OUR ASTRONOMICAL COLUMN.

THE PHOTOGRAPHY OF FAINT MOVING CELESTIAL OBJECTS.—An ingenious but simple method of photographing unseen or very faint moving but known celestial objects has recently been suggested by Prof. Barnard (*Astr. Nachr.* No. 3453). Every one knows that in order to photograph a faint celestial object, it is only necessary to prolong the exposure until a sufficiently burnt-out image is recorded on the photographic plate. If, however, the object has a rapid motion, then the image will not remain on one part of the plate a sufficiently long time to record its impression, since the clockwork of the instrument is regulated to counterbalance the apparent motion of the stars. Prof. Barnard's idea is to use, in the eyepiece of the guiding telescope for following the object in question, two guiding cross wires attached to a light frame which can be moved by a delicate clockwork (the works of an ordinary watch are sufficient), the speed of which can be regulated to the motion of the object. Arrangements can also be made that its direction of motion can be regulated to any position-angle. When adjusted to the eye end of the guiding telescope, the instrument is set so that the amount and direction of motion of the cross wires shall coincide with that of the comet or minor planet.

A star in the field of view is then bisected by the cross wires, and the mechanism set in operation, the star being kept bisected by the ordinary slow motions for star guiding. It will thus be seen that although the operation is exactly the same as if the star itself were being photographed, it is the image of the comet which will remain stationary as regards the photographic plate, while the stars will produce trails. Prof. Barnard mentions that the device will be very serviceable for photographing visible comets with ill-defined nuclei, as these have no definite points to guide by, and it is for this work that he is going to have an instrument of this kind made.

SUNSPOTS AND THE WEATHER.—Although nearly every one is agreed that sunspots do influence our weather, the relation between them is evidently not a very simple one. Statistics of the weather from places situated in moderate latitudes do not, at any rate, bring out very clearly direct indications of such a connection; but when they are gathered from a large region near the equator, such as India, then the effect of the sunspot cycle on the weather is more decisive. The first effects of solar disturbances would be felt at the equator, and as the mean temperature does not vary very much from the extremes, a general small increase or decrease would make itself apparent. In more northern latitudes local disturbances seem to tend to a great extent to mask the effects of a variation in the amount of solar radiation.

Mr. Alexander MacDowall has, however, examined a number of weather statistics from several European stations—viz. Bremen, Paris, Geneva, Greenwich—and he finds that they are suggestive of a relation to the sunspot cycle (*Quarterly Journal of the Royal Meteorological Society*, vol. xxiii. No. 103).

In making out his curves he says he has used smoothing methods freely, sometimes smoothing with averages of five and sometimes with additions of five. In this investigation the author has compared corresponding portions of successive years, such as the winter half, summer half, the four seasons, &c. To sum up the inquiry in his own words, he says: "In the climate of Western Europe there is apparently a tendency to greater heat in the summer half and to greater cold in the winter half near the phases of minimum sunspots than near the phases of maximum; the contrast between the cold and heat of the year thus tending to be intensified about the time of minimum sunspots. . . . If we accept the view to which direct observation of the sun seems to lead, that solar radiation of heat is greater about the time of maximum sunspots, we appear to have a direct explanation why, on the one hand, our winter cold should thus be moderated; and as to the contrary effect in the summer half, it is not difficult to conceive that solar activity may, by increased evaporation, bring about the presence of more cloud, and so give us cool, rather than hot, summers."

The conclusions drawn by Mr. MacDowall are exactly what would be expected, and they corroborate those that were formed many years ago. Thus, for instance, in a pamphlet published in 1879, and submitted to the Indian Famine Commission, we read: "For it is an acknowledged and readily accountable fact that presence of cloud in the summer is associated with coolness, and in the winter with warmth; and in like manner that a clear sky, which in the summer, by promoting solar radiation, favours the development of great heat, in the winter, by giving free scope to terrestrial radiation (in the then comparative absence of solar radiation), tends to produce excessive cold. The fact, therefore, that clouds are more prevalent in the *summers* of maximum sunspot years, and in the *winters* of minimum sunspot years, is only another way of saying that both summer and winter are *cooler* at the former epoch and *warmer* at the latter."

COMET PERRINE, OCTOBER 16.—The following is a continuation of the ephemeris of this comet, computed by Herr. J. Möller (*Astr. Nachr.*, No. 3454) from the observations of October 16, Mount Hamilton; October 18, Strassburg, and October 20, Hamburg (two observations).

12h. Berlin M.T.

1897.	R.A. h. m. s.	Decl. ° ′	log *r*.	log Δ.	Br.
Nov. 7	19 25 54	+75 21·9	0·1563	9·9387	1·0
8	15 59	74 19·4	1550	9429	1·0
9	7 31	73 17·0	1537	9473	1·0
10	19 0 19	72 15·0	1524	9517	1·0
11	18 54 10	71 14·0	1512	9563	1·0
12	48 51	70 14·1	1500	9609	1·0
13	44 13	69 15·4	1488	9656	1·0
14	40 10	68 18·0	1477	9703	0·9
15	36 36	67 22·0	1466	9751	0·9
16	18 33 30	+66 27·5	0·1456	9·9799	0·9

The following comments relate to the appearance of this comet:—

Karl Mysz: 6-inch refractor in Pola. October 18, comet 10 mag.; axis of tail, 200°; nucleus appears sometimes double or oblong. October 19, same appearance and brightness as yesterday; nebulosity has diameter of 5′.

J. Möller: 8-inch refractor in Kiel. October 20, nucleus 10·3 mag., oblong and hazy; fan-shaped tail of about 2′ in length, having a position angle of 200°.

Schorr and Ludendorff: Hamburg refractor. October 20, comet has faint nucleus, 10·5 mag.; tail, 0′·5 towards south. October 24, fainter than October 20; no distinct nucleus.

Picart: at Bordeaux, October 20. The comet has a very feeble tail; its general form is that of an elliptical nebula.

THE DIRECTOR OF THE LICK OBSERVATORY.—We regret to read in the *Astronomische Nachrichten* (No. 3454) that, after a continuous connection with the Lick Observatory for twenty-three years, and a service at Mount Hamilton since the year 1888, Prof. Holden has resigned his post, and will terminate his official relations with the Observatory December 31, 1897. His address after October 1 will be Smithsonian Institution, Washington.

RELATION BETWEEN INDIVIDUAL AND RACIAL VARIABILITY.[1]

MR. BREWSTER'S memoir refers to "allied races" without defining that phrase, but apparently basing it on the idea of divergent races sprung from a common source. The mean (or typical) characters of these races differing from one another, as individuals of the same race differ among themselves, two systems of variables exist in respect to each and every character: (1) a single system, referring to the means of the different races; (2) several separate systems, referring alike to the individual values of the same character; in each and every race. He supposes the ordinary law of frequency to be approximately applicable to both systems, so that the peculiarities of every series admit of being roughly expressed by its own mean and quartile (=probable error). In order to reduce the variability of each series to a common scale, he works, not with the observed quartiles, but with what may be called *reduced quartiles*, namely the indices formed by dividing each quartile by its corresponding mean. These being comparable on equal terms, are his "measures of variability."

The first and more important part of the memoir deals with eighteen different characters in eight human races, the data being derived from Weisbach's *Körpermessungen*. The number of individuals in each of the selected races is unfortunately very small, ranging from eight to twenty-six, though he is able to

1 "A Measure of Variability and the relation of Individual Variations to Specific Differences." By Edwin Tenney Brewster. (*Proc.* Amer. Acad. Arts and Sciences, May 1897.)

utilise twenty races for obtaining the common racial mean. His method of discussion is based on the safe ground that, if racial variability be associated with individual variability, whenever any specified character is more variable than another specified character in the one, it will (on the whole) be more variable in the other also. Therefore if the reduced quartiles of the two characters, in the series of means of races, be called A and B, and those in that of the individuals of any given race be called a and b, then if A be greater than a, B would (on the whole) be greater than b, and conversely. More briefly and fully, if the *signs* of the differences (A-B) and $(a-b)$ are alike, the evidence, so far as it goes, favours the suggested idea of a connection between racial and individual variability; if the signs are different it discountenances it.

The test is rough, but is of value when applied on a considerable scale with concurrent results, as in the present instance. The eighteen characters admit of $\frac{1}{2}(18 \times 17) = 153$ different pairs of combinations of the form $(a-b)$, in each of the eight races; that is 1224 pairs in all. Each of these has been compared with its associated pair in the series of means of races, of which there are altogether $\frac{1}{2}(8 \times 7) = 28$. The result is that in seven out of the eight races the cases testifying to the existence of the suggested association are from twice to thrice as numerous as the others, and in the eighth race they are $1\frac{1}{2}$ times as numerous. Nay more, there is some evidence that the most variable characters in the one, are the most variable in the other. This conclusion is corroborated by three other inquiries of the same kind, two into rodents and one into carnivoræ. The error introduced by the strained assumption, that the ordinary law of frequency holds good for the series of means of allied races, does not seem likely to invalidate the general conclusion to a serious extent. It therefore appears that Mr. Brewster has provisionally established his thesis that whenever any specified character varies much in individuals of the same race, it is probable that it will be found to vary much in "allied" races, and conversely.

ON THE CONSTITUTION OF THE ELECTRIC SPARK.[1]

IF a Leyden jar is discharged through metal electrodes, and the spectrum of the spark is examined, it is found that the metallic lines are not confined to the immediate neighbourhood of the poles, but are seen sometimes in the centre of the spark, several millimetres away from the electrodes, from which they must have been projected with considerable velocity.

It has always seemed to me to be a problem of interest, to measure the velocity of projection. A knowledge of it may teach us something concerning the mechanism of electric sparks and, in addition, we may hope to obtain information on some important points in spectrum analysis, which are at present under discussion. Thus, for instance, if the speed with which a molecule is pushed forward into the centre of the spark depends on molecular weight, we may separate from each other those lines of the spectrum which belong to different molecular combinations. For many years past I had made various unsuccessful attempts to deal with this problem, when I became acquainted with the elegant method, used by Prof. Dixon in some of his recent experiments, in which a photograph is taken on a film fixed to the rim of a rapidly revolving wheel, of which the speed may easily be made sufficiently large to measure velocities of moving luminous particles up to 2000 $\frac{\text{metres}}{\text{second}}$. This number might be doubled or trebled with improved appliances.

The experiments were conducted by Mr. Gustav Hemsalech, to whose care and skill their success is largely due. Without entering into a detailed description of the apparatus, it will be sufficient to say that the photographs, which I now submit to the Section, were taken on a film moving with a linear speed of about 80 $\frac{\text{metres}}{\text{second}}$ in a direction at right angles to the slit of the spectroscope. The lines of the metal appear inclined instead of straight, in consequence of the finite velocity of the luminous molecules. The air lines, on the other hand, though slightly broadened, remain straight. The sparks were taken from five large Leyden jars, charged by means of a Voss machine. Each single spark produces a good spectrum, reaching approximately from $\lambda = 5000$ to $\lambda = 4000$.

One of the photographs, in which zinc poles were used, shows that the velocity of the molecules is gradually diminishing as they move away from the pole. Close to it the speed seems very great, the average velocity up to a distance of about one millimetre being about 2000 metres per second. At a distance of four millimetres the speed is reduced to something like 400.

In another experiment one pole was zinc, while the other was bismuth. Some bismuth lines are found to be decidedly more curved than those of zinc, indicating a smaller velocity. But the line of bismuth, which lies at 4560, seems almost straight.

When the poles are moistened with a solution of calcium chloride interesting results are obtained, the calcium line at 4226 being more inclined than H and K.

The experiments were made with comparatively rough appliances, but a more perfect apparatus is in course of construction; and the author hopes to continue the research in conjunction with Mr. Hemsalech.

[1] By Prof. Arthur Schuster, F.R.S. (Read before Section A of the British Association at the Toronto meeting.)

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE section of Physiology at the British Association meeting at Toronto was a large and active one. Under the presidency of Prof. Michael Foster a large body of physiologists attended in about equal numbers from the east and west of the Atlantic. Meetings were held on the Thursday and Friday, August 19 and 20, and on the Monday, Tuesday and Wednesday, August 23, 24 and 25.

Among those present were Messrs. Bowditch, Boyce, Cushny, Crookshank, Gaskell, Halliburton, Huber, Huerthle, Lee, Loeb, Lombard, Billings, Lister, Macallum, Osler, Wesley Mills, Noël Paton, Porter, Waymouth Reid, Sherrington, G. N. Stewart, Anderson Stuart, Kellog, W. H. Thompson, Charles Richet, Waller, Welby, Shore, MacAlister, O. Grunbaum, Baldwin, Braun, Reynolds Green, Meldola, and A. S. Grunbaum.

Prominent among proceedings in the Section were the following:—

Prof. Bowditch read a paper on the physiology of unstriped muscular tissue as exemplified in the wall of the stomach of the frog. The rhythmic contractility of the tissue is well seen. When the organ or a strip of it is fitted to a recording apparatus, in the majority of instances after a lapse of not more than three hours, contractions of rhythmic recurrence are registered. Often two or more sets of rhythmic contractions are superposed. This may be best accounted for by supposing the muscle-cells to contract not all together but in two or more groups. In the discussion Prof. Sherrington referred to experiments published by him in which had been recorded contractions of the urinary bladder removed from freshly-killed monkeys and placed in warm normal saline solution, while connected with a volume recorder. In these the isolated bladder began to "beat" almost at once, and continued "beating" for an hour or less, at rate somewhat quicker than once a minute. The contractions thus obtained from the viscus only exceptionally displayed the compound character shown in Prof. Bowditch's curves.

Prof. Carl Huber brought forward observations on the cells of the sympathetic system of vertebrates. In Amphibia nearly all sympathetic cells are unipolar. In other vertebrates the prevailing type is multipolar. All sympathetic neurons have one axon only. The dendrites form a network between the cell-bodies of the neurons constituting a ganglion. The axon of each sympathetic nerve-cell becomes either a non-myelinated nerve-fibre (grey fibre) or a fine myelinated nerve-fibre. The fibres of the white rami are axons of cells lying within the spinal cord, and these axons reach the sympathetic ganglia through the white rami, and in the ganglia undergo branching, ending in baskets which enclose the perikarya of the sympathetic neurons. In mammalia and birds the circumcellular baskets are comparatively simple networks of varicose fibrillæ. In Reptilia and Amphibia instead of simple end baskets the fibre is spirally wound and completely contorted. This is the explanation of Beale's spiral fibre in the sympathetic cells of the frog figured by him forty years ago. In all vertebrates the pericellular baskets are intracapsular. Langley and his pupils have shown that an impulse travelling along a spino-sympathetic efferent chain may be blocked in a sympathetic ganglion by the injection of nicotin. This has been applied to practically all regions of the