LETTERS TO THE EDITOR.

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Visibility of Halley's Comet.

THE discovery of Halley's comet at a time so far preceding the date of perihelion passage adds another proof of the great capacity of the photographic method. The interesting point to many observers is as to when the comet will become visible to them as a telescopic object. This must, of course, depend in a large measure upon the diameter of their glasses and on their powers of vision. After the present moon has left the sky, say during the second week in October, the comet ought to have increased in light sufficiently for it to be observed in a 12-inch telescope. The calculated magnitude of the comet will be 14½ on October 15, and its distance from the earth about 230 millions of miles. Its apparent position will then be five degrees west of γ Geminorum, and near 72 Orionis. On October 16 the comet will be just two degrees south of 71 Orionis (mag. 5·5), and ought to be visible as a very faint nebulosity, especially if the night is good. The transparency of the air has an important influence on the perception and aspect of faint comets and nebulæ, for a really suitable sky will enable objects to be glimpsed which are utterly invisible on bad nights when there is diffused light, thin cloud, mist, or fog prevalent. The comet will be visible in an excellent position nearly all night during most of the winter, but will continue small and faint until it blazes out next April.

W. F. DENNING.

The Presence of Hæmoglobin in Invertebrate Blood.

MAY I make use of your columns to correct a statement in my article on Crustacea in vol. iv. of the "Cambridge Natural History," which I am afraid may seriously mislead the reader? Referring to the alleged presence of hæmoglobin in the blood of Branchipus and Daphnia, I have stated in a footnote on p. 30 that the fact that the red blood of Lernanthropus has been proved not to contain hæmoglobin throws doubt on the reality of its presence in the other two animals. At the time of writing I was not aware that the authority on which the presence of hæmoglobin in Branchipus and Daphnia rested, and I was inclined to impugn, was Sir Ray Lankester, who, in the late 'sixties and early 'seventies, published a series of researches which laid the foundation of a comparative knowledge of the distribution of hæmoglobin and similar respiratory pigments in the animal kingdom (see especially Proc. Roy. Soc., vol. xxi., December, 1872, p. 70). After reading these articles it is clear to me that Sir Ray Lankester's statement as to the presence of hæmoglobin in the blood of Branchipus and Daphnia, resting as it does on careful microspectroscopic examination, is quite unaffected by what may or may not be the case in Lernanthropus, so that I can only withdraw my footnote with many apologies to him and to readers of the "Cambridge Natural History." With regard to Lernanthropus and its allies, small crustacea parasitic on fish and mussels, which possess a closed vascular system containing a red fluid, there is still some doubt. Van Beneden, who discovered Lernanthropus in 1880, states (*Zoologischer Anzeiger*, Bd. iii., p. 35) that he examined the blood spectroscopically, and found the oxyhæmoglobin lines.

More recently Dr. Steuer (*Arbeiten Zool. Inst. Wien*, vol. xv., p. 14, 1903) sent numerous specimens of an allied form, Mytilicola, to Prof. R. von Zeynek in Vienna, who came to the conclusion that the blood did not contain hæmoglobin, since (1) with glacial acetic acid and sodium chloride no hæmin crystals were obtained; (2) after reduction with potassium cyanide and ammonium sulphide, the characteristic reduced hæmoglobin lines were not formed; (3) there was no hæmochromogen reaction.

Curiously enough, we are not told whether the simple examination of the blood gives the oxyhæmoglobin lines, as Van Beneden stated, or not, so that we are left in doubt whether Van Beneden was altogether in error or the red substance in the blood of Lernanthropus possesses one of the properties of hæmoglobin but not the others. The matter being in this unsatisfactory state, it is very desirable that someone, to whom the opportunity is offered, should re-investigate the blood of Lernanthropus.

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MAGNETIC STORM OF SEPTEMBER 25.

DR. CHREE, F.R.S., has sent us the following communication on the above:—

The magnetic storm of September 25 exhibited the rapid oscillatory movements that are usually associated with the appearance of aurora. As recorded at Kew, the storm commenced suddenly at about 11.43 a.m. During the next nine hours there was an almost uninterrupted succession of large oscillatory movements in the magnetic curves, especially those of declination and horizontal force. The storm was of comparatively short duration, no movements of any great size being recorded after 8.30 p.m. on September 25, and by 1 a.m. on September 26 little trace of disturbance was left. When the storm was at its height the oscillatory movements were so rapid that the record left on the photographic paper was frequently too faint to show minute details, and the limits of registration were at times exceeded.

At the commencement there would appear to have been an exceedingly rapid oscillatory movement of the declination needle, after which the needle moved to the east continuously for about 15 minutes. After the first 12 minutes, during which a movement of 72′ was recorded, the trace got off the sheet, so that the full extent of the easterly drift is not shown. After a few minutes' absence the trace reappeared, but, after some oscillatory movements of the needle, the trace got off the sheet again on the same side as before at about 12.12 p.m., and remained off on this occasion for nearly 40 minutes. During the whole of this time the needle pointed at least 70′—at times, probably, a good deal more—to the east of its normal position. After coming on the sheet about 12.52, the trace exhibited some minor oscillations superposed on a rapid drift across the sheet. The entire width, representing 2° 7′, was crossed in less than half an hour, and the trace at about 1.20 p.m. got off the sheet on the opposite side. The needle then pointed about 1° to the west of its normal position. Between 1.20 p.m. and 8.30 p.m. there were a number of large oscillations, movements of 40′, 60′, or more, now east, now west, taking place in the course of a few minutes. The largest of the rapid oscillations clearly shown took place between about 8.7 and 8.22 p.m., a westerly movement of 98′ being followed by an easterly movement of 84′. The disturbance shown by the horizontal-force curve was no less remarkable. The commencing movement at 11.43 a.m. went beyond the lower limit of registration, a fall of 430 γ taking place in about 10 minutes. At this time the trace was off the sheet for only about 5 minutes. After reappearing it showed large oscillations. By 12.53 p.m. it had crossed the sheet to the other side, the change of force during one period of 13 minutes being no less than 625 γ. The trace was off the sheet continuously from 3.55 to 5.10 p.m., the horizontal force during the whole of this time exceeding its normal value by more than 300 γ. Except when off the sheet, the trace showed continuous large oscillatory movements during the whole afternoon. The largest clearly shown was partly synchronous with the large declination oscillation near 8 p.m. already described; it consisted of a rise of 520 γ and fall of 710 γ, all in the course of 17 minutes.

The declination range, 2° 7′, and the horizontal-force range, 740 γ, actually recorded, represent merely the full width of the photographic paper. How much these ranges were exceeded it is impossible to say, but, judging by the look of the curves, the excess was probably considerable. The vertical-force trace got off the sheet only on one side, and this element would appear to have been less disturbed than the other two. Still, as the trace was off the sheet continuously for nearly an hour after 3.35 p.m., the chances are that the true range exceeded somewhat largely the range 530 γ actually recorded. The duration of the storm was comparatively short, but whilst it lasted it exhibited an energy which has been very seldom rivalled at Kew. The oscillatory movements were quite as rapid as those of October 31, 1903, and the range of the elements has probably not been exceeded during the last twenty years, not even during the great storm of February 13, 1892.

Magnetic storms such as the present inevitably create an interest in the explanations that have been advanced to account for the phenomenon. The theories of Arrhenius and of Nordmann, the theories and researches of Birkeland, and the deductions made by Maunder from the Greenwich disturbances all point to the sun as the ultimate source, and to some form of discharge—ions, electrons, or such like carriers of electricity—as the immediate vehicle. The electrical nature of aurora is difficult to dispute, and the fact that storms like the present appear to be invariably associated with aurora visible far outside the polar regions unquestionably supports in some ways theories such as those of Birkeland or Arrhenius.

When we come, however, to details, difficulties present themselves. If magnetic storms are directly due to the electrical currents which render the upper atmosphere luminous, how comes it to pass that the visual phenomena of aurora are so constantly changing, whilst even in the most conspicuously variable of magnetic storms the larger movements of the magnets take usually 5, 10, or 20 minutes to accomplish, the force appearing to alter at a nearly uniform rate for minutes on end? The relatively gradual nature of the magnetic change is a true phenomenon—as clearly indicated by the short-period magnets of the Eschenhagen pattern, as in the larger Kew magnets with periods of 10 seconds or more. There is, again, the very remarkable fact that when we go to high latitudes, where aurora and magnetic disturbance are both almost daily occurrences, the association of the two phenomena becomes much more difficult, if not impossible, to recognise. The absence of visible aurora during active magnetic disturbances may be reasonably accounted for during the Arctic summer, when the sun is above the horizon, but it is a different matter when we find the magnets rather quieter than usual during the occurrence of a bright aurora. Unless we are to assume a fundamental difference of type between auroras presenting the same spectroscopic lines, or a variety of sources for different magnetic storms, there is a difficulty which is not easily surmounted. The only explanation that has occurred to me is the possibility that the visual phenomena may represent merely intense local concentration of electrical current, and that the main portion of the discharge frequently makes no appeal to the eye, and is of a much more steady and persistent character. Another difficulty in regarding the phenomena of magnetic storms as entirely and directly due to the action of electrical currents associated with aurora is that it is a frequent occurrence—as on the present occasion—for the horizontal force to be considerably depressed below the normal value when the storm has apparently ceased and for some considerable time thereafter. It is possible, of course, that the external currents have partly demagnetised the earth, or at least modified its distribution of magnetism, and that there are recuperative tendencies tending to cause reversion to what is for the time being a more stable distribution; but if this be the true explanation, the demagnetising action and the recuperative tendencies are presumably in action during the course of the storm, and profoundly modify the magnetic phenomena. To many minds subscription to some theory may be a necessity for intellectual comfort, but in the case of magnetic storms reservation of judgment appears at present the more scientific attitude.

In addition to the foregoing we have received the following communication from Prof. A. Fowler, of the Imperial College of Science and Technology, South Kensington:—The possible occurrence of a magnetic storm and auroral display on September 24 or 25 was suggested by observations of the large spot which was then on the sun's disc. On September 24 the spot was a little west of the central meridian—which appears to be the most favourable position in relation to magnetic disturbances—and spectroscopic observations showed that it was of the same disturbed type as the spot associated with the great magnetic storm of October 31, 1903 (NATURE, vol. lxix., p. 6).

On Friday evening (September 24) the sky was overcast, and it did not then occur to me to test the possible presence of aurora by the spectroscope. On Saturday evening, however, although the sky was at first completely clouded over, the spectroscope gave unmistakable evidence that an auroral display was in progress. From 6.40 to about 7.30 (the sun set at 5.52), the whole sky was filled with a feeble light, with brighter patches here and there, and the characteristic green line of the auroral spectrum was seen in every direction. The greatest intensity was at first near the zenith, but the line was easily visible over the entire sky, and was even seen in the light reflected by a pocket handkerchief. This condition continued with diminished brightness until near 8 p.m. Between 8 and 9 o'clock the display was very feeble, but shortly after 9 the auroral line was again fairly distinct in a faintly luminous belt about 10° above the northern horizon. After 9.30 no evidence of aurora was obtained, although the sky was then partially clear.

The general distribution of the green line over the heavens in clearer skies has been occasionally noted by Angström and others, but I have not yet found any previous record of such a wide diffusion of the auroral light when the sky was completely clouded. If wholly above the clouds, the aurora must have been of extraordinary brightness in order to produce this effect.

Besides the green line, there were three fainter nebulous lines or bands in the green and blue, which have been frequently mentioned by previous observers. A careful search was made for the red line which appears in "crimson" auroræ, but its presence was not even suspected.

As to the sun-spot, there was a brilliant reversal of the C line of hydrogen over one of the umbræ when I observed it at 12.20 p.m. on September 24, and on opening the slit it was clear that this appearance was produced by a very bright overlying prominence. Reversals of the chromospheric lines b_3 and 1474 K were also suspected, but the observations were stopped by clouds. According to Tacchini and Lockyer, it is the prominence, rather than the spot, which should be considered as related to the magnetic disturbance.