel, fitted up at his own expense, and at a personal sacrifice, of which it was often his honest pride to speak, will, I had almost said, be a *living monument* of his zeal in the Christian cause, and of the importance which, notwithstanding the *continued* and *unceasing* claims of *his other duties,* he attached to that *solemn vow* and *engagement* which, at his ordination, he had made before the Altar of God.

. . . . . .

In this temple, not only his own household but his neighbours, both Dutch and English, worshipped their God in common, and heard the words of eternal life.

Yes! though we might almost literally declare that he knew the number of the stars, and could call them by their names, yet he forgot not God who created both him and them.

With the wisdom of true philosophy he united the simplicity and playfulness of a child. In him not only has science (in whose cause he fell a martyr) lost a distinguished ornament, and England a faithful and unwearied servant, but society has to mourn the departure of an honest, upright, and single-minded man.

. . . . . .

The poet's praise in its best and kindest spirit is all his own.

He shone, but it was with a still and tranquil light which ENVY trembled to invade.

He perished—and is missed and loved indeed.

Urit enim fulgore suo qui prægravat artes
Infra se positas—extinctus amabitur idem."

Fallows did not leave his observations completely prepared for publication, although the current reductions were far advanced. They consisted of about 3,000 transits, several hundred observations with the mural circle, and some series with the invariable pendulum. Sir George Airy completed the reductions, and the results were published in the Memoirs of the Royal Astronomical Society—a catalogue of 425 stars, of which 88 only were observed in declination. There is also a series of observations of the Sun's right ascension and declination, and a number of observations of the Moon, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and two of the Comet of 1830.

When Fallows came to South Africa there was no lighthouse on the coast, but shortly after his arrival one was built at Green Point, by order of Sir Rufane Donkin, and the light was first exhibited on 12th April, 1824.

In accordance with Admiralty instructions, a daily time signal has been given by the Observatory from the first days of its activity, for the use of shipping in Table Bay. In the days of Fallows and Henderson, the astronomer, a few minutes before the appointed hour, ascended to the roof of the Observatory, taking with him a chronometer and a large brass-barrelled pistol. (This ungainly weapon is still preserved at the Royal Observatory as an interesting relic.) When the second hand of the chronometer showed the instant of noon the pistol was discharged, and its flash was observed in a telescope beside the quay at Cape Town by a signalman, who, by means of a rope attached to his foot, dropped a time ball.

Though discouraged by " my Lords " in his desire to prevent the drift of sand by planting trees and shrubs in the vicinity of the Observatory, Fallows opened a school and taught the children of the neighbouring farmers, his fee being a load of earth for each lesson; and to this circumstance is mainly due the soil that now covers it and the vegetation which has since grown up and " beautified " that bare and sandy waste.

Fallows used the large S.W. room in the Observatory as a chapel, and it was there that the first regular services of the Church of England were held in South Africa.

The marks where the altar rails were attached to the eastern wall were still visible until quite recently.

In an obituary, published in the Monthly Notices of the Royal Astronomical Society, in 1832, February 10th, occurs the following tribute:—

"To those who were acquainted with Mr. Fallows, it is unnecessary to dwell upon the integrity and simplicity of his character, or the depth and clearness of his understanding: as an astronomer he had few rivals.

Perfectly acquainted with the practical and scientific departments of astronomy, he carried into the Observatory the same straightforward zeal and honesty which were the distinctive features of his private character; and if his life had been spared, would unquestionably have realised the most sanguine expectations of his friends and admirers."

May a long succession of His Majesty's Astronomers, and the people of South Africa, never forget how much they owe to the patient, self-sacrificing and arduous labours of the Reverend Fearon Fallows.

—o—

A FALL OF METEORITES IN THE COLD BOKKEVELD—1838 OCTOBER 13:

With a note on the Victoria West Meteorite.

By D. G. McIntyre, F.R.A.S.

I.—THE COLD BOKKEVELD METEORITE.

On 1838 October 13, a number of meteoric stones were seen to fall somewhere in the Cold Bokkeveld.

Though, as will be shown, this fall was the largest ever recorded as witnessed in South Africa, and indeed in the Southern Hemisphere, there are few references to it in standard works on Astronomy. It is not included in the catalogue of "Falls of Meteoric Stones Seen by Eye Witnesses" on page 592, Vol. III., of Chamber's Handbook of Astronomy (4th Edition).

(i) *Account of the Fall.*

The first account of the fall was brought to Cape Town by Mr. Justice Menzies, a famous and stormy character of the 'thirties. On the morning of the fall, he was returning from circuit and had stopped to rest at an outspan on the banks of

the Blood River. He was accompanied by a companion, Mr. George Thompson; and suddenly both of them were startled by a detonation and the fiery rush of a meteorite from the north west. That evening they reached the homestead of Mr. Pieter du Toit, where they were told that a meteorite had exploded in the morning.

On their return to Cape Town they naturally described what they had seen to friends. Mr. (afterwards Sir Thomas) Maclear, His Majesty's Astronomer at the Cape, hearing of their experience, interviewed both the judge and Mr. Thompson. There are available three accounts of the fall from Sir Thomas' pen. Two of them, in the form of letters to Sir John Herschel, are reprinted in the Philosophical Transactions of the Royal Society, Pt. I., 1839, and Pt. I., 1840 ("Particulars of the Fall of the Cold Bokkeveld Meteorolite," and "Further Particulars . . . .").

The third account is a letter published in the *South African Commercial Advertiser* for 1839 December 11. This account was reprinted in the Cape Government Gazette a little later. It is easily the most accurate account of the three—particularly in the spelling of the proper names of eye-witnesses.

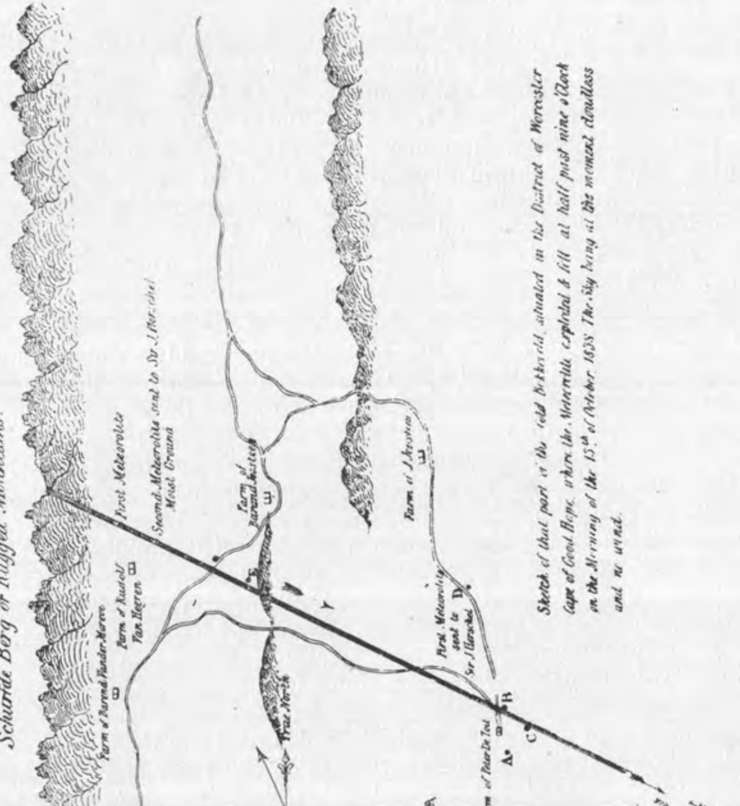
"The meteor appeared to the best of my judgment," Mr. Thompson told Sir Thomas, "to approach from the west with great velocity, and precisely similar to a Congreve rocket of large dimensions. The phenomenon expanded rapidly overhead . . . ." Mr. Thompson also learned that the explosion was heard within a few miles of Clanwilliam; on the Zonder-End River, and on the Cape Downs (a radius of about 70 miles).

At that time there was a very active Literary and Philosophic Society in Cape Town, and among its members was a Mr. F. Watermeyer. To him was sent by a missionary, the Rev. Mr. Fahn, one of the stones which had fallen in the Bokkeveld. He asked that it might be forwarded to Sir John Herschel, who had just returned to England from the Cape, and who had presided over the South African Literary and Philosophical Society. "I have another somewhat larger stone in the Bokkeveld," wrote Mr. Fahn, "which was too heavy for me to carry on horseback."

The stone procured by Mr. Fahn was handed to Sir Thomas, and was duly dispatched by him to Sir John Herschel.

Sir John's first act on receiving the stone was to hand a fragment to Faraday for analysis, to which we shall refer later. His next act was to write to Maclear suggesting that he should proceed to the locality of the fall, obtain what further stones he could, and get first-hand accounts of the event from eye-witnesses.

PLATE I.


Schuurde Berg or Rugged Mountains.
Farm of Barend Vander Merve
Farm of Rudolf Van Heeren
First Meteorolite
Second Meteorolite sent to Sir J. Herschel. Moist Ground
Farm of Barend Kirsten
Farm of J. Kirsten
First Meteorolite sent to Sir J. Herschel
True North
Farm of Pieter De Toit
Farm of Jan Hugo
A
B
C
D
Sketch of that part of the Field Bokkeveld, situated in the District of Worcester Cape of Good Hope, where the Meteorolite exploded & fell at half past nine o'Clock on the Morning of the 15th of October 1838. The Sky being at the moment cloudless and no wind.

That Sir John wrote to Maclear on these lines is clear from an unpublished letter dated 1839 May 6, written by Sir Thomas to Mr. Treuter, the Magistrate at Worcester, in which Maclear said that he intended attempting to secure the remainder of the meteorite, as suggested by Herschel, but that he did not think it advisable to offer any public reward for fragments, as Herschel had also suggested, because

> "an advertised reward might be the occasion of unnecessary trouble to ignorant persons who, wishing to obtain it, might offer apparently similar substances—or cause others who really have portions of the meteorolite to keep them back in the hope of obtaining a higher price, on the supposition that they are of real value, whereas their only value is with the investigator of natural knowledge."

So he asked Mr. Treuter to endeavour to obtain stones without promising a reward.

Sir Thomas could not leave for the Bokkeveld until 1839 November 9. He and his party went by wagon to Tulbagh—a five-day journey—and from there travelled to the scene of the fall on horseback.

Maclear has left a sketch map of the locality. This was reproduced in the Royal Society's Transactions and a copy of the reproduction appears in this Journal (Plate I.). To determine the exact locality and the area covered by the fall it is necessary to "place" Maclear's map upon an accurately surveyed map of the Cold Bokkeveld.

(ii) *The Locality of the Fall.*

In attempting such a determination of locality it is first necessary to identify the farms mentioned by Maclear. Unfortunately, Maclear mentions these farms by the names of their owners or occupiers, and this complicates the search from the outset. Maclear complicated matters further by spelling the names in different ways in his different documents. Thus Jooste is sometimes Joosten and Du Toit sometimes De Toit.

No early diagrams show the names of farmers—they show the names of the farms. So to identify the locality it becomes necessary to examine the title deeds of farms lying along the east side of the Schurfde Berg, and to trace who owned them in 1838. Through the good offices of several officials in the Surveyor-General's Department this has been done, though the process proved unexpectedly laborious—particularly on account of Maclear's variants "Jooste" and "Joosten," both of which names were encountered in the search.

There is just the shadow of a doubt about the exact locality of Du Toit's farm. Though the old diagrams show farmhouses, the area in which Du Toit appears to have resided in 1838 remained Crown land for many years after that date.

When the locality had been ascertained, diagrams sufficiently large in scale and early in date had to be obtained in order, particularly, that the homesteads and the old roads of Maclear's sketch might be identified. It so happened that the beautiful diagrams at the Surveyor-General's office by Moorrees and Bosman, compiled over 50 years ago, covered this area. From them the map reproduced in Plate II. was prepared. The track of the meteorite is placed high in the map for two reasons: the first, that the position of the fall relative to Tulbagh and Prince Alfred's Hamlet might be shown; the second, that the topography of Moorrees and Bosman extends no further to the north-east.

(iii) *Area Covered by Fall.*

Maclear gave various estimates of the extent of the area covered by the fall. In one place he says 20 miles; in the Commercial Advertiser he said "a zone 1 mile in breadth and 16 miles long"; in a letter dated 1871 April 6 to Mr. Layard (a famous authority on meteorites) he speaks of "a track 12 or more miles long."

The map now prepared shows that Maclear tended to overestimate the area, which was approximately 12 miles by 1½ miles, at least; for stones may have fallen beyond Du Toit's farm in mountains devoid of habitation.

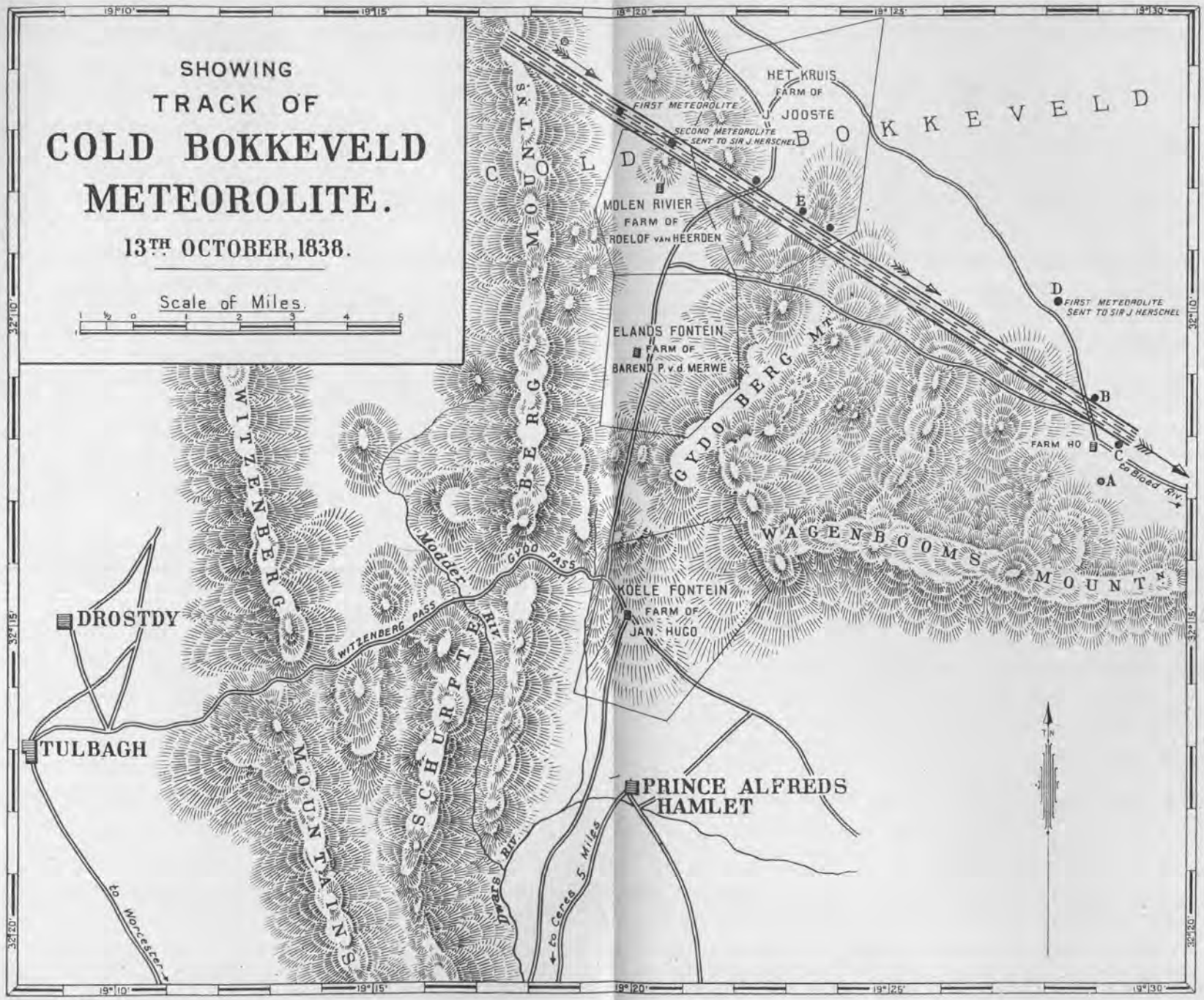
Even after this reduction it remains one of the most extended falls ever witnessed, as appears from the following table of extensive falls compiled chiefly from Farrington and Jackson:—

Homestead ..	7 x 4	miles	Weston	10 x —	miles
L'Aigle	7½ x 2½	„	Hessle	10 x 3	„
Stannern	8 x 3	„	New Concord ..	10 x 3	„
Esterville	8 x 1¾	„	Castalia	10 x 3	„
Pillstfer	8 x 2¼	„	Cold Bokkeveld	12 x 1½	„
Mocs	9 x 2¼	„	Macao	14 x —	„
Knyahina	9 x 3	„	Khairpur	16 x 3	„

(iv) *Number and Sizes of Stones.*

Though the area is so extended, it is probable that the number of stones which actually fell on 1838 October 13 has been vastly exceeded in other more concentrated falls. Yet the number is not inconsiderable.

PLATE II.


SHOWING
TRACK OF
COLD BOKKEVELD
METEOROLITE.
13TH OCTOBER, 1838.
Scale of Miles.
1 ½ 0 1 2 3 4 5
19°10'
19°15'
19°20'
19°25'
19°30'
32°10'
32°15'
32°20'
HET KRUIS
FARM OF
JOOSTE
FIRST METEOROLITE
SECOND METEOROLITE
SENT TO SIR J. HERSCHEL
COLD BOKKEVELD
MOLEN RIVIER
FARM OF
ROELOF VAN HEERDEN
D
FIRST METEOROLITE
SENT TO SIR J HERSCHEL
ELANDS FONTEIN
FARM OF
BAREND P. v.d. MERWE
GYDO BERG MTS.
B
FARM HO
C
To Bloed Riv.
A
WAGENBOOMS MOUNTS.
KOELE FONTEIN
FARM OF
JAN HUGO
WITZENBERG MOUNTS.
Modder R.
GYDO PASS
WITZENBERG PASS
DROSTDY
TULBAGH
SCHURFTE RIV.
MOUNTAINS
To Worcester
Doars RIV.
To Ceres 5 Miles
PRINCE ALFREDS
HAMLET
N

Only six people actually saw the fall:—

(i) Van Heerden's son standing between his father's house and the Schurfdeberg saw meteorite No. 1 (see Map) fall to the ground.

(ii) His mother saw another plunge into swampy ground north-east of the house. This specimen was sent to Sir John Herschel.

(iii, iv, v) Barand Jooste, with two servants, near E on Map, saw something fall, igniting grass. This specimen was sent to Captain Beaufort by H.M.S. Scout (Captain Craige).

(vi) A servant of P. du Toit also saw something fall, but this specimen was untraced.

"Each of these persons," Maclear wrote in the Commercial Advertiser, "asserts that on approaching the meteorolites they were so hot that they could not be taken up in the hand; also that the sky was cloudless and calm."

Maclear included in his communication to the Advertiser a catalogue of all the stones he had seen or traced:—

		lb.	oz.
No. 1.	Sent to Sir J. Herschel	1	13½
2.	Sent to Sir J. Herschel	4	2
3.	To Capt. Beaufort	3	14½
4.	In fragments, found by Barend Jooste, most in my possession ..	3	15½
5.	Given to me by Dr. Versveld, of Stellenbosch, the property of this Observatory (the Royal Observatory of the Cape of Good Hope)		15½
		14	13
	Estimated amount of the portions in the hands of private gentlemen, most of which I have seen	6	
		20	13

Maclear himself considered that many more stones had fallen:—

"It appears that six people only chanced to be in this tract (the zone of fall) at the time—two of them within a mile of each other . . . three close together . . . and one at Du Toit's. Beyond Du Toit's the

line of direction is over rugged mountains for a considerable distance and I believe uninhabited. Hence I conceive that I am warranted in supposing that but a small proportion of the original mass has been found . . . . "

Many more stones appear to have been found; but of their finding there is no record. According to the British Museum Catalogue of Meteorites, there are 21 pieces of Cold Bokkeveld Meteorite in the British Museum, 1 piece in the Paris collection, 1 piece in the Vennia collection, and 1 large piece in the South African Museum.

Besides these, there are apparently many other stones. A letter dated 1899 April 11 (copy with the Geological Commission) from Sir W. J. Herschel to Vice-Admiral J. P. Maclear reads:—

"Dear Maclear,—The 'large mass' of the Cold Bokkeveldt meteorite in my hands weighs (to the nearest ounce) 4-lbs. 6-oz. . . .

"Correspondence kept in the containing box shows that another box was, in 1845, sent by the Admiralty to Sir J. F. W. Herschel at the request of Mr. König (preferred by J. Farshall of the B[ritish]. M[useum].) for his decision as to what it contained and the use to be made of it. K. had spotted it at the Admiralty, where it had lain, after being sent to the Admiralty some years before, neglected. J. F. W. H. found it to contain small lumps, of which he selected 50 best for Mr. König, the rest being mere crumbs fit only for analysis, etc. Farshall weighed each of the 50 and sent a list of them with the official acknowledgement, which is here in the box. J. F. W. H. says he had no instruction from T. Maclear about them and acted only for the best. J. Farshall looks on the lot as a great acquisition for purposes of exchange (? in K.'s hands, for *his* collection).

"A. S. Herschel knows of a *small* piece which the widow of a [?] sold *to him* for the B.M., where it is now in deposit.

"I have not yet seen the correspondence about the 'large mass' as Sir J. F. W. H. labels the box containing it.

"In haste,

"W. J. HERSCHEL."

The number of stones which fell, it seems from this evidence, was certainly over 50, and probably well over 100. In size they appear to range from the smallest pieces weighing fractions of an ounce to pieces weighing 3 and 4 pounds avoirdupois. There is also the stone so large that Mr. Fahn could not carry it on horseback. All trace has been lost of this—the bulkiest and heaviest stone discovered after the fall.

(v) *Composition of the Stones.*

In the year of the Faraday Celebrations, an extract from Faraday's report on the Cold Bokkeveld Meteorite may prove of interest. Faraday analysed the fragment sent to him by Sir John Herschel and found that it was composed of the following substances, in the proportions shown:—

Water	6.50
Sulphur	4.24
Silica	28.90
Protoxide of Iron	33.22
Magnesia	19.20
Alumina	5.22
Lime	1.64
Oxide of Nickel	0.82
Oxide of Chromium	0.70
Cobalt—a trace.	
Soda—a trace.	
	100.44

Traces of water—very rare in meteors—were found, but were probably of terrestrial origin. The Bokkeveld stones may be slightly deliquescent, and this might account for the fact that the Herschel stone, which in 1839 weighed 4-lbs. 2-oz., was, in 1899, four ounces heavier.

Later examination by A. W. Wright showed that the stones also contained such gases as hydrogen, carbon monoxide, carbon dioxide, etc. Carbon dioxide comprised 93.11% of the total gases obtained from the specimen examined. This is the highest percentage which Wright obtained for this gas in an extended investigation of the gas content of many meteorites.

(vi) *Professor O. Buchner's Account of the Fall.*

In "Die Meteoriten in Sammlanger (Leipzig's 1862, p. 60), Professor O. Buchner gives a highly coloured account of the

Cold Bokkeveld Meteorite. This account is quoted here, as it possibly has led to meteorites in many collections being labelled Cold Bokkeveld when they are, in fact, fragments of another meteorite which was cut up in the South African Museum about 1860.

"The air," writes the Professor, "was audibly shaken for more than 80 miles in every direction [about 70 miles would be a truer estimate]. At Worcester, 40 miles from the fall, several persons felt shocks like those of electricity in their knees [all that Treuter, Magistrate of Worcester, reported was that his windows were shaken]. . . . Many stones fell in 3 heaps, all within an area of 40-50 yards square. According to the accounts the stones were dispersed over a tract of 150 English miles all in the same direction, so that with intermittences stones were found at 10, 15, 20, 50 and 100 miles apart. Those which fell at Tulbagh alone are estimated to have weighed several cwts. Most of the stones were carried away as soon as they were discovered."

Ridiculous as this account sounds, it is probable that Prof. Buchner has committed a not unnatural error of confusing two meteors. On page 594 of the volume of Chamber's Handbook already quoted, there is mentioned an iron meteorite seen to fall at Victoria West in 1862.

———o———

II.—THE VICTORIA WEST METEORITE.

If an iron meteorite was seen to fall at Victoria West in 1862, that fall would be even more important than the Cold Bokkeveld fall. In collections of meteorites, iron meteorites predominate; and when a geologist picks up a meteorite it is usually iron. Yet of the "seen to fall" very few are iron. Between 1801 and 1923 there were 850 meteorites seen to fall. Of these, only 14 were iron.

If Buchner has confused the Bokkeveld and the Victoria West meteorites, it would explain why he mentions a distance of 150 miles along which the stones fell. It would also explain why the analysis which he gives of the Bokkeveld meteorite differs entirely from the analyses of Faraday and Wright, and is, in fact, the analysis of an iron—and not a stone—meteorite.

Buchner is not to blame for this error because no account of the Victoria West meteorite appears to have been published until 1868, six years after his book. Then a geologist, V. W. Gregory, described in the Geological Magazine for May, 1868, how he

was returning from the Orange River some time previously, and how he had collected evidence that an iron meteorite was seen to fall by a farmer named Auret between Victoria West and Prince Albert in 1862. This meteorite was in the South African Museum.

An iron meteorite from Victoria West was secured by the South African Museum in 1860. It was cut in half there. One half was kept by the Trustees, and is still at the Museum. The other was re-cut into several pieces which were exchanged with other museums. All these museums are mentioned by Buchner as having specimens of Cold Bokkeveld Meteorites.

In 1871 an intensive effort was made to verify Gregory's account of the 1862 fall. " I have never heard of the *fall* of the iron mass regarding which full information is wanted from Auret, of Prince Albert or Victoria West, 'seen to fall,' " Sir Thomas Maclear wrote to Mr. Lazard on 1871 April 6. Gregory's story was never verified as Mr. Auret was never traced, nor did anyone in the locality know anything about the fall. The outcome of the investigation was that Sir L. Fletcher removed the Victoria West meteorite from the British Museum's catalogue of iron meteorites " seen to fall." It should be deleted from Chamber's Handbook as well; while the Bokkeveld Fall should be added to the " seen to fall " catalogue in that volume.

I have to acknowledge the great assistance received from officials of the Surveyor-General's Department, the Geological Commission, the South African Museum, the South African Public Library and the Royal Observatory of the Cape of Good Hope. Without that assistance this article could not have been written.

———o———

PHOTOGRAPHS OF THE LUNAR ECLIPSE,

2nd April, 1931.

The remarkably fine series of photographs, reproduced in Plates III. and IV., was taken by Mr. A. van Reede van Oudtshoorn, F.R.P.S., the President of the Cape Town Photographic Society, with a half-plate camera, and extension (constructed by himself) fitted with a telephoto lens of French make, open aperture *f*8, the focal length being 30 inches.

As Mr. van Oudtshoorn had no apparatus for counteracting the motion of the earth, he experimented by taking photographs of the moon on the night previous to the eclipse, so as to ascertain the minimum time which would yield a well-exposed negative: this he found to be 2 seconds, in which time the movement was inappreciable.

Plate III. a and b and Plate IV. a are reproduced from photographs taken on Ilford Panchromatic soft-gradation plates, daylight speed 700 H. and D., the lens being stopped down to *f*11, and the exposure 2 seconds. The photograph from which Plate IV. b is reproduced was taken on a Barnet Matt plate, speed 350 H. and D., using the full aperture of *f*8, and the exposure was increased to 5 seconds.

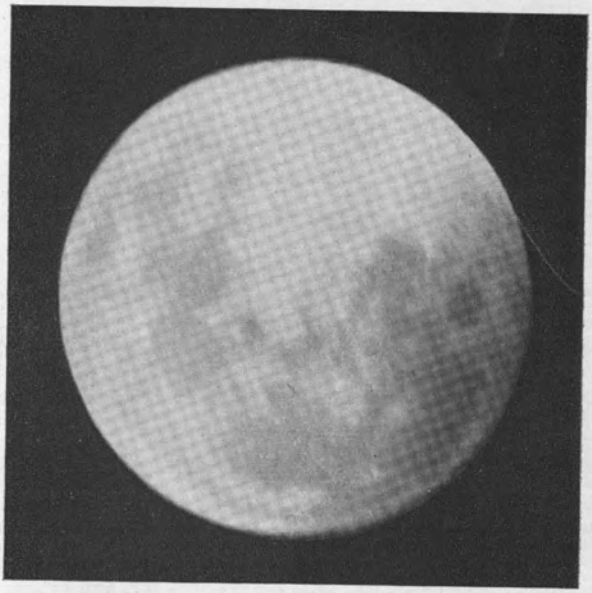
Mr. van Oudtshoorn's method of making the exposures avoided all possibility of vibration—it was to uncap the lens a few seconds before the time fixed for the commencement of each exposure, holding, at the same time, a large piece of dark cardboard in front of the lens: when the stop-watch indicated the moment for making the exposure, he swung the cardboard away from the lens, and restored it to its former position after the 2 or 5 seconds had elapsed, afterwards replacing the cap.

Each negative was developed immediately after exposure, with metol-borax developer, for 6 minutes.

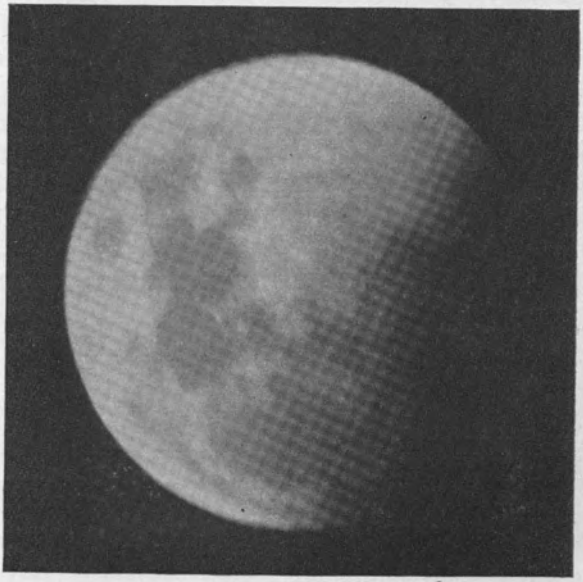
Mr. van Oudtshoorn is to be congratulated on his achievement, and for the ingenuity and perseverance shown: it is hoped that he will continue to display his interest in astronomical photography.

D. C.-S.

PLATE III.

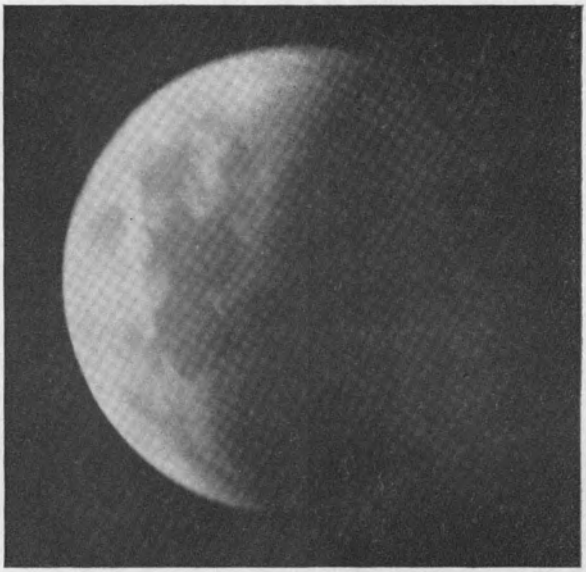


(a)

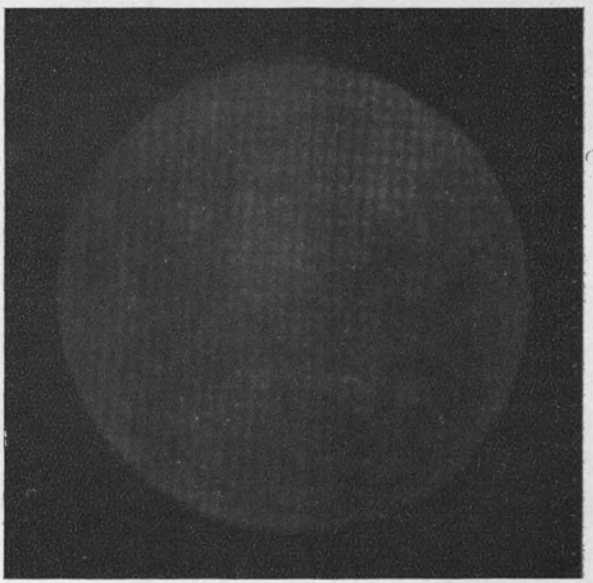


(b)

PLATE IV.



(a)



(b)

REVIEWS.

"Catalogue of Bright Stars." By Frank Schlesinger. [Pp. (6) + 208.] (Yale University Observatory, 1930. Price $3.75.)

The full title of this publication is "Catalogue of Bright Stars, containing all important data known in June, 1930, relating to all stars brighter than 6.5 visual magnitude, and to some fainter ones." The *Revised Harvard Photometry*, containing 9,110 stars, is used as the basis, so that the current numbers in this catalogue are in agreement with those of the HR. The catalogue gives for each star the following particulars:—(1) The HR number; (2) the name of the constellation, with the Flamsteed number and the Bayer letter, the boundaries of the constellations being those recently decided upon by the International Astronomical Union; (3) the Durchmusterung number; in accordance with Harvard usage, the Bonn Durchmusterung is used from the North Pole to —23°, the Cordoba Durchmusterung from —23° to —52° and the Cape Photographic Durchmusterung south of —52°; (4) the number in the "Preliminary General Catalogue" of Boss; (5) the right ascension for 1900, to the nearest second of time, and the annual precession in right ascension; (6) the declination for 1900, to the nearest minute of arc; the precession in declination is given at the foot of each page; (7) the visual magnitude and spectral type as given in the "Draper Catalogue"; (8) the proper-motions in right ascension and declination, extracted from Boss's Catalogue or other available source; (9) the absolute parallax, based upon trigonometrical, spectroscopic, dynamical or other values; (10) radial velocity in kms. per second, based upon all reliable determinations; (11) Remarks, such as magnitude limits of variable stars, periods of visual and spectroscopic binaries, magnitudes and separations of visual binaries, velocities of centres of gravity of spectroscopic binaries, etc.

The following data are given in appendices: (1) Tables for deriving the galactic longitude and latitude, corresponding to a given right ascension and declination, based on a position of the galactic pole of 12h.40m., + 28° (1900); (2) The international limits of the constellations, as recently delimited; (3) The three letter international abbreviations for the names of the constellations; (4) an index to the right ascensions for 1900 of the stars given by their Flamsteed numbers or Bayer letters.

From the summary of the contents given above, it will be evident that the volume is one which will be well-nigh indispensable to the practical astronomer. Information which hitherto could have been obtained only by reference to a number of publications is here collected together and reduced to a uniform basis. Whether particulars relating to a single star are required or statistical data for a number of stars, the volume will be found equally of value. It has been used in manuscript form for many years as a basis for various observing programmes for the Allegheny and Yale University Observatories, and its publication has been made possible by a grant from the publication fund of the National Academy of Sciences, Washington. Astronomers are under a deep debt of gratitude to Prof. Schlesinger for this excellent compilation.

Copies can be obtained for $3.75 by writing to the Treasurer, Yale University, New Haven, Connecticut, U.S.A.

"Les Observatoires Astronomiques et les Astronomes.' Par P. Stroobant, Directeur, J. Delvosal, E. Delporte et F. Moreau, Astronomes, et H. L. Vanderlinden, Astronome Adjoint de l'Observatoire Royal de Belgique. [Pp. 315.] (Tournai, Paris. Etablissements Casterman, S.A., 1931. Price not stated.)

This valuable reference volume has been prepared under the auspices of the International Astronomical Union by the staff of the Royal Observatory, Uccle. The Uccle Observatory published in 1907 a volume with the same title, and the need for a new and up-to-date edition had long been felt. The publication of the present edition, which follows the same plan as the earlier edition, has been made possible by a grant from the International Astronomical Union.

The observatories are arranged alphabetically according to geographical position: thus, the Yale Observatory appears under Newhaven. The latitude, longitude and height above sea-level are given, followed by a list of publications, names of the members of the staff, brief historical notes, details of the instrumental equipment and a summary of the astronomical work undertaken at the Observatory.

Lists of Astronomical Societies (arranged in order of foundation), of National Committees of Astronomy and of astronomical journals and reviews will prove of value for

reference. It is of interest to note that the Royal Astronomical Society, founded in 1820 under the name of the Astronomical Society of London, is the oldest of the astronomical societies by 39 years.

An alphabetical list of names of astronomers, cited in the volume, is given at the end. This list includes also the particular names, printed in small capitals, of certain observatories, such as Lick, Harvard, etc.

"Délimitation Scientifique des Constellations (Tables et Cartes)." Par. E. Delporte, Astronome à l'Observatoire Royal de Belgique. [Pp. 41 with 27 maps.] (Cambridge: At the University Press, 1930. Price 10s. 6d. net.)

The first portion of the introduction to this volume gives an interesting historical account of the demarcation of the sky into constellations and explains the purpose of the present volume. The following is a translation:—

"The ancients have bequeathed to us, in their descriptions, the heavens divided into asterisms, but without any defined limits. Bode, in his star atlas, was the first astronomer to add to the symbolic figures of the ancients lines of demarcation between the constellations; C. L. Harding, in his *Atlas Novus Coelestis* (Göttingen, 1822), retained these limits, whilst omitting the symbolic figures. Those who came after took many liberties in tracing the limits, which consequently differed from one Star Atlas to another. An attempt by John Herschel to delimit the constellations in the form of spherical quadrilaterals appeared too radical; his plan indeed shifted too many of the principal stars from one constellation to another; F. Baily, in the preface to the *Catalogue of Stars of the British Association* (1845), enunciated a number of rules such that, in his opinion, their application would give stable limits to the constellations whilst at the same time keeping them in close agreement with Ptolemy's descriptions. No attempt at a practical application was made. About the same time, Fr. Argelander published (1843) his *Uranometria Nova*. The limits which he assigned to the constellations of the northern hemisphere were to be adhered to in the naming of variable stars, according to a resolution of the Astronomische Gesellschaft in 1867. However, subsequent authors of star atlases took no heed of this resolution and such atlases differ one from another in the limits of the constellations and even in the number of the constellations.

"Argelander's limits are not, moveover, susceptible of mathematical definition.

"Now, the precise delimitation of the constellations is of capital importance for many astronomical purposes, such as the

systematic observation of shooting stars and meteors, the study and naming of variable stars, the observations of novæ, etc.

" The work of B. A. Gould (*Uranometria Argentina*, 1877) realised this reform for the southern hemisphere, the limits of the constellations being formed by meridians of right ascension and parallels of declination for the equinox of 1875.0 and, in some special cases, by curves approaching as nearly as possible to great circles, whose position is defined by their intersections with the meridians and the parallels.

" In 1923, the Belgian National Committee on Astronomy, on the proposal of its President, M. P. Stroobant, examined the question of the revision of the limits of the constellations of the northern hemisphere. The assembly of the International Astronomical Union, held in Rome in 1922, had already taken the first step by codifying the abbreviations of 88 constellations, covering the entire sky.

" At the request of the Belgian National Committee, the matter was placed on the agenda for the Assembly in Cambridge, in 1925. At this meeting, M. Delporte presented a preliminary plan, based on work at Uccle, jointly with M. Casteels. The General Assembly of the International Astronomical Union considered desirable the revision of the limits of the northern constellations and asked for a report to be presented at the Leiden meeting, in 1928.

" A sub-committee of the Notations Commission (No. 3) was charged with the preparation of the work. According to a resolution of the Variable Star Commission, the revision was to take into account the existing designations of variable stars and was to keep these stars in their respective constellations.

" The sub-committee consisted of MM. G. Bigourdan, L. Casteels, E. Delporte, J. C. Duncan, E. B. Knobel, Miss Mary Proctor and M. R. K. Young.

" On the proposal of M. Delporte, the following conditions were agreed to: a scientific delimitation of the boundaries of the constellations of the northern hemisphere to be made, the limits being mathematically defined for a certain equinox, these limits departing as little as possible from the limits as drawn in modern star atlases, thus avoiding as far as possible the shifting of stars from one constellation to another and subject to the express condition that catalogued variable stars must retain their existing names.

" For the sake of homogeneity, the sharing of the work of delimitation was not recommended.

" M. Delporte was then charged with the complete theoretical delimitation. As the work advanced, he communicated

to the members of the sub-committee four reports between October, 1925, and September, 1927, containing the results already obtained. He requested the members to express their views and these were taken into account in the final report.

"The equinox chosen was 1875.0, to agree with the maps of Gould for the southern hemisphere.

"The boundaries consist entirely of arcs of hour circles and of parallels of declination. A simple calculation of precession, applied to the co-ordinates of a star, fixes its position in a definite constellation with absolute certainty. The contours of the constellations follow as closely as possible the boundaries in the principal existing star-atlases."

The present volume contains the report of the committee, as presented at the Leiden meeting of the International Astronomical Union in 1928, supplemented by a rectification of Gould's boundaries for the southern constellations where Gould had used oblique arcs. This rectification was entrusted to M. Delporte and has been carried out without transferring any star in Gould's Catalogue into another constellation.

The precise boundaries are given of each constellation, arranged in alphabetical order, followed by a series of 13 charts for the northern hemisphere and 13 for the southern, with a key chart for the whole sky. On these charts, stars to the sixth magnitude are shown and variable stars are indicated. None of the stars have been lettered; the scale of the charts is rather too small for this to have been done without overcrowding.

The volume is well printed on good quality paper by the Cambridge University Press.

M. Delporte has published also an "Atlas Céleste," in which the same charts are reproduced. Facing each chart is a list of all the stars to magnitude $4^{m}.5$, together with lists of variable stars, double stars and the principal clusters and nebulæ; magnitudes and spectral types of the stars are given and right ascensions and declinations of all objects are given for the two epochs 1875 and 1925. This atlas is published by the Cambridge University Press for the low price of 5s. Containing, as it does, the authoritative constellation boundaries, as approved by the International Astronomical Union, it is indispensable to all practical astronomers.

"Comets." By Charles P. Olivier. [Pp. x. + 246, with 7 plates and 6 text figures.] (London: Baillière, Tindall and Cox. Price 16s. net.)

No recent book on the subject of comets is available in the English language and such standard works as Chambers' "The

Story of the Comets" have long been out of date. The new volume by Prof. Olivier, the Director of the Flower Observatory, University of Pennsylvania, is not intended to replace such works, but to form a sequel to them and also to his own volume on "Meteors," which has previously been reviewed in our pages. A brief historical review of the subject is given, followed by an account of the present theories of the origin, constitution, changes and dissolution of comets. The chapter on the spectra of comets gives a brief account of the recent work of Baldet and Bobrovnikoff. Several chapters are devoted to individual comets of interest, including Halley's Comet, Biela's Comet, Pons-Winnecke's Comet and Comet 1910 *a*. The relationship between comets and meteors is discussed in some detail, and a full description is given of the remarkable meteor-fall in Siberia on 30th June, 1908. No adequate account of this, the greatest meteor-fall of modern times, has hitherto been available in English. It was not until the visit of Prof. Kulik in 1927 that the circumstances of the fall were fully investigated. Two photographs by Prof. Kulik are reproduced; one shows an area of trees struck down by the air blast which followed the impact, the tree trunks all lying parallel to one another, with their tops away from the centre; it is stated that the total area so affected was from 30 to 40 miles in diameter. The other photograph shows a number of craters produced by fragments accompanying the main fall. The effects of this disturbance were recorded on seismographs to a distance of 900 kms. and the sounds were heard to distances of more than 1,000 kms. An account is given also of the great meteor crater (Coon Butte) in Arizona, which was undoubtedly formed by a much greater fall many centuries ago.

The question of the origin of comets is a difficult one which has not yet been definitely settled. An account of various theories is given. The author's own view is that the comets were formed of matter expelled from the sun at the same time as the matter which ultimately formed the planets; the matter expelled from low latitudes is supposed to have aggregated into planets, that from higher latitudes to have formed the comets.

No mention is made of some interesting periodic comets such as Forbes's periodic comet or the Schwassmann-Wachmann comet, which can be photographed round its entire orbit, lying between the orbits of Jupiter and Saturn.

The volume is readable and non-technical and is free from serious errors. It is a welcome addition to the literature on the subject. The price is unduly high for a volume of this size and the sales will undoubtedly suffer as a result.

" Man and the Stars." By H. T. Stetson, Director of the Perkins Observatory, Ohio Wesleyan University. [Pp. xiii. + 221, with 30 plates and 25 text illustrations.] (London: The McGraw-Hill Publishing Co., Ltd., 1930. Price 12s. 6d. net.)

The great growth of popular interest in astronomy is evidenced by the continued output of volumes intended for the lay reader. This volume comes under this category. It is neither a text-book nor a popular guide to the heavens, but a series of essays on various aspects and developments of astronomy, including accounts of the work of some of the pioneers, such as Copernicus, Tycho Brahe, Kepler, Galileo, Newton and the Herschels. The volume is eminently readable and a clear account of many of the modern developments is given. In a volume such as this, the balanced treatment required for a text-book is not to be expected, and some matters receive more space than their importance really warrants; thus a whole chapter, in the section entitled " The Changing Universe," is given to an account of an investigation by Prof. Stetson into the variation of radio reception with solar activity.

The volume is divided into four sections: I. Looking Skyward; II. Changing Concepts; III. The Changing Universe; IV. Man Wonders. The first two parts are historical and lead up to Herchel's conception of the structure of the universe; they are well written and the facts are presented with attractive clearness. The third section gives a brief account of modern astronomy. The last section is speculative, dealing with the questions whether there is life on other planets, whether life has any cosmic significance and whether science has displaced religion. There are numerous illustrations and plates. The volume cannot fail to be of interest to the general reader and it will doubtless induce many to study the subject further.

" The Mysterious Universe." By Sir James Jeans, M.A., Sc.D., D.Sc., LL.D., F.R.S. [Pp. ix. + 154 with 2 plates.] (Cambridge: At the University Press, 1930. Price 3s. 6d. net.)

It rarely happens that a scientific book becomes a " best seller." It is not difficult to understand why this small volume has proved so popular. There are few thinking people who are

not interested in the riddle of existence and in the ultimate mysteries of the universe. The public has been quick to realise that in this book they will find an authoritative account of what science has to tell "as to ascertained facts and provisional hypotheses," written with a charm of style and lucidity of expression which smooth away the difficulties of the reader.

The book is an expansion of the Rede lecture delivered before the University of Cambridge in 1930, and is intended to be read as a sequel to the author's former book, *The Universe Around Us*. The first four chapters lead up to the final chapter, entitled "Into the Deep Waters," and contain an attractive presentation and discussion of fundamental astronomical and physical data. Wave-mechanics, the interaction of matter and radiation, the annihilation of matter, the expanding universe and the space-time continuum of the theory of relativity are each discussed in turn. The conclusion is reached that "a soap-bubble with irregularities and corrugations on its surface is perhaps the best representation, in terms of simple and familiar materials, of the new universe revealed to us by the theory of relativity. The universe is not the interior of the soap-bubble but its surface, and we must always remember that, while the surface of the soap-bubble has only two dimensions, the universe-bubble has four—three dimensions of space and one of time. And the substance out of which this bubble is blown, the soap-film, is empty space welded into empty time." The irregularities and corrugations are interpreted as matter and radiation, the ingredients of which the universe appears to be built.

The final chapter, "Into the Deep Waters," contains the interpretations which the author places on the scientific facts and hypotheses discussed in the previous chapters. It is pointed out that every one has the right to draw his own conclusions from the facts and that many will disagree with the author's own conclusions. Emphasis is laid on the fact that "*all* the pictures which science now draws of nature, and which alone seem capable of according with observational facts, are *mathematical* pictures." When a mathematical formulation of a phenomenon has been obtained, we have all the knowledge that we require. The days of mechanical models have gone; such models are a step away from reality. From this point of view, it becomes immaterial to discuss whether light consists of waves or particles; everything is contained in the mathematical formula which expresses an undulatory, if abstract, nature. "Many would hold that, from the broad philosophical standpoint, the outstanding achievement of twentieth century physics is . . . the general recognition that we are not yet in contact with ultimate reality. To speak in terms of Plato's well-known simile, we are

still imprisoned in our cave, with our backs to the light, and can only watch the shadows on the wall. At present the only task immediately before science is to study these shadows, to classify them and explain them in the simplest possible way. And what we are finding, in a whole torrent of surprising new knowledge, is that the way which explains them more clearly, more fully and more naturally than any other is the mathematical way, the explanation in terms of mathematical concepts." Thus all we need to know is how a thing behaves, not what it is; the mathematical formula contains all that is essential and we can interpret it in one way or another according to the mood of the moment.

The author then argues that the universe can be considered as a universe of thought—the thought of a mathematical thinker and that its creation must have been an act of thought. "Indeed, the finiteness of time and space almost compel us, of themselves, to picture the creation as an act of thought; the determination of the constants such as the radius of the universe and the number of electrons it contained imply thought, whose richness is measured by the immensity of these quantities. Time and space, which form the setting for the thought, must have come into being as part of this act. Primitive cosmologies pictured a creator working in space and time, forging sun, moon and stars out of already existent raw material. Modern scientific theory compels us to think of the creator as working outside time and space, which are part of his creation, just as the artist is outside his canvas."

The viewpoint of Sir James Jeans is summarised in the following extract: "To-day there is a wide measure of agreement, which on the physical side of science approaches almost to unanimity, that the stream of knowledge is heading towards a non-mechanical reality; the universe begins to look more like a great thought than like a great machine. Mind no longer appears as an accidental intruder into the realm of matter; we are beginning to suspect that we ought rather to hail it as the creator and governor of the realm of matter—not of course our individual minds, but the mind in which the atoms out of which our individual minds have grown exist as thoughts."

The author recognises that his conclusions are speculative and uncertain, and will not be accepted by all. It is pointed out that the stream of knowledge has turned back on itself many times in the past and that it may do so again. The clearness of expression, the aptness of the illustrations and the force of the arguments make this volume one of great interest, whether or not the final conclusions are accepted.

"The Rotation of the Galaxy: being the Halley Lecture delivered on 30th May, 1930." By Sir A. S. Eddington, M.A., D.Sc., LL.D., F.R.S. [Pp. 30 with frontispiece and 3 figures.] (Oxford: At the Clarendon Press, 1930. Price 2s. 6d. net.)

Sir Arthur Eddington's Halley Lecture was devoted to an account of the rotation of the Galaxy, as indicated by observation, and of the theory of the rotation. The rotation of the galaxy can be derived from the study of either radial velocities or proper motions; the investigations of Oort, Lindblad, Plaskett and Dyson have conclusively established within recent years that the galaxy is in rotation about a centre in the direction of the constellation Sagittarius, in galactic longitude about 300°. Sir Arthur Eddington's attention was directed by Prof. Lindblad to the fact that Gyldèn in 1871 discovered the rotation from the analysis of the proper-motions of stars; to make the conclusion more convincing, Gyldèn applied his method to the apparent motions of the asteroids and deduced the direction of the sun, the centre of the system, with an error of only 6°. Such investigations of the rotation of the galaxy determine the change of velocity in going towards or away from the centre; they do not determine the actual velocity at any point. The stars in our neighbourhood appear to have an orbital speed of between 200 and 300 km. per second.

Two important consequences of the rotation of the galaxy are pointed out; it is well known that in general the spiral nebulæ are receding from us at high speeds, the speed being the higher the greater the distance. There were only two known exceptions to this rule. It is of interest to note that when the rotation of the galaxy is allowed for, a velocity of approach is no longer found for these two nebulæ. The second concerns the high velocity stars, which are known to have an asymmetrical velocity distribution, moving towards one hemisphere of the sky. This direction is the reverse of the direction of our orbital motion and the stars of apparent high velocity are actually the extreme laggards. If there were originally stars moving with the same relative velocity in the opposite direction, they would long ago have escaped from the system, the attraction being unable to hold such stars.

The distance of the stars in our neighbourhood from the centre of the system is at present badly determined. When the distance is known, the mass of the system which controls the orbital motion can be calculated. For purposes of illustration the figures corresponding to an assumed orbital speed of 250 kms. per second may be quoted. The corresponding distance

from the centre is 11,000 parsecs and the mass of the system is 150,000,000,000 times the Sun's mass. The period of a complete rotation is about 250 million years, so that since the Earth was formed the Sun has made several complete revolutions.

The last few pages are devoted to a discussion of the dynamical problem involved in the admission of galactic rotation. It is commonly supposed that the Sun is near the centre of a local aggregation of stars, called the "local cluster," with a diameter of about 700 parsecs. The differential rotation is such that the inner edge of the cluster will make eight revolutions whilst the outer edge makes seven, so that such a clustter cannot be permanent. Eddington concludes that "it would be contrary to observation to deny the existence of irregularities of distribution like star-clouds, but I think they must be regarded as transitory eddies in a whirlpool, which form and dissipate continually." He finds it difficult to invent a galaxy with an age equal to that of the Earth which will at the same time embody the main observed features of stellar motion and distribution; with an age equal to that now assigned to the stars it is quite impossible. Further problems connected with the dynamics of the galaxy and the rotation of the cosmic cloud are considered. The final conclusion is that "Perhaps the lesson of the galaxies is to wake us from our dream of leisured evolution through billions of years. It is hard to credit our stellar system with so much age and endurance. It is more like a young man in a hurry."

"Text-Book on Spherical Astronomy." By W. M. Smart, M.A., D.Sc. [Pp. xi. + 414 with 146 figures.] (Cambridge: At the University Press, 1931. Price 21s. net.)

A new text-book in the English language was overdue; Chauvenet's great text-book was written in 1863 and though still valuable for the advanced study of the ground which it covers, it is in many respect out-of-date. Ball's text-book is good in parts but was written with a view to the Cambridge Mathematical Tripos. The new text-book by Dr. Smart is therefore welcome. It covers the subject up to the standard of a normal university honours degree, is not too long and includes modern developments of the subject. The methods of reduction of astronomical photographs, and the determination of proper-motions and parallaxes of stars by photographic methods require a place in any modern text-book on spherical astronomy. It may be noted that the evaluation of the second order terms in differential refraction has not been included, nor has any account been given of Schlesinger's valuable method of dependencies. A

chapter is devoted to proper-motions of the stars, radial velocities, secular parallaxes and the determination of the solar motion and apex. Another chapter gives a brief account of a few methods for determining the orbits of visual and spectroscopic binary stars. On the determination of position at sea, Dr. Smart writes authoritatively and concisely and the chapter devoted to this subject is a valuable addition.

The author has used the *Nautical Almanac* for 1931 in the numerical applications. The many changes in this publication, commencing with the year 1931, have made references to the *Nautical Almanac* in the older text-books obsolete. In the nomenclature for time, the author has not followed the *Nautical Almanac,* however. He has used G.C.T. (Greenwich Civil Time) to denote mean time, for the meridian of Greenwich, reckoned from midnight. Astronomical time reckoned from mean noon has been denoted by G.M.A.T. (Greenwich Mean Astronomical Time). These symbols are in accordance with recommendations of the International Astronomical Union. These recommendations did not meet with universal assent and have been by no means generally followed. The *Nautical Almanac* uses G.M.T. to denote mean time, for the meridian of Greenwich, reckoned from midnight. The designition U.T. (Universal Time) or the German equivalent W.Z. (Weltzeit) has met with wide acceptance and is free from ambiguity; there is much to be said in favour of its universal adoption.

The diagrams are numerous and, in general, are admirably clear. No chronograph yet constructed will give a trace, however, such as is shown in Fig. 43. The diagrammetric representation of a transit circle in Fig. 32 could have been improved. The treatment of planetary aberration is not ideal. But on the whole the volume is remarkably free from errors. More numerical illustrations might with advantage have been included, so as to emphasise the practical applications. A series of exercises for the student are given at the end of each chapter. The work can be strongly recommended as suitable for honours courses in universities and as a volume for reference by the practical astronomer. The printing and paper are of the high quality which is customary for publications by the Cambridge University Press.

"Elementary Mathematical Astronomy." By C. W. C. Barlow, M.A., B.Sc., and G. H. Bryan, Sc.D., F.R.S. Fourth Edition. Revised by A. C. D. Crommelin, D.Sc., B.A. [Pp. xviii. + 445 with 166 figures.] (London: University Tutorial Press, 1930. Price 9s. 6d. net.)

This useful elementary text-book on mathematical astronomy was written forty years ago to fill a gap that existed between descriptive non-mathematical works on astronomy and the standard treatises which involve advanced mathematics. A knowledge of elementary geometry, algebra, trigonometry and dynamics is all that is assumed of the reader.

The fourth edition, which has been thoroughly revised by Dr. A. C. D. Crommelin, incorporates a number of modifications designed to bring the book into line with modern advances. The extensive changes in the *Nautical Almanac* from 1931 onwards have called for numerous alterations in the references to that publication and many of the examples dealing with time have required alteration on account of the change of the beginning of the astronomical day from noon to midnight. The added matter includes a new section on the Julian Day, and additional information on the Metonic cycle, eclipse limits and cycles, calendar construction, and planetary elements. Reference is made to the discovery of Pluto. In addition, minor revisions have been made throughout where necessary.

In this revised edition, the elementary student will find a reliable and up-to-date text-book, which will give him an accurate knowledge of the fundamental facts and principles of mathematical astronomy. Of proved worth in the past, the volume is now assured of a new lease of life.

"The Stars of High Luminosity." By Cecilia H. Payne. [Harvard Observatory Monographs, No. 3. Pp. xiii. + 320 with numerous text figures.] (McGraw-Hill Publishing Co., Ltd., 1930. Price 17s. 6d. net.)

The series of Harvard Observatory Monographs commenced with the publication in 1925 of "Stellar Atmospheres," by Miss Payne, in which a general survey was given of the current knowledge of the subject in relation to the recently developed ionisation theory. This monograph is now out of print and in some ways out of date. Instead of reprinting it in a revised form an entirely new monograph has been written by Miss Payne to replace it. In the period of five years which has elapsed between the appearance of the two volumes there have been considerable extensions on the theoretical side, advances in technique due to a large extent to the application of microphoto-

meters to the study and investigation of spectral details, and a steady accumulation of observational data. As regards the relationship of the new monograph to the earlier one, Miss Payne writes in her Preface: " It is difficult to enumerate exactly the parts of the former monograph that are superseded in the present one. The whole picture is fuller, the details more convincing, than they were five years ago. I believe that the chief advance (besides the improved technique that replaces qualitative by roughly quantitative results) resides in the wider correlation of data, and its effect on the background of astrophysical thought —matters entering the text implicitly rather than explicitly. In many ways the results are less clear-cut than they were five years ago, a consequence of the greater wealth of data; the picture of the stellar atmosphere sketched in Monograph No. 1 may well seem simpler and more convincing than the present one.

" Although the analysis of the stellar atmosphere is still in its early phases, the present treatment marks a definite stage. It carries the work as far as I believe it can be carried with the kind of material available to me—spectra of comparatively short dispersion, either unstandardised or standardised by simple and unrefined methods. It seems as though further work demands greater refinement of method, and probably also far larger dispersion, if the scope of the study is to be enlarged, or much greater accuracy attained."

The author defines the star of high luminosity, or supergiant star, as a star with an absolute visual magnitude brighter than —2. This limit is purely arbitrary, but it rules out most of the normal giant stars. The supergiant stars, as thus defined, occur with about the same absolute brightness and about in the same proportions in all spectral classes. They are characterised by large mass, very low density, extremely high energy output per unit of mass and they are commonly variable in brightness. They include most, if not all, of the long-period variables, the cepheids of periods longer than 10 days, the RV Tauri stars and most other classes of variables. Variable radial velocity is also common in this class of stars. It would thus appear that their surface conditions are unstable. The supergiant stars are relatively very few in number, which may be an indication of a tendency to instability, probably coupled with shortness of duration of the supergiant stage. The high energy output may well result in the supergiant star passing rapidly through the supergiant stage.

The importance of the high luminosity stars lies in the fact that they provide the chief medium of determining very great

stellar distances. Beyond distances of the order of 10,000 parsecs we must rely almost entirely on the absolute magnitudes of the supergiant stars for estimating distances of celestial objects. This makes their detailed study a matter of prime importance.

The first section of the monograph is concerned with a brief account of the methods and technique of stellar spectrophotometry and of observation of the contours of spectral lines and their interpretation. This is followed by a brief general survey of the material from which it appears that there are about 20,000 known high luminosity stars. In succeeding chapters the observational material is discussed for each spectral class individually, from the aspects of distribution, luminosity and the physical interpretation of the observed spectrum. In completion of this section devoted to the presentation of the observational data is a chapter on the variable star, considered in relation to high luminosity.

In the final two chapters the observational data are summarised for the normal star and the supergiant star respectively. The strengths of the stellar absorption lines are expressed in terms of the numbers of effective atoms over unit area of the star's surface, thus providing a quantitative analysis of the stellar atmospheres along the spectral sequence. For the normal star the results are in generally good agreement with Milne's generalisation of the Saha theory. As might be expected in the present state of the subject, there are a number of minor disagreements which await more detailed investigation. For the supergiant star, the pressure in the atmosphere is very low and there is apparently an enormous hydrogen content as compared with the normal star.

In two appendices are given a catalogue of stars whose spectra show the c-characteristics and a catalogne of Cepheid variables.

The compilation of this monograph has involved an immense amount of research. As a reference volume on observational details it is invaluable; on the theoretical side it has carried the discussion as far as it is profitable at present and by indicating where theory and observation are not in agreement it has indicated directions in which further investigation is most desirable.

NOTES.

High-flying Egrets at Night.

Astronomical and ornithological readers may be interested to hear of a somewhat extraordinary experience I had rather early in the morning of 16th February while sweeping for comets. About 12.30 a.m. I was suddenly startled to see in the field of view of my $7\frac{3}{4}$-inch reflector, using an eye-piece giving about 35 power, about twelve to fifteen large golden-coloured objects, like third magnitude stars much out of focus, and thus enlarged, crossing the field at a fair pace. At first I wondered what it could be. It was as if a star cluster like the Pleiades had suddenly taken to flight. I soon recognised as I followed the objects in the telescope that they were a flight of the little white egrets, passing a little more than a mile away, and so high up that the electric lights of the city lit up the under side of their wings, giving them a golden colour like stars. I followed them for about two minutes, first in the reflector and then in the finder, until they got out of my reach towards the west. When first I saw them they were perhaps a little to the east of the Southern Cross, and about the same altitude, say 45°-50°. They travelled west and passed 4° or 5° below Canopus, and then I lost them, as they got too far west for my balcony.

These egrets are often seen in these parts following cattle and eating the flies in their track or on their bodies. It would be interesting to know if anyone has seen such a thing at night before. They were flying in a wedge shape, and I could see the motion of their wings, probably about one mile high and one mile away. Of course, in the daytime birds have been seen crossing the Sun's disc, but this was midnight.

THEODORE B. BLATHWAYT.

—o—

ASTRONOMICAL SOCIETY OF SOUTH AFRICA.

Session 1930-1931.

Annual Report of the Council.

In presenting its Annual Report the Council is able to record that the Session 1930-1931 has been one of steady progress. The membership at present is made up as follows:—Cape Centre: Members, 97; Associates, 7. Johannesburg Centre: Members, 18; Associates, 2. The retiring President, Captain D. Cameron-Swan, has chosen as the subject of his Presidential Address, to be delivered at the Annual General Meeting on Wednesday, 22nd July, 1931, "The Rev. Fearon Fallows, First H.M. Astronomer at the Cape."

During the year the Council met five times, those members residing away from Cape Town being represented by their alternates. Alterations in the Council during the year were: (a) Mr. Jearey replaced Mr. Forbes as alternate for Mr. Jackson; (b) Mr. Long acted as Treasurer during Mr. Smith's absence from 1st June onwards.

The financial statement at the end of the Session shows a balance of £22 18s. 10d., which, taking outstanding accounts into consideration, compares very closely with the balance at the end of last year. The thanks of the Council are due to Messrs. B. F. Jearey and Houghton and Captain Cameron-Swan for donations to the Society's funds.

During the year No. 5 of Vol. II. of the Journal of the Society was published. This number completed Vol. II. The standard set by previous numbers was fully maintained.

Of the observing sections, perhaps Mr. Ensor is most to be congratulated on his Variable Star Section—with more than 3,600 observations of 121 variable stars, the section has this year eclipsed last year's remarkable figures. Attention may be drawn to Mr. Ensor's appeal for more workers in this section, especially in view of the temporary absences of some of his present helpers. Despite regular searching, no comet was discovered during the year by members of the Comet Section. Mr. Forbes points out that this is the first year since 1916 during which no comet was discovered in South Africa—a record of which the Society may well be proud.

Considerable use continues to be made of the Library, principally by town members. The Council desires to draw attention of country members to the fact that they are entitled to borrow books from the Library, subject to payment of postage. The Librarian reports that one volume (Astronomy, Vol. I., by Russell, Dugan and Stewart) is missing and cannot be traced.

Much good work has been done by Mr. Horrocks, on the one hand, and Messrs. D. L. Forbes and C. F. Wickes, on the other, towards bringing about the amalgamation of the Natal Astronomical Association with the Society. It was hoped that a definite proposal to this effect might have been submitted at the General Meeting, but unfortunately the matter has not yet reached a sufficiently advanced stage for this to be possible. However, the set-back appears to be merely of a temporary nature, and the Council hopes that the coming year will see effect given to this scheme.

As an amendment to the constitution, the Council hopes to create a new class of members suitably to reward those members who have given long and meritorious service to the Society, and who by reason of their S.A. domicile are not eligible for Honorary Membership.

Among miscellaneous matters the Council has taken into consideration the question of the renovation and care of the Herschel Memorial at Claremont. The Council has taken steps to interest the South African National Society (for the preservation of objects of historic interest and natural beauty in South Africa) in the matter. A sub-committee, appointed by the National Society, has examined the Memorial and framed certain recommendations bearing on its preservation and accessability.

———o———

REPORTS OF SECTIONS.

For the Year ended 30th June, 1931.

COMET SECTION.

Members of the section have been active during the past year and much work in searching for new comets has been done, but, despite these efforts, this is our first report since 1916 that contains no record of any new comet discovered in South Africa.

In looking back over the last twelve reports of the Comet Section we find that during that period—counting new comet discoveries only and not including periodicals or photographic discoveries—19 comets have been discovered in the northern hemisphere and 18 in the southern (17 by members of our Society), so that we can take courage and can renew our efforts with the confidence that though our workers are few we will be able to keep up our end. We would be glad if more of our members would take an interest in comet searching and undertake to search part of the sky monthly.

Mr. Blathwayt records spending about 130 hours in search during the year. The writer, with the exception of the last two months, has carefully gone over the southern skies every month.

We have to thank the Director and Staff of the Royal Observatory for much help and encouragement, and the Director and Staff of the Union Observatory for assistance and for maps of the southern skies.

The following notes of interest and particulars regarding new comets discovered during the year are given:—

Comet 1930*d*, noticed in our last report, came within five million miles of the Earth, and was an interesting object to observers. Many noticed its resemblance to a spiral nebula. M. F. Baldet observed it at Meudon with the great Meudon reflector and found it had a very small nucleus and that the cometary envelope appeared as an elongated nebulosity 5′ long and 1′ wide, the latter corresponding to about 1,500 miles.

Comet 1930*f* (Temple II., periodical). Mr. H. E. Wood, of the Union Observatory, Johannesburg, photographed on 26th August, 1930, a faint cometary object which was identified as this periodical. Its position was found to be very near the position given in the published ephemeris. It was still under observation at some observatories as late as February, 1931, but it never became a very bright object.

Comet 1930*g* (Nakamura), magnitude 13.5, was discovered by Prof. Nakamura at Kyoto, Japan, on 13th November. Its position being R.A. $3^h\ 40^m$, N. Dec., $18°\ 53'$. Its inclination was $8°\ 7'$. It seems to have faded very rapidly. *Kwasan Observatory Circular* gives photographic positions. It is thought, however, that it may be a minor planet, though it sometimes looked nebulous.

Comet 1931*a* (Encke's periodical). Though it was known it would not be far from its predicted place, observers in the northern hemisphere with their big instruments tried in vain to locate it before perihelion, but after perihelion it was photographed at the Union Observatory on June 14 and 16. Its position, June $21^d\ 22^h\ 23^m.2$, was R.A. $113°\ 51'$ N.P.D. $81°\ 38'$. Mr. R. Watson, who observed it on the 4th, 5th, 6th and 7th July, reports it as being magnitude 9 on the 4th, declining to magnitude 10.5 on the 7th. It was circular and about 10 minutes of arc in diameter, cloudy, bright in centre, but having no nucleus. He also found it to be very near its predicted position in right ascension, but $1°.6$ south of its predicted position in declination.

Professor van Biesbroeck, at the Yerkes Observatory, is still observing Comet 1925*II* (Schwassmann-Wachmann *I*) which passed perihelion $5\frac{1}{2}$ years ago. He thinks it will be observed round the whole orbit. If so, it would establish a new record for comets. He has observed a remarkable increase in the light of this comet. At the beginning of 1931 it had sunk to magnitude $17\frac{1}{2}$, but on 10th February it rose to magnitude 13 and on 11th February to $12\frac{1}{2}$. By 10th March it had sunk to magnitude 16. He says of the appearance on 10th February:—

"Instead of a little nucleus surrounded by a very faint coma, as it usually appeared, it showed a large disc, as if the nucleus had expanded without any increase in the size of the coma, which was hardly visible."

Professor van Biesbroeck is also observing Comet 1927*IV* (Stearns) which passed perihelion $3\frac{3}{4}$ years ago. These two comets are also being observed at the Bergedorf Observatory.

A. F. I. Forbes, *Director.*

VARIABLE STAR SECTION.

In presenting the report for the 1930-31 Session your Director is pleased to be able to record a successful year; 3,642 observations were recorded, of 121 variables, an average of 30 observations per variable. Last year's total was 3,270 observations of 115 variables.

The observations are divided among the members of the section as follows:—

H. E. Houghton ..	1,617	observations of	83 variables.
G. E. Ensor	1,538	„	„ 117 „
Miss Colleen Orpen	392	„	„ 36 „
W. H. Smith	95	„	„ 42 „

Mr. Houghton's instrument is a 3½-inch refractor, Mr. Ensor's a 6½-inch reflector, Miss Orpen's a 6-inch refractor, and Mr. Smith's a 4-inch refractor.

The section is in urgent need of new members, particularly in view of the fact that Messrs. Houghton and Smith are both away from South Africa, and not due to return until the end of the year. Miss Orpen also will be unable to undertake further variable star work for some considerable time. This leaves your Director as the only member in a position to carry on the work of the section.

Your Director's thanks are tendered to H.M. Astronomer, the Union Astronomer, and Dr. van den Bos, for the latest information in connection with Nova Pictoris and its companions. Also to the Union Observatory and Harvard College Observatory for circulars and current literature; and to J. Hallifax, Esq., Pretoria, for the continued loan of his 4½-inch refractor.

NOTES.

Nova Pictoris.—The decrease in the brightness of this nova has been very slow during the past two years; magnitude 7.7 was recorded on 1st July, 1929, and the present magnitude is 8.4. Dr. van den Bos, as quoted in the note in last year's Report, is of the opinion that the fading of the companions B and C would account for most if not all of the decrease in the combined brightness, as observed by the variable star observers; so that the central star seems to have remained nearly constant for the past three years.

Dr. Spencer Jones has very kindly supplied your Director with the following data in connection with the spectroscopic changes in the nova:—

"In response to a request made to the Union Astronomer, an objective prism spectrogram of Nova Pictoris, with an exposure of 6½ hours, was obtained for me by Mr. Worssell at the Union Observatory in February last. This spectrogram possesses several features of particular interest. The two strongest emissions are one at 6087A, of unknown origin, and not previously observed in any nova, nebula, or star; and the Hα line of Hydrogen. The decrement of the Balmer Series is much greater than in 1928.

"No trace is apparent of the typical N_1, N_2, nebular lines. These lines were never a prominent feature of the spectrum of Nova Pictoris. With the disappearance of these lines some years after the outbreak, Nova Pictoris has behaved similarly to Nova Aurigae, 1891, and Nova Persei, 1901, the spectrum becoming essentially of the Wolf-Rayet type.

"An investigation of the spectrographic evidence, considered in conjunction with the magnitude changes, leads to the conclusion that there was a general expansion of the star up to the time of the first observed maximum. Between discovery and maximum, the radius of the nova increased daily by an amount equal to about 14 times the radius of the Sun. Prior to the outburst, the radius was rather less than twice that of the Sun; at maximum it was 384 times the Sun's radius. The Parallax is 0".0015, corresponding to an absolute magnitude at maximum of —7.9.

"At maximum brightness, shells of gaseous matter began to be thrown off from the nova, whose radius then started to decrease. The observations at Johannesburg of a growing nebulosity around the nova can be interpreted as these shells of gas moving outwards. The parallax and the observed rate of motion given by the spectroscopic data accord well with the Johannesburg observations.

"The further interpretation of the observations is complicated by the fact that with the appearance of the bright band spectrum, the radiation from the nova departs more and more widely from that of a black body. The general sequence of the spectral changes points to an increasing degree of ionisation which can only be interpreted as due to an increase in the effective temperature of the nova. At present this seems to be about 50,000°. The present radius of the nova is less than the radius before the outbreak and is decreasing, but in the absence of any means of determining the correction to bolometric magnitude, the precise value cannot be determined. It is probable that there will be a

further decrease of several magnitudes in visual brightness, so that the final state of the nova is likely to be one of great density. It is of interest to note that Wolf-Rayet stars are of high density. Some support is thus afforded to Prof. Milne's view that a nova outbreak is due to instability resulting when a certain luminosity is attained.

"A collapse of the material of the star ensues, with the rapid release of a large amount of potential energy. The increased radiation pressure appears at first to blow out the outer layers of the star and finally to cause shells of gas to be ejected. The final state of the nova is a dense star, akin to a white dwarf."

With respect to the micrometric measures of the nova and its companions, the following data have been supplied by Dr. van den Bos, by kind permission of the Union Astronomer:—

"The changes already noted in earlier oppositions have become still more pronounced. The companions B and C are now very faint, and difficult to measure, as they hardly stand out any more from the general nebulosity around the central star."

The magnitudes were estimated to be (for epoch 1931.10):
A, $9^m.0$; B, $11^m.8$; C, $12^m.7$ van den Bos (A, B, C, 3 nights)
$8^m.8$; $11^m.3$; $12^m.3$ Finsen (A, 2 nights; B, C, 5 nights)

The measures by Dr. van den Bos give:—

AB	1931.10	75°.0	1″.12	3 nights
AC	1931.10	234°.6	1″.02	3 „

The measures by Mr. Finsen gave:—

AB	1931.05	69°.8	0″.85	5 nights
AC	1931.05	224°.8	0″.96	5 „

The two sets are in sufficient agreement, allowing for the difficulty of the object.

No change in angle is shown, but the distances are still increasing. It is to be hoped, but by no means certain, that measures will be obtainable in the next opposition.

RY Sagittarii.

This interesting irregular variable, a southern replica of R Coronae Borealis, is normally of magnitude 6.5.

There was a very faint minimum, lasting from March, 1930, till February, 1931, during which the variable remained at less than magnitude 13.0. RY Sagittarii is now increasing in brightness again; it was magnitude 10.7 on July 1st.

Eros.

Observations of the brightness of this minor planet during its last opposition were made by Miss Orpen, Messrs.

H. E. Houghton, R. Watson, and G. E. Ensor. Unfortunately very few were made during the months when the amplitude of variation was at its greatest.

Mr. R. Watson sent in a useful series of observations made during February, 1931. Your Director's observations were made during March, 1931; the Union Observatory chart of the area was used during these observations to plot the path of the planet. This chart was of the greatest assistance during the observations of Eros, since it showed the faintest stars visible in the telescope, and rendered the following of the planet an easy matter, even when fainter than magnitude 10.0.

A photographic copy of the chart was made and enlarged to about three times the original size; the enlarged copy was very convenient, and easy to read by the faint light of the observing lamp.

The amplitude of variation in February and March was very small and difficult to follow.

G. E. Ensor, *Director.*

Maxima and Minima, 1930-31.

Desig.	*Variable*	*Phase*	*Civil Date*	*Julian Date* 2,426,000+	*Magn.*
001032	S Scl	Max	1930, Oct. 30	280	6.6
001862	S Tuc	Max	1930, Oct. 23	273	10.1
005475	U Tuc	Max	1931, Mar. 15	416	8.4
025050	R Hor	Min	1930, Nov. 27	308	12.8
025751	T Hor	Max	1930, Dec. 19	330	8.1
043263	R Ret	Max	1931, Feb. 12	385	7.5
050022	T Lep	Max	1931, Feb. 9	382	8.0
050848	S Pic	Max	1930, Dec. 30	341	6.7
051247	T Pic	Max	1931, Apr. 10	442	9.3
051533	T Col	Max	1931, Jan. 18	360	7.5
054629	R Col	Max	1930, Oct. 24	274	8.2
055686	R Oct	Max	1930, July 24	182	8.1
070772	R Vol	Max	1931, Feb. 16	389	10.0
074241	W Pup	Max	1930, Nov. 12	293	8.3
do.	do.	Min	1931, Jan. 8	350	12.6
do.	do.	Max	1931, Mar. 9	410	8.1
do.	do.	Min	1931, May 10	472	12.0
082476	R Cha	Max	1930, Nov. 21	302	8.6
091868	RW Car	Max	1930, July 3	161	9.4
092962	R Car	Max	1930, Oct. 13	263	4.2
do.	do.	Min	1931, Mar. 27	428	10.0

Desig.	*Variable*	*Phase*	*Civil Date*	*Julian Date* 2,426,000+	*Magn.*
094023	RR Hya	Max	1931, May 20	482	8.9
094953	Z Vel	Max	1930, Nov. 24	305	8.6
095563	RV Car	Max	1931, Apr. 28	460	11.3
100661	S Car	Min	1930, July 29	187	9.0
do.	do.	Max	1930, Oct. 10	260	5.5
do.	do.	Min	1930, Dec. 24	335	8.6
do.	do.	Max	1931, Mar. 9	410	5.5
do.	do.	Min	1931, May 25	487	9.6
101058a	Z Car	Max	1931, Jan. 10	352	11.4
101153	W Vel	Max	1931, May 5	467	8.3
103270	RZ Car	Max	1931, May 28	490	10.3
111561	RY Car	Max	1930, June 17	145	10.6
111661	RS Cen.	Max	1930, Aug. 6	195	8.6
115058	W Cen	Max	1930, Oct. 2	252	8.4
do.	do.	Max	1931, Apr. 23	455	8.3
131283	U Oct	Max	1931, Mar. 15	416	8.0
122854	U Cen	Max	1931, June 24	517	7.9
122422	R Hya	Max	1931, Jan. 21	363	4.2
133155	RV Cen	Max	1930, Dec. 19	330	7.7
133633	T Cen	Min	1930, July 30	188	7.8
do.	do.	Max	1930, Aug. 31	220	5.9
do.	do.	Min	1931, Jan. 18	360	7.9
do.	do.	Max	1931, Mar. 3	404	6.1
do.	do.	Min	1931, May 2	464	8.0
134236	RT Cen	Max	1930, Sep. 16	236	9.7
134677	T Aps	Max	1930, Aug. 8	197	9.0
do.	do.	Max	1931, May 12	474	9.0
140528	RU Hya	Max	1930, Sep. 15	235	7.8
140959	R Cen	Max	1930, Aug. 21	210	5.8
do.	do.	Min	1931, Jan. 15	357	8.1
do.	do.	Max	1931, Mar. 11	412	5.8
151822	RS Lib	Max	1931, May 15	477	7.8
152849	R Nor	Max	1930, Aug. 23	212	8.0
153654	T Nor	Max	1931, Feb. 25	398	7.3
154736	R Lup	Max	1930, Aug. 26	215	9.7
155823	RZ Sco	Max	1931, Apr. 10	442	9.0
160021	Z Sco	Max	1930, Sep. 20	240	9.4
164319	RR Oph	Max	1930, Aug. 26	215	8.2
164844	RS Sco	Max	1930, June 24	152	6.0
do.	do.	Max	1931, May 16	478	6.5
165030a	RR Sco	Max	1931, Apr. 5	437	5.6
172486	S Oct	Max	1930, Sep. 21	241	8.5
do.	do.	Max	1931, May 28	490	7.8
173543	RU Sco	Max	1930, Oct. 17	267	9.1
174135	SV Sco	Max	1930, Oct. 15	265	10.0

Desig.	*Variable*	*Phase*	*Civil Date*	*Julian Date* 2,426,000+	*Magn.*
do.	do.	Max	1931, June 24	517	10.0
174162	W Pav	Max	1930, Sep. 25	245	9.1
do.	do.	Max	1931, July 13	536	9.9
190818	RX Sgr	Max	1931, Apr. 21	453	9.9
190819a	RW Sgr	Min	1930, July 8	166	10.4
do.	do.	Max	1931, Apr. 26	458	9.6
191019	R Sgr	Max	1930, July 14	172	6.6
193972	T Pav	Max	1930, Sep. 24	244	8.3
do.	do.	Max	1931, May 23	485	7.3
195142	RR Tel	Max	1930, Sep. 20	240	12.0
212030	S Mic	Max	1930, Nov. 2	283	9.8
221938	T Gru	Max	1930, Sep. 18	238	8.9
do.	do.	Min	1930, Nov. 14	295	11.1
232746	V Phe	Max	1930, July 26	184	9.6
235265	R Tuc	Max	1930, Oct. 30	280	8.8

In the majority of instances the observed dates are in fairly close agreement with the Harvard predictions. Many maxima and minima have been missed owing to proximity of the variable to the Sun. As a rule the minima are too faint for observation through small telescopes.

COMPUTING SECTION.

Mr. Theodore Mackenzie has computed a table giving E the excentric anomaly for each tenth of a degree of M to $M = 3^\circ$, e going from 0.80 by hundredths to $e = 1.00$.

When requested, individual members have continued to provide predictions of occultations of stars by the Moon.

R. T. A. INNES, *Director.*

CAPE CENTRE ANNUAL REPORT, 1930-1931.

Your Committee, in presenting this, the Seventeenth Annual Report, has to record the continued progress and activity of the Centre during the period under review.

The total membership is now one hundred and four (97 Members and 7 Associates). This is an increase of seven, there having been nine elections, one death and one resignation.

The meetings continue to be held at Benson House, Long Street, in the rooms of the Mountain Club of South Africa. During the period under review there have been eight ordinary meetings, which have been well attended. The following is a list of addresses and papers presented at the meetings:—

"Observing conditions at Pretoria and tour of observatories in U.S.A.": Dr. W. H. Steavenson, F.R.A.S.

"The origin of comets and meteors": Mr. H. C. Mason.

"Double stars": Mr. D. C. Burrell.

"Visualising the orbit of a comet": Mr. H. E. Wood, M.Sc., F.R.A.S.

"Terrestrial magnetism": Mr. E. N. Grindley, M.Sc.

"Determining the temperature, density and pressure of stars": Dr. J. K. E. Halm, Ph.D.

"How we got our calendar": Mr. T. MacKenzie, F.R.A.S.

"Method of finding the right ascension and declination of a comet": Mr. A. F. I. Forbes, M.I.A.

"The boundaries of the constellations": Mr. H. E. Houghton, F.R.A.S.

"When is an inch not an inch?": Mr. D. G. McIntyre, F.R.A.S.

"Eclipse of the Moon of 2nd April, 1931": Capt. D. Cameron-Swan, F.R.A.S., F.R.P.S.

"Observations of minor planet Eros": Mr. C. L. O'B. Dutton.

"The circulation of the atmosphere and how it is kept up": Prof. J. T. Morrison.

"Nova Pictoris": Dr. H. Spencer-Jones, Sc.D., F.R.S.

The Annual Observational Meeting was held on February 18, 1931, at the Observatory of Mr. Bertram F. Jearey, F.R.A.S., at Muizenberg, and was greatly appreciated by the large number of members and friends who attended.

Thanks are due to His Majesty's Astronomer for an invitation to hold an Observational Meeting at the Royal Observatory on the evening of October 12, 1930. Owing to inclement weather this had to be abandoned. Your Committee has met seven times.

The finances of the Centre continue to be satisfactory.

Your Committee regrets to report the resignation (on account of leaving Cape Town) of Mr. A. F. I. Forbes as Treasurer to the Centre and desires to place on record its appreciation of his services to the centre in that capacity since his appointment in 1923.

Articles contributed by Mr. A. W. Long, F.R.A.S., detailing predicted astronomical phenomena continue to be published monthly in the "Cape Times." The articles are accompanied by charts of the sky and diagrams of the position of the planets in their orbits throughout the month. Articles in Afrikaans are contributed to "Die Burger" by Mr. T. Mackenzie, F.R.A.S. Both series of articles are greatly appreciated by members and the public generally.

Financial Statement for the Year ended 30th June, 1931.

INCOME.	£	s.	d.	EXPENDITURE.	£	s.	d.
To Balance in hand at 30th June, 1930 .	12	1	7	By Contributions to Headquarters ..	31	1	8
„ Subscriptions:				„ Rent of Meeting Room	10	0	0
Arrears .. 2 17 9				„ Rent of P.O. Box .	1	5	0
Current Year 57 4 1				„ Typewriting & Stationery	4	19	9
In Advance 2 2 0				„ "Cape Times" and Postage to Country Members ...	5	18	3
	62	3	10	„ Engraving on Pointer—late A. Bull	0	5	0
„ Subscriptions to "Cape Times" .	0	6	0	„ Lamp for Lantern	1	7	6
„ Commission on Cheques	0	6	3	„ Subscription to Astrom. Society of Pacific	1	1	0
				„ Secretary's Expenses	2	19	9
				„ Treasurer's Expenses	0	12	0
				„ Bank Charges ...	1	1	3
				„ Balance	14	6	6
	£74	17	8		£74	17	8

JOHANNESBURG CENTRE ANNUAL REPORT, 1930-1931.

The past year of the Johannesburg Centre's history has not been marked by any startling incident—it has been, perhaps, too uneventful.

One new member was enrolled during the period, and three members resigned, the membership now being 20.

The Centre held eight meetings during the year, those in October and June being at the Union Observatory, by courtesy of the Union Astronomer. In July (1930) a question night evoked interesting discussions and diversity of views on the questions raised, and in August Mr. Stevens gave an address on "Double Stars," indicating that this branch of astronomy utilised all descriptions of equipment—telescopic, spectroscopic and mathematical—each having its place in elucidating the problems presented. September was marked by an address by Mr Worssell on "Meteors," in which were outlined the plotting of paths, determination of radiants and the physical and chemical constitution of these visitors from space. He concluded with an indication that this was a matter in which the amateur with no equipment could do much really useful work; this appeal was supported by Dr. Innes. At the November meeting (deferred to the beginning of December) Mr. Beamish spoke on "Daylight Saving," and after surveying the various aspects of the matter pointed out that the difference of conditions in South Africa, as compared with England, militated against any advantage being attained by clock-shifting in the Union.

The January (1931) meeting was held at the house of Mr. Holmes on the 28th to observe the occultation of the Pleiades; clouds unfortunately made observations impracticable. In March Dr. Innes addressed the members on "The Nautical Almanac" and stated that this publication has become primarily an astronomer's year-book—an abridged edition being issued for mariner's use—and was indispensable to every astronomical observer, whether amateur or professional.

At all meetings the ensuing discussions shewed the keen interest and appreciation of the members present; and the comments of the Union Astronomer, members of his staff, and Dr. Alden were most helpful to a better understanding of the questions raised by the generality of the members.

The cordial thanks of the Centre are due to the Union Astronomer and his staff for the courtesy and hospitality extended to the members on their visits to the Union Observatory, also to Mr. Geddes for his efficiency as Treasurer and for the continued use of his post-box; and finally, to those who have

furthered the success of the year now reviewed by the contribution of papers or initiating discussions.

FINANCIAL STATEMENT FOR THE YEAR ENDED 30TH JUNE, 1931.

INCOME.	£	s.	d.	EXPENDITURE.	£	s.	d.
To Balance on hand at 30th June, 1930 .	33	11	6	By Rent Salstaff Socy. June 1928 to June 1931	3	17	6
„ Subscriptions	17	7	0	„ Secretary's Membership to British Astrom. Assoc. .	1	1	0
				„ Periodicals	2	0	0
				„ Photographs	3	9	6
				„ Advertising	4	17	6
				„ Postages	0	6	6
				„ Bank Charges	0	16	5
				„ Transfer to headquarters	8	13	3
				„ Balance brought forward	25	16	10
	£50	18	6		£50	18	6

ASTRONOMICAL SOCIETY OF SOUTH AFRICA.

FINANCIAL STATEMENT FOR THE YEAR ENDED 30TH JUNE, 1931.

INCOME.	£	s.	d.	EXPENDITURE.	£	s.	d.
To Balance June 30th, 1930	22	2	10	By Printing Journal (Vol. II., No. 5)	42	3	7
„ Subscriptions:				„ Printing and Stationery	2	5	0
Cape Centre ...	31	1	8	„ Postages	2	2	9
Johannesburg Centre	8	13	3	„ Sundries	0	16	8
„ Sale of Journals ..	1	9	3	„ Bank Charges and Cheque Book ..	0	4	0
„ Sale of Sundial Charts	0	17	10				
„ Donations:							
Capt. Cameron-Swan .. 2 2 0							
B. F. Jearey 3 3 0							
H. E. Houghton 1 1 0							
	6	6	0				
				„ Balance carried forward	22	18	10
	£70	10	10		£70	10	10

Audited and found correct:
E. J. STEER.
21st July, 1931.

W. H. SMITH,
Hon. Treasurer.

NATAL ASTRONOMICAL ASSOCIATION.

Annual Report, 1930-1931 (Ninth Session).

The Association has maintained its activity and seven monthly meetings were held. Three Committee Meetings were held to conduct the Association's business.

The following lectures and papers were delivered during the year:—

August.—"Island Universes": Mr. C. F. Wickes.

September.—"Planetary Discoveries": Mr. H. Horrocks, M.A. F.R.A.S.

October.—"The Infinitely Large and Infinitely Small": Mr. J. Willis.

November.—"The Astronomy of Shakespeare": Mr. J. Bennett Mumford.

March.—"Astronomy in Surveying": Mr. A. L. Forbes.

April.—"The Spectroscope in Astronomy": Mr. H. Roadknight.

May.—"Ancient and Modern Ideas of the Universe": Mrs. M. A. Lautre.

Thanks are due to the lecturers for the illuminating addresses they gave and to the Natal Technical College for accommodating the Society at its meetings. The average attendance at these meetings was 22, or 65 per cent. of the membership; this is a slight increase on the average attendance of last year, and it is hoped that this improvement will continue. The membership has decreased by 4 and now stands at 33, of whom 30 are Town Members and 3 Country Members. During the year numerous visitors came to the Observatory, and were shown some of the wonders of the universe with the aid of the equatorial telescope, under the able demonstration of Messrs. Forbes, Roadknight and Bell.

In the past it has been customary to report that our cordial relations have been maintained with the Astronomical Society of South Africa; these relations have made appreciable developments of late.

It will be remembered that in the early days of the Association (May 1922) the Astronomical Society of South Africa, with headquarters in Cape Town, approached this Society with the view to an amalgamation. The time was not then considered opportune for the change to come about.

These representations have been intermittently continued and, with the purpose of furthering this object, Mr. H. Horrocks, Chairman of the Cape Centre, whilst visiting Durban last September, addressed the Association upon this matter, when many of the obstacles and obscure points which confronted this question were elucidated. Your Committee has discussed this question of amalgamation and recommends that this be proceeded with.

A sub-committee was appointed to deal further with the matter, and in doing so it drew up a provisional set of rules and bye-laws for the proposed Natal Centre in the event of the amalgamation taking place.

———o———

ASTRONOMICAL SOCIETY OF SOUTH AFRICA.

Officers and Council, 1931-32.

President: H. L. Alden, A.B., Ph.D., Yale University Station, University of the Witwatersrand, Milner Park, Johannesburg.
Vice-Presidents: W. H. Cox, D. L. Forbes, F.R.A.S., H. W. Schonegevel.
Hon. Secretary: H. Horrocks, M.A., F.R.A.S., Royal Observatory, Cape of Good Hope.
Hon. Treasurer: W. H. Smith, "Arum Villa," Plumstead, C.P.
Members of Council: Capt. D. Cameron-Swan, F.R.A.S., F.R.P.S., F.S.A. (Scot.); Bertram F. Jearey, F.R.A.S., F.R.M.S.; H. Spencer Jones, M.A., Sc.D., F.R.S., F.R.A.S.; A. W. Long, F.R.A.S.; D. G. McIntyre, F.R.A.S.; H. E. Wood, M.Sc., F.R.A.S.
Alternate Members of Council: Rev. Andrew Graham, W. Andrews, D. C. Burrell, H. C. Mason, R. R. Pratt.
Hon. Auditor: E. J. Steer.

Directors of Observing Sections.

Comet: A. F. I. Forbes, M.I.A., "Blairythan," Main Road, Hermanus.
Mars: B. F. Jearey, Villa Carina, Alexander Road, Muizenberg.
Variable Stars: G. E. Ensor, Pretoria Hospital, P.O. Box 201, Pretoria.
Hon. Editor: H. Spencer Jones, Sc.D., F.R.S., Royal Observatory, Cape of Good Hope.
Hon. Librarian: D. C. Burrell, Pinelands, Cape Town.

COMMITTEE OF CAPE CENTRE.

Chairman: H. Horrocks, M.A., F.R.A.S., Royal Observatory, Cape of Good Hope.
Vice-Chairman: H. C. Mason.
Hon. Secretary: H. W. Schonegevel, P.O. Box 2061, Cape Town.
Hon. Treasurer: R. R. Pratt, B.Sc., A.M.I.C.I., "Rochester," Boundary Road, Rondebosch, C.P.
Committee: Capt. D. Cameron-Swan, F.R.A.S., F.R.P.S., F.S.A. (Scot.); B. F. Jearey, F.R.A.S.; A. W. Long, F.R.A.S.; D. G. McIntyre, F.R.A.S.; R. Watson.
Hon. Librarian: D. C. Burrell.
Hon. Auditor: E. J. Steer.

o

COMMITTEE OF JOHANNESBURG CENTRE.

Chairman: J. D. Stevens, P.O. Box 1782, Johannesburg.
Hon. Secretary: A. Forrest, P.O. Box 2402, Johannesburg.
Hon. Treasurer: T. Beamish, P.O. Box 2402, Johannesburg.
Committee: Miss H. L. Troughton, W. B. Jackson, M.Sc., H. E. Wood, M.Sc., F.R.A.S., W. Geddes, W. M. Worssell, F.R.A.S. (of Johannesburg) and G. E. Ensor and S. C. Venter (of Pretoria).

o

AMENDMENT OF CONSTITUTION.

The following amendment of the Constitution was submitted at the Annual General Meeting and adopted:—

Article XIX. of the Constitution be amended by altering the title to "Honorary members and members *emeriti*" and by addition of the words "Upon the recommendation of the Council, a General Meeting may elect as a member *emeritus* any member who has rendered distinguished and outstanding services to the Society. Such member *emeritus* shall be exempt from the payment of any subscription, but shall have all the rights and privileges of a member, notwithstanding anything to the contrary in the Constitution of the Society."

On the proposal of the Council of the Society the names of Dr. J. K. E. Halm and Mr. E. J. Steer were submitted to the General Meeting for election as members *emeriti*. These two members were elected.

NEW MEMBERS.

Berrange, R. F., M.C., Civil Service Club, Cape Town.
Collings, C., 79, Fletcher's Chambers, Cape Town.
Cousins, A. W. J., Power Station, Congella, Durban.
Forbes, Mrs. L. E., "Blairythan," Main Road, Hermanus.
Frith, Rev. E., F.R.Met.S., Wesley Manse, Fort Beaufort.
Greenwood, H. K., c.o. Walker and Hall, Yorkshire Buildings, 38, Strand Street, Cape Town.
Inglis, W. W., P.O. Box 685, Cape Town.
Karno, J., 53, Von Brandis Street, Johannesburg.
Linton, J., 1, Deva Terrace, Rouwkoop Avenue, Rondebosch.
Murray, T. A., B.Sc., F.F.A., c.o. South African Mutual, Darling Street, Cape Town.
Peers, C. E., "Cheshunt," Annerley Road, Rosebank.
Potgieter, Dr. C., M.P., LL.D., Parliament House, Cape Town.
Raleigh, Lt.-Comdr., V.A.
Rose, Colonel J. G., D.S.O., V.D., Beau Soleil, Wynberg.
Shipman, R. C., Alliance Assurance Co., Strand Street, Cape Town.
Webster, Miss A. W., c.o. Mrs. J. D. Thomson, St. Lawrence, Fish Hoek.
Walgate, C. P., A.R.C.A., A.R.I.B.A., M.I.A., Hilliard's Chambers, Church Square, Cape Town.

The addresses of the following persons are now as stated below:—

Bentley, W. W., Campsie Glen, Umhlali, Natal.
Beusch, A., P.O. Box 5, Swakopmund, S.W.A.
Bleksley, A. E., M.Sc., F.R.A.S., Smithsonian Solar Radiation Station, Mount Brukkaros, S.W.A.
Butler, J., Galatea, Blaauwberg Strand,
Cowen, G., c.o. Alperstein Bros., Middeldrift, C.P.
Crowther, H. N., 95, Rissik Street, Sunnyside, Pretoria.
Ensor, G. E., P.O. Box 201, Pretoria.
Forbes, A. F. I., "Blairythan," Main Road, Hermanus.
Forbes, D. L., F.R.A.S., P.O. Box 2226, Durban.
Graham, Rev. A., "Vrede," Pinelands.
Greenway, C. T., Louis Trichardt, Transvaal.
Heyes, E., Springbok, Namaqualand.
Holmes, A., 17, Jessie Avenue, Norwood, Johannesburg.
Hudson, J., Balbirnie, Worcester Road, Sea Point.
Innes, Dr. R. T. A., 3, Clairwood Mansions, Webb Street, Yeoville, Johannesburg.
Mitcheson, Mrs. H. K., Ocean View Hotel, Durban.
Orpen, Miss C., P.O. Afrika's Kop, O.F.S.

Pratt, R. R., B.Sc., A.M.I.C.E., "Rochester," Boundary Road, Newlands.
Rossiter, Prof. R. A., 13, Innes Avenue, Bloemfontein.
Shepherd, Mrs. C. E., 29, Balfour Street, Woodstock.

———o———

The Society acknowledges the receipt of publications, etc., from the following:—*New South Wales Branch of the British Astronomical Association; Vereinigung von Freunden der Astronomie und kosmischen Physik; Antwerp Astronomical Society; Harvard College Observatory; Lick Observatory; South-West Africa Scientific Society; Argentine Astronomical Society; Argentine Association of Friends of Astronomy; University of Tartu (Dorpat) Observatory; Union Observatory, Johannesburg; West of Scotland Branch of the British Astronomical Association; Astronomical Society of New Zealand; Astronomical Society of the Pacific; Yale Observatory; Royal Observatory, Uccle.*

———o———