OUR ASTRONOMICAL COLUMN.

WEINEK'S LUNAR ENLARGEMENTS.—Selenographers will be glad to hear that Prof. Weinek proposes to publish a Lunar Photographic Atlas, which will contain an accurate and artistic representation of the whole visible surface of the moon. The materials that will form the basis and bulk of this atlas have been mainly derived from the series of negatives of the Lick Observatory, which have been enlarged twenty-four times. The maps will be printed by the phototype process direct from Prof. Weinek's enlarged glass diapositives, and will be constantly under his supervision and control during their reproduction by the Art Photographical Institute of Carl Bellmann in Prague. The proposed scale of the atlas will be 4 metres to the diameter of the moon; there will be in all 200 maps 26 × 31 cm., and each sheet will give the selenographical latitude and longitude for the centre of the picture, and also the selenographical longitude of the terminator for the latitude 0°. This will greatly facilitate the arrangement of the sheets according to the relative positions of the lunar objects they portray. The publication of such an atlas as this, which requires a great deal of outlay, cannot be undertaken unless a considerable number of subscribers are forthcoming. Prof. Weinek appeals in the first instance to all the observatories of the world to become subscribers for the ten issues, each to contain twenty lunar landscapes. There should be no difficulty in obtaining a sufficient number of applicants, as such a useful and epoch-making publication in selenography should be in the possession of every observatory.

MARTIAN MARKINGS.—In the current number of *Knowledge*, M. Antoniadi brings together in an interesting summary all the more important observations made from the year 1864 of that well-known marking on the surface of Mars, namely, Syrtis Major. The discussion shows that, on the whole, decided changes have taken place in the form of this marking, and that its expansion has invaded the regions occupied by Mœris Lacus and Lilaga. Two new canals have also been recorded during the last few years in this region. The diagramatic sketch, showing the gradual changes recorded during the last thirty-three years, brings out very clearly the reason of the disappearance of the lake as such mentioned above. M. Antoniadi remarks, as regards the displacements of "seas" and "lakes," that "absurd and imaginary as they might seem to the ordinary reader, they are simply familiar occurrences to the areographer. Evidently the surface of Mars has some fixed areographical markings; but the stability of the lesser details and of the polygonians of the canal system is so frail, that at times the changes assume a fantastic, grotesque, and almost ridiculous character."

LEAKAGE FROM ELECTRIFIED METAL PLATES AND POINTS PLACED ABOVE AND BELOW UNINSULATED FLAMES.[1]

§ 1. IN § 10 of our paper "On Electrical Properties of Fumes proceeding from Flames and Burning Charcoal," communicated to this Society on April 5, results of observations on the leakage between two parallel metal plates with an initial difference of electric potential of 6·2 volts between them, when the fumes from flames and burnings were allowed to pass between them and round them, were given. The first part (§§ 1-4) of the present short paper gives results of observations on the leakage between two copper plates 1 centimetre apart, when one of them is kept at a constant high positive or negative potential; and the other, after being metallically connected with the electrometer-sheath, is disconnected, and left to receive electricity through fumes between the two.

The method of observation (see Fig. 1) was as follows. Two copper plates were fixed in a block of paraffin at the top of a round funnel 86 centimetres long and 15·6 centimetres internal diameter. A spirit-lamp or a Bunsen burner, the only two flames used in these experiments, was placed at the bottom of the funnel, 96 centimetres below the two copper plates. One terminal of a voltaic battery was connected to one plate, and the other terminal was connected to the sheath of a Kelvin quadrant electrometer. The other copper plate was connected to one of the pair of quadrants of the electrometer in such a way that by pulling a silk cord with a hinged platinum wire at its end, this copper plate and this pair of quadrants could be insulated from the sheath of the electrometer and the rest of the apparatus. On doing so with no flame at the bottom of the funnel, no deflection from metallic zero was observed, even when the other plate was kept at the potential of 94 volts by the voltaic battery; this being the highest we have

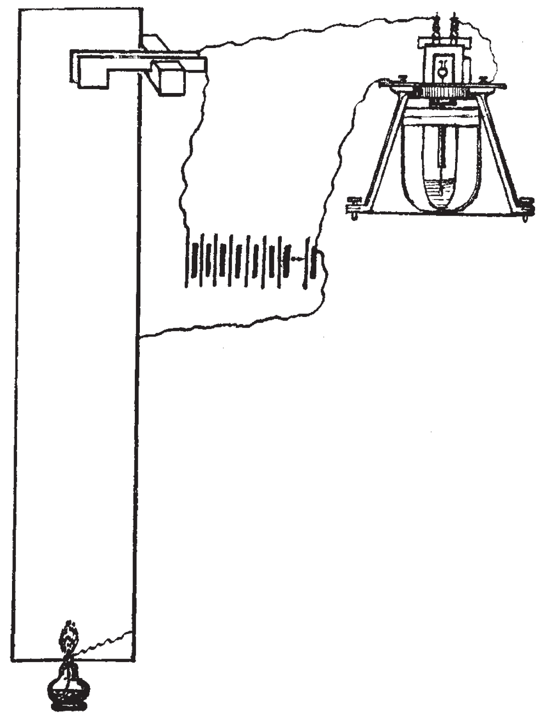

FIG. 1.

as yet tried. When the plate was kept at potentials of 2, 4 ... 10 volts, the deflection from metallic zero in three minutes was observed; but for higher potentials, merely the times of attaining to 300 scale divisions from metallic zero were observed.

§ 2. The results obtained are summarised in the following table. In every case for potentials below 90 volts there was greater leakage when the uninsulated plate was connected to the negative terminal of the battery.

Spirit Flame.

Sensitiveness of electrometer = 60·7 scale divisions per volt. Hence 300 scale divisions corresponds approximately to 5 volts.

Difference of potential		+to plate, −to sheath		−to plate, +to sheath	
Volts		Deflection	Time	Deflection	Time
		Divisions	Min. Sec.	Divisions	Min. Sec.
2		+ 35	3 0	− 80	3 0
4		+ 92	3 0	− 133	3 0
8		+ 205	3 0	− 265	3 0
10		+ 240	3 0	− 311	1 15
Initial	Mean				
12	9·5	+ 300	0 53	− 300	0 38
18	15·5	+ 300	0 25	− 300	0 16
44·5	42·0	+ 300	0 4·5	− 300	0 4
89	86·5	+ 300	0 2·5	− 300	0 2·5

[1] Paper communicated to the Royal Society, Edinburgh, on July 5, by Lord Kelvin, G.C.V.O., F.R.S., and Magnus Maclean, D.Sc.

Bunsen Flame.

Sensitiveness of electrometer = 60·7 scale divisions per volt.

Difference of potential		+ to plate, – to sheath		– to plate, + to sheath	
Volts		Deflection	Time	Deflection	Time
		Divisions	Min. Sec.	Divisions	Min. Sec.
2		+10	3 0	– 99	3 0
4		+73	3 0	–159	3 0
8		+200	3 0	–300	2 20
Initial	Mean				
12	9·5	+300	1 48	–300	0 48
16	13·5	+300	1 12	–300	0 30
19	16·5	+300	0 46	–300	0 18
31	28·5	+300	0 15	–300	0 13
47	44·5	+300	0 11	–300	0 8
75	72·5	+300	0 6·5	–300	0 5
94	91·5	+300	0 5	–300	0 4

§ 3. If the leakage in these experiments were proportional to the difference of potential, then the product of mean difference of potential into time should be constant for the same deflection from metallic zero. Taking the numbers obtained for the 300 scale divisions of deflection in virtue of the Bunsen flame, we have :—

Positive charge	Negative charge
s.	s.
9·5 × 108 = 1026	9·5 × 48 = 456
13·5 × 72 = 972	13·5 × 30 = 405
16·5 × 46 = 759	16·5 × 18 = 297
28·5 × 15 = 427	28·5 × 13 = 370
44·5 × 11 = 489	44·5 × 8 = 356
72·5 × 6·5 = 471	72·5 × 5 = 362
91·5 × 5 = 457	91·5 × 4 = 366

Thus it is proved that the leakage between two plates, each 10 square centimetres in area, 1 centimetre apart when the fumes from a Bunsen burner pass between them and round them, is approximately proportional to the difference of potential between them, when that difference is above 20 volts and up to 94 volts, the highest we have tried ; but that, below 20, it diminishes with diminishing voltages more than according to simple proportion.

§ 4. To determine the currents which we had in our arrangement, we took a movable plate of a small air condenser charged to a known potential, and applied it to the insulated terminal of the quadrant electrometer. In this way we found that a quantity equal to 0·15 electrostatic unit, gave a deflection of 300 scale divisions. Hence in the experiments with the Bunsen flame and with a potential of +94 volts kept on the uninsulated copper plate, the current to the insulated copper plate opposite to it, when 300 scale divisions was reached in 5 seconds, was—

$$\frac{0{\cdot}15}{3 \times 10^9} \times \frac{1}{5} = 10^{-11} \text{ ampere.}$$

$$= \frac{1}{100000} \text{ mikro-ampere.}$$

§ 5. One of us about the year 1865, when occupied in experimenting with the latest form of portable electrometer, found that if it was held with the top of its insulated wire (which was about 33 centimetres long) a few inches below a gas-burner, a charge of electricity, whether positive or negative, given to this wire was very rapidly lost. The disinsulating power of flames and of hot fumes from flames was well known at that time, but it was surprising to find that cold air flowing up towards the flame did somehow acquire the property of carrying away electricity from a piece of electrified metal immersed in the cold air.[1] Circumstances prevented further observations on this very interesting result at that time, but the experiment was repeated with a portable electrometer in December of 1896, and we were made quite sure of the result by searching tests. During April and May of the present year observations were again made by means of (1) a multicellular electrometer reading up to 240 volts, and (2) a vertical electrostatic voltmeter (Fig. 3, p. 235) reading up to 12,000 volts. A steel wire 43 centimetres long was fixed to the insulated terminal of the multicellular electrometer, with its needle-point vertically below an ordinary gas-burner, as shown in Fig. 2.

§ 6. By means of a small carrier metal plate (a Coulomb's proof plane) a positive or negative charge was given to this wire and the quadrants of the multicellular till the reading on the scale was 240 volts. The leakage was then observed (*a*) with gas not lit, (*b*) with gas lit at different vertical distances above the point of the wire. We found that there was rapid leakage when the flame was one centimetre above the wire ; and the times of leakage from 240 volts to about 100 volts increased as the flame was raised to greater distances above the point ; or, otherwise, the rate of fall of potential in one minute from 240 volts diminished as the distance of the flame above the point was increased. When the vertical distance of the flame above the point was 15 centimetres, or more, the time of leakage from 240 volts was practically the same as if the flame was not lit at all. A plate of metal, glass, paraffin, or mica, put between the point and the flame, diminished the rate of leakage. The leakage from 200 volts during the first minute is given in the following table, for different distances of the flame, with no intervening plate.

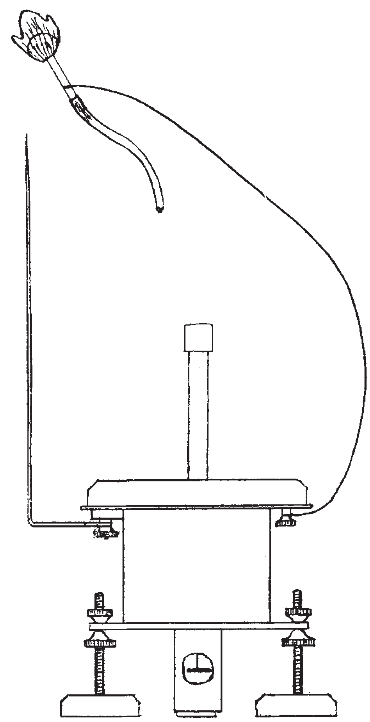

Fig. 2.

Distance of flame above point	Leakage during one minute	Remarks
Centimetre	Volts	
1·0	200 to 60 = 140	
1·5	200 to 92 = 108	
3·0	200 to 179 = 21	
6·0	200 to 196 = 4	
	200 to 197 = 3	No gas lit, but wire on the electrometer as in the other tests.*

* We sometimes found the multicellular electrometer to insulate so well that in five minutes there was no readable leakage from 240 volts.

[1] We have recently (June 1897) found the following statement, in Worthington's communication to the British Association (1889 Report, pp. 225, 227) "On the Discharge of Electrification by Flames" ; . . . "the observation seems to have been made by Priestley, that the discharge takes place *with apparently equal rapidity*, if the rod be held at the side of, or even below, the flame at the distance of, say, five centimetres" The four words which we have italicised are clearly erroneous, as we find *enormously greater leakage* five centimetres above a flame than five centimetres below it : but it is very interesting to learn that Priestley had found any leakage at all through air five centimetres below a flame.

§ 7. Similar experiments were made with higher voltages measured by the vertical electrostatic voltmeter, and we found that when the flame was three or four centimetres above the point, there was very rapid discharge; but when the flame was 60 centimetres or more above the point, the leakage from 3500 volts was practically the same as if the flame was not lit.

In place of the metal point, a round disc of zinc, 8 centimetres in diameter, was fixed, as shown in Fig. 3, to the end of another steel wire of the same length; and leakage from it to the flame above it, observed. For the same distance between the flame and either the point or the metal disc, the rate of leakage through the same difference of potential, was *less for the point than for the disc.* Thus with the flame 25 centimetres above the point the time of drop from 3000 volts to 2000 volts was 1 min. 53 secs., and with the flame the same distance above the horizontal plane of the disc the time of drop from 3000 volts to 2000 volts was 1 min. 14 secs. *This is a very important result.*

§ 8. Experiments were next made to find if, and if so, how much, the leakage is diminished by putting non-conducting plates of glass, paraffin, mica, between the point or disc and the flame. At a corner of each plate was pasted a little square of tinfoil, so

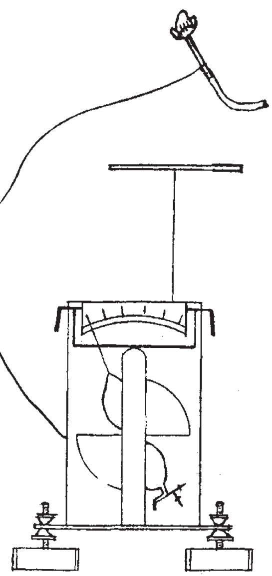

FIG. 3.

as to prevent any electrification of the non-conducting substance by handling. These pieces of tinfoil were always kept metallically connected with the sheath of the electrometer. Each plate was fixed with its under surface 1 cm. above the steel point. In preliminary experiments (of which a continuation is deferred until the insulation of the electrometer is made practically perfect by coating its vulcanite insulators with paraffin) the following numbers were obtained:—

I. *Glass Plate* 18 *cms. by* 19 *cms. by* 0·3 *cm.*

Distance of flame above point	Time of fall from 3000 to 2000 volts		Remarks
Cms.	Min.	Sec.	
—	5	30	Insulation test, with no flame.
12	2	5	Flame lit: no intervening plate.
,,	4	7	,, ,, glass plate between.

II. *Mica Sheet* 18 *cms. by* 9 *cms. by* 0·1 *cm.*

—	6	46	Insulation test, with no flame.
12	1	56	Flame lit: no intervening plate.
,,	3	50	,, ,, mica sheet between.

III. *Paraffin Plate* 11 *cms. by* 11 *cms. and* 0·75 *cm. thick.*

—	6	40	No flame. Insulation test.
12	1	53	Flame lit: no intervening plate.
,,	2	20	,, ,, paraffin plate between.

We hope to return to the investigation with the insulation of the electrometer perfected; and to determine by special experiment, how much of the fall of potential in the electrometer in each case is due to the electricity of opposite kind induced on the uppermost surface of the non-conducting plate, and how much, if any, is due to leakage through the air to the metal disc or point below.

§ 9. To test the quality of the electrification of both sides of the non-conducting plates of glass and paraffin, a thin copper sheet was fixed to one of the terminals of a quadrant electrometer, as represented in Fig. 4, where A is the plan of plate C attached to the electrometer, and B is the plate of paraffin or glass under test.

In the primary experiment (Fig. 3) the non-conducting plate was fixed in a horizontal position one centimetre above the electrified metal (point or disc), and eleven centimetres below the flame. A charge was given to the metal, to raise its potential to about 3500 volts. After some minutes, generally till the potential of the metal fell to 2000 volts, the non-con-

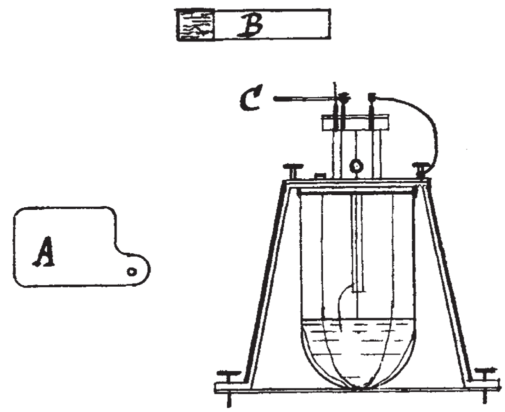

FIG. 4.

ducting plate was removed and placed, as shown in Fig. 4, above the metal plate C attached to the quadrant electrometer, and the deflection was observed. For a thin piece of glass (0·3 cm. thick) the whole effect of the two sides was negative when the electrified metal point or disc had been charged positively and *vice versâ.* But on putting two plates of glass above the electrified metal, we found the top plate to be oppositely charged and the under plate to be charged similarly to the point or disc, but not so highly. We found corresponding results with a plate of paraffin 0·75 cm. thick, and with two plates of paraffin 0·5 cm. and 0·75 cm. thick. When a plate of paraffin 3·25 cms. thick was used, we always found the top face charged oppositely to the charge of the metal, whether disc or needle-point, and the under face charged similarly to the metal below. Thus the apparent total charge of the two faces of a thin non-conducting plate is due to the fact that the face of the plate away from the electrified metal is more highly charged oppositely than the face next the metal is charged similarly.

A NEW LAW OF HEREDITY.

THE truth of a law of heredity proposed by Mr. Francis Galton, has been verified in particular instances, in a memoir[1] read by him before the Royal Society on June 3.

He first put forward the law, with hesitation, in his book "Natural Inheritance" (Macmillan and Co., 1889), page 134, because it was founded at that time almost wholly upon *à priori* grounds. Now, being found to hold good in a large group of

1 "The average Contribution of each several Ancestor to the total Heritage of the Offspring," by Francis Galton, D.C.L., Sc.D., F.R.S.