A circular scale graduated to degrees, with its centre just below the centre of the coil and its plane horizontal, is placed with its zero point on a line drawn on the mirror bottom of the box at right angles to the plane of the coil, so that when the needle and coil are in the magnetic meridian the index may point to zero. The accuracy of the adjustment of the zero point is to be tested by finding whether the same current produces equal deflections on the two sides of zero. To test whether the centre of this divided circle is accurately under the centre of the needle supposed at the centre of the coil, draw from the point immediately under the centre of the needle two radial lines on the mirror bottom, one on each side of the zero point and 45° from it, and turn the needle round without giving it any motion of translation. If the index lies along these two radial lines when its point is at the corresponding division on the circle the adjustment is correct.

When taking readings the observer places his eye so as to see the index just cover its image in the mirror bottom of the box, and reads off the number of degrees and fraction of a degree, indicated on the scale by the position of the index. Error from parallax is thus avoided.

A mirror with attached magnets may be used, as in the magnetometer, instead of the needle and index. When this arrangement is employed the coil is in the magnetic meridian, when equal deflections of the spot of light on the scale on the two sides of zero are observed. These scales, as has been already remarked, should always be carefully glued to a wooden piece instead of being, as they frequently are, fixed with drawing pins.¹

ANDREW GRAY

(To be continued.)

PROFESSOR HENRY DRAPER, M.D.

THE late Professor Henry Draper, whose death we announced last week, was born in Virginia in 1837, but three years later removed to New York, at the time when his father, Prof. J. W. Draper, was appointed to the Chair of Chemistry in New York University. At this University Dr. Draper was educated, graduating in Medicine in 1858, after which he travelled abroad. In 1860 he was elected to a professorship in his own University, which he retained till his death the other day. In 1866 he was elected Professor of Physiology in the Medical Department of the University and managing officer of the institution, a position he resigned in 1873.

Dr. Draper's scientific work began with a series of experiments in 1857 on the function of the spleen, carried out by the aid of microscopic photography, an art then in its infancy. On his return from Europe, stimulated by a visit paid to Lord Rosse's 6-foot reflector, he began the construction of a $15\frac{1}{2}$ -inch reflecting telescope, and with this, when completed, he took photographs of the moon. A full account of the methods of grinding and polishing reflecting mirrors and the system of testing them was printed in 1864 in the Smithsonian "Contributions to Science."

Dr. Henry Draper subsequently constructed an equatorial reflecting telescope of 28 inches aperture, making both the mounting and the silvered glass speculum himself. The object for which this instrument was intended, and which it succeeded in accomplishing in 1872, was photographing the spectra of the stars, a work which has been carried on with such success by Dr. Huggins in this country. Since the invention of the gelatino-bromide dry process the difficulties of this research have much decreased; all the more credit is therefore due to Draper and the other pioneers in this branch of inquiry; he had taken more than a hundred spectra of various stars.

In 1872 Dr. Draper produced a photograph of the diffraction spectrum of great excellence. It comprised the

region from below G, wave length 4350, to O, wave length 3440, on one plate.

In 1874 Draper was appointed by the United States Transit of Venus Commission, Superintendent of its Photographic Department, and his duties in this connection were so satisfactorily performed, that in the fall of that year the United States Government caused a special gold medal to be struck in his honour at the Mint in Philadelphia, bearing the inscription, "Decorati Decus Addit Avito." This was the first time that such a public recognition had ever been accorded to a scientific man in the United States by the Government.

In 1877 Dr. Draper printed his paper on the "Discovery of Oxygen in the Sun and a New Theory of the Solar Spectrum." This research has given rise to as much interest as any in recent times; whatever the future verdict may be upon it, it was the result of several years' work and most costly and elaborate apparatus. In 1877 Dr. Draper went to the Rocky Mountains, and made experiments on the transparency and steadiness of the atmosphere at elevations up to 11,000 feet. In the succeeding summer he took a party into the same region to observe the total eclipse of the sun, and was fortunate enough to photograph the diffraction spectrum of the solar corona, which on this occasion was shown to be continuous.

During the last autumn and winter he took photographs of the nebula in Orion. These were the first he ever made, and required an exposure in the telescope up to 140 minutes, even when the most sensitive of Eastman's gelatine plates were used.

Dr. Draper's work has been done mainly at his observatory at Hastings-on-Hudson, and at his laboratory in New York. In the former he had three large telescopes.

Dr. Draper's genial nature won him many friends and many English men of science well know the hospitable home at Dobb's Ferry. These and many more will sympathise with Mrs. Draper in the loss which not only she but science has sustained in the death of so earnest a seeker after truth.

THE COMET

WE have received the following communications on this subject:—

The latest information indicates that the September comet was first seen on the 3rd of that month at Auckland.

The sketch, No. 1, represents the appearance of the spectrum of this comet on October 15 and 16, and subsequent mornings. The spectroscope used was one of Browning's direct-vision, with five prisms. It was attached to the comet-seeker, which has a 4-inch object-glass, the focal length of the instrument making a distinct general view of the spectrum easy. As the spectroscope was not furnished with any means of comparing spectra, the positions of the bands, as shown in the sketch, were obtained by adjusting the viewing telescope so that each band was, in succession, just in the edge of the field, clamping the telescope, and then viewing the spectrum of a candle. This operation was repeated several times on October 16, and subsequently on the 25th. The position of the band in the orange-yellow was referred directly to the sodium line in the candle-flame. The band in the middle of the green was much the brightest, and on the least refrangible side was sharply defined; but, in the other direction, gradually diminished in brightness. When the slit of the spectroscope was gradually closed, the light was gradually diminished, but no separate line made its appearance, as the well-defined edge of the band would have led one to expect.

The other two bands were of about equal brightness; both of them fading rapidly on the more refrangible side, but much more slowly in the other direction.

¹ ERRATUM.—In the preceding art of this article, p. 30, col. 1, line 24 from top, for 27 read 2.

It will be remembered that the first spectroscopic observations, by M. Thollon, at Nice, reported the spectrum of the nucleus as continuous, very brilliant, and much extended toward the violet. The head gave the sodium lines very brilliant, clearly double, and appearing displaced toward the red. This report was confirmed on the same day by a similar one from Mr. Lohse, with the additional remark, that he saw *many bright lines*, the sodium being the brightest, and all apparently displaced toward the red.

October 15. This state of things had entirely changed. The change had probably been gradual, and was dependent upon the distance of the comet from the sun.

No. 1.—Spectrum of Crul's Comet, October 15 and 16.

The first observation made on September 18, when the comet was near the sun, gave a continuous spectrum, which was due to the strong reflected light, while the bright lines were due to the vapours developed by the intense heat of the sun.

On October 15 the spectrum resembled the spectra of the comets of 1868; of the sodium line there was no trace, although the spectrum contained light of about the same refrangibility. The tail of the comet gave a faint but apparently continuous spectrum brightest in the green.

A somewhat similar change was observed, I believe, in the spectrum of the Comet Wells as it approached the sun, except that its nucleus gave always a continuous spectrum, to which was added the sodium line as the comet neared the sun. If we are soon to witness a return of the September comet, it is desirable that many observers should be prepared to watch the changes as the comet approaches the sun.

Sketch No. 2 represents the comet as it appeared in the comet-seeker on the morning of October 10, which

No. 2.—October 10, 1882.

was particularly clear. This outer envelope I first noticed on the morning of the 8th, when I traced it far beyond the head of the comet in the direction of the sun, but only on the east side. On the 10th it appeared as represented in the sketch. The outer edges were perfectly sharp and parallel to the axis of the comet, thus forming a cylinder whose diameter was about four times the diameter the tail measured several degrees from the head: When I again looked for this envelope on the

25th, it could be traced only on the east side, but retained the same relation to the tail. The greatest length to which this attained was about four degrees beyond the head.

Sketch No. 3 represents the head of the comet as it appeared on October 25 in the 26-inch equatorial. Owing to the low altitude of the comet, this instrument had not been used before. The head appeared more elongated than at any time before but instead of the uncertain, delusive appearance which it presented in the 10-inch equatorial, the image brought out the peculiarities of each portion of the head, and left little doubt that there was, at that time, an essential difference between the central portion or nucleus proper, and the other two portions. The central part was circular, of considerable apparent

No. 3.—Nucleus of Comet, October 25, as seen in 26-inch Equatorial.

diameter, and of quite uniform brightness throughout. The other two portions were irregular in shape, much less bright than the nucleus, and their brightest parts were also irregular in shape. Both were apparently separated from the nucleus, though on its side they were joined to each other. The portion extending in the direction of the tail was the longest and brightest.

The next opportunity to examine the comet was on November 3, when it had decidedly changed in appearance, as represented in No. 4. The nucleus remained as when last seen, as did also the portion of the coma nearest the sun. The other portion showed a circular

No. 4.—Nucleus of Comet, Nov. 5, 1882, as seen in 26-inch Equatorial.

condensation almost as distinct as the original nucleus, and about two-thirds its size; still further in the direction of the tail was another condensation, smaller and less distinct than the second. On November 6 these condensations were still more pronounced, and shone with a much stronger light than the coma in which they were enveloped.

The following micrometric measurements were made on the 3rd and 6th, using the 26 in. equatorial:—

Distance $a = 0.66$	} November 3.
„ $b = 1.70$	
„ $c = 0.84$	
Distance $a = 0.74$	} November 6.
„ $b = 1.66$	
„ $c = 1.03$	

Assuming 0.1705 and 0.1714 to be $\log. \Delta$ on those days respectively, the distance a would be about 4000 miles, the distance b about 10000 miles, and the distance c about 5500 miles.

It would not be surprising, judging from the history of this comet, if another condensation developed in the portion of the coma nearest the sun, thus forming four nucleuses.

W. T. SAMPSON,
Commander U.S.N.

Naval Observatory, Washington, November 11

Since my first communication, with sketch of the comet, on October 21, which appeared in NATURE, vol. xxvi. p. 622, I have had good views on 21 out of 31 days. The fine weather and clear atmosphere of this place give exceptional facilities for the continued and frequent observations which are needed to obtain a knowledge of so anomalous and surprising an object. Some windows of my villa command an extensive sky and sea view (including at times the mountains of Corsica, 120 miles distant), and from my bedroom—sometimes even from my bed—I have been able to watch the comet with ease for from a quarter of an hour to an hour, on each of those twenty-one days; using only a good field binocular in occasional aid of a strong natural sight. I have more powerful telescopes, but for this object they give no help; and I am not astronomer enough to avail myself of other instruments.

The comet was seen in all its brightness on October 20, 21, 23, and 24, with its nucleus like a star of first magnitude, but elongated and nebulous—its tail beginning with slender stem, slightly curved, with downward convexity, and gradually expanding to its extremity, the diameter of which was about five times that of the head. The lower, slightly convex margin, was brighter, and more defined; but a strong nebulous light pervaded the length and breadth of the tail, shaded along the upper margin in gradually diminishing haze. The tail ended in an elongated crescent, the lower or eastern horn of which was longer than the other. Both horns were prolonged in faint lines, hardly perceptible, a few degrees further (as noticed by your correspondent, Mr. Larden). No such prolongation could be seen from the hollow of the crescent, which terminated by a narrow fringe of diminishing light, beyond which was an oval patch of shade, *obviously darker than any other portion of the visible sky*. This appeared to me nothing else than a *shadow* projected by the comet on the space beyond the end of its tail. I cannot admit the correctness of Major Herschel's *suspicions*, "that this impression was produced by contrast only" (NATURE, vol. xxvii. p. 4). The still greater contrast between the brightness of the lower margin and the adjoining sky produced no such shade there *at that time*: later I shall allude to such a shade appearing there also. The ultra-caudal patch was obviously darker than any other spot of the sky: so it appeared to me, and my experience in landscape painting has given me some skill in appreciating lights and shades. I am quite aware of the difficulty of physically explaining the existence of light and shadow in the vacuity of space, but this is a question of pure observation, to which I invite further attention. Two of your correspondents, Mr. Larden of Cheltenham, and Mr. Cecil of Bournemouth, describe "a black rift in the sky," and "a strong apparent shadow" behind the comet—seemingly in confirmation of my observation.

When the comet was next seen, after an interval of bad weather, on the 29th it had lost in dimensions, but still more in brightness, and its form was changed. The

upper margin from the head upwards had expanded and become more feathery; so had the end of the tail, which had lost its crescentic form; the shadow beyond had quite disappeared, and was replaced by an ill-defined luminosity, losing itself in the darkness of the sky. The lower margin of the tail had lost less of its brightness and definition; and now if there was a shadow anywhere, it was along this edge, down even to the head of the comet; but the shade was much less marked than had been that beyond the tail, and I might have ascribed it to contrast but that it was not present when this margin was brighter and the contrast greater. This shadow is noticed by Mr. Cecil in NATURE, vol. xxvii. p. 52.

The comet was well seen on October 30 and 31, and November 2, 3, 4, 6, and 7, gradually diminishing in brightness and in the definition of its outline, its light being now further paled by moonlight. So faint was it that I am not surprised at Major Herschel's description of its non-appearance in the London sky of November 5; but I cannot help "suspecting" that this was due not to moonlight only (as the testimony of others proves), but also to the gas-lit haze of the London atmosphere, which from fifty years' experience I know to be, at its clearest, quite sufficient to mask a faded comet, even although the brighter light of stars may still remain visible. On the 8th the comet was seen before moonrise, more distinct, although pale and hazy in outline; lower margin still the brightest, with a slight attendant shade. It was seen every day (except the 13th, 14th, and 15th) until the 22nd, with little other changes than that it was gradually becoming fainter, although still a conspicuous object in the dark sky from 2 to 5.30 a.m. On the 21st I made a careful portrait of it in oils, with its attendant stars, by the side of one that I had painted from the sketch taken October 21, when it was in its glory. The alteration which has taken place in the month is such that it now seems the mere ghost of its former self. The comparison strikes one as showing how much more it has lost in brightness and compactness, than in length and breadth. Is not this in exact conformity with what has been ascertained (see NATURE, vol. xxvii. p. 58) that the comet has been receding more rapidly from the sun than from the earth.

C. J. B. WILLIAMS

Cannes, November 23

THE APPROACHING ECLIPSE OF MAY 6, 1883¹

THE sixth of May next year will witness, in the distant regions of Oceania, one of the rarest and most important astronomical phenomena of the century, viz. a total eclipse of the sun, which, owing to the respective positions, but rarely realised, of the sun and the moon, will have a duration quite extraordinary.

Now, in the present state of science, when the most important questions as to the constitution of the sun and that of the unexplored spaces near him, and the existence of those hypothetical planets which Le Verrier's analysis indicated within the orbit of Mercury, are still pending, a phenomenon which presents to us, for long minutes, all those regions, with the sun's dazzling brilliancy withdrawn, and renders them accessible to observation, is one of the first order.

We shall presently examine the conditions under which this rare solar occultation will be produced; let us first see what is the state of the questions which have to be considered on this occasion. One of the most important is that regarding the constitution of the space immediately bordering on the envelopes of the sun at present known.

The great Asiatic eclipse of 1868, came wonderfully *à propos*, both by its long duration and by the maturity of the problems that had to be attacked, enabled us in some sort to tear the veil which hid from us the

¹ Report to the Bureau des Longitudes, by a Commission consisting of MM. Fizeau, Admiral Cloué, Lœwy, and Janssen (reporter).