

the ice, which it loosens momentarily from their mutual cohesion, and allows to be re-arranged under the influence of gravity. Heat, he says, is the *condition*, gravity the *cause* of the motion which takes place, molecule by molecule rather than in masses. It seems very doubtful, however, if this theory is more tenable than the one it is intended to supersede. If heat entering the glacier loosens the molecules in its passage and enables them to move insensibly into new positions, it is difficult to understand what causes the numerous longitudinal and transverse fissures of a glacier, the production of which is often attended by loud reports, and which indicate movements of masses, not of molecules. And how could molecular motion lead to that heavy grinding of the ice over its bed, which scores and wears down the hardest rocks, and whitens great rivers with the finely triturated mud?

None of the opponents of Canon Moseley have noticed what seems to the present writer to be a radical fallacy in his argument about "shearing force." He assumes that, whatever the bulk or weight of the glacier, or of any portion of it to which the formula of the shearing force may be applied, the whole mass shears at once by the action of gravity on the same mass, and does not recognise the possibility of one portion of a glacier acting by its weight to shear another and much smaller portion. But this must inevitably occur; for, owing to the excessive irregularity of the bed in which every glacier moves, the mass must be every where in varying states of tension and compression, and must contain at each instant certain lines and planes of least resistance, the extent of which lines and surfaces may be very small compared with the dimensions of the glacier itself. At any moment, therefore, the whole descending weight of a portion of the glacier containing perhaps thousands of cubic yards of ice, may act so as to cause the shearing of a few superficial feet where the tension is greatest. This being effected, a partial equilibrium is produced there; but the points or surfaces of greatest tension are shifted, and another small shear or fracture occurs; and by this process and the continued regelation of fractured surfaces brought into contact, it may easily be seen that the glacier as a whole would be gradually moulded to its bed, which it would descend as surely as if it were a viscous mass. Another source of motion not taken into account either by Canon Moseley or Mr. Croll is the irregular melting away of the under surface of the glacier by terrestrial heat, which would often form unsupported hollows till a fracture occurred, and every such fracture must result in a downward motion of a portion of the glacier. The observed difference of the rate of motion between winter and summer, day and night, is more probably due to the different quantities of water which descend the crevasses into the bed of the glacier at those periods, than to any direct action of the heat. It is well known that in the higher portions of a glacier the supply of water from melting snow diminishes during the night, as it does in a still greater degree during the winter; and the large quantity of water that flows beneath every glacier in the summer must greatly assist its motion, both by melting away its lower surface, and by, to some extent, buoying it up.

Mr. Matthews's important experiment of the bar of ice which gradually curved by its own weight, should be tried again in an atmosphere kept at the freezing point. This would settle the question whether heat is an essential condition for the curvature or motion of ice by gravitation; but so far as the facts lead us at present, the arguments of Canon Moseley and Mr. Croll by no means *prove* that glaciers do not descend by the force of gravity alone.

ALFRED R. WALLACE

[The publication of this article has been delayed. It was in our hands before the appearance of Mr. Ball's paper in the *Philosophical Magazine* for February, where a view almost identical with Mr. Wallace's is ably advocated.—ED.]

AN ACCOUNT OF THE ECLIPSE AS SEEN FROM VILLASMUNDA BY AN UNSCIENTIFIC OBSERVER

THOSE set in authority over the branch of the Eclipse Expedition stationed at Agosta having decided against depending only upon observations to be made from the Observatory there, deputed Mr. Ranyard to proceed to another point upon the line of totality, and selected me as his coadjutor. Accordingly we set off, accompanied by Jarvis and Burgoyne, two of Colonel Porter's Sappers, at half-past nine in the morning of the eventful day; and, after driving some eight miles inland, we attained about eleven o'clock a point which appeared to my companion to present advantages for our object. Leaving the road, we went into the middle of a field of springing oats, on the highest point of a rocky ridge at an elevation of 600ft. above sea level, and of 520ft. above the *glacis* of Fort Agosta, where were posted the rest of our friends. The spot which Mr. Ranyard selected as the most suitable lay about a hundred



FIG. 1.

A our position; B the sun; CC, CC the lines of cloud; D the road to Agosta.

yards from a roadside farmhouse, called Casa Vecchia, upon the property of that friend of Science, the Marchese di Sanguiliano, and about two miles distant from the village of Villasmunda. A keen wind was blowing with considerable violence from the north-west, and the situation we had chosen being exposed to its full fury, we at first felt very uneasy with regard to our probable success, for we feared every moment that the telescope would be overturned and injured. A happy thought, however, soon extricated us from our dilemma. Causing our luckless coachman (who wept true Sicilian tears over the imaginary danger to his springless vehicle) to drive it, in the cause of Science, over the rock-sprinkled field, we utilised our carriage as a temporary shelter for the precious instrument, and were ready some time before

the first contact took place. During the time occupied in perfecting the necessary preliminaries, I noted the position and the structure of the cloud-banks which were instilling into our minds feelings of the keenest anxiety. We were standing in the centre of what I may describe as a comparatively cloudless longitudinal "slit" in the sky, which was otherwise completely covered; so that, while over our heads the sun was shining brightly, its refulgence obscured only occasionally by light, fleecy, flying clouds; to our front and rear were lying parallel lines of heavily-banked "cumuli-strata" running from south-west out-east. Perhaps the accompanying rough diagram (Fig. 1) may serve to illustrate their position in relation to our own.

I also set down the following readings of the barometer and thermometer (wind N.N.W.) :—

	At first contact.		Five minutes before totality.	At 2.20 P.M.	
Barometer	28.65	28.79	28.88	28.80	28.75
	At first contact.				
Thermometer in shade					56°
" in sun exposed to wind					54°
" in sun					58°
	Immediately after totality.				
Thermometer in sun exposed to wind					55°

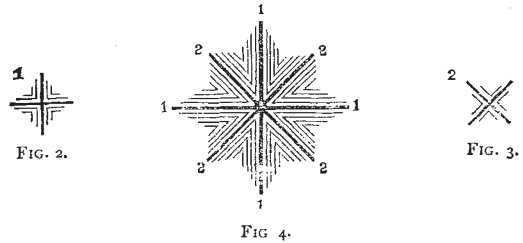
Two minutes before the commencement of totality, the clouds behind us, and those in front of us, were black and threateningly lowering, as if a thunderstorm were imminent. Etna, which lay well in our view to the N.N.W., was clothed to its very base with a shroud of the most sombre clouds, while as the seconds flew by the temperature fell sensibly lower and lower.

To the S., and S.W. also, the sky was filled by a strange, steamy, V-shaped (the point of the V being near the earth), filmy mist, through which the sun showed such a feeble and uncertain light, as to give me cause for fear lest our observations should be brought to an abrupt and resultless termination by the total disappearance of the sun behind this curious veil. Immediately before totality commenced, a dark vaporous shadow glided very swiftly up over the heavens from the westward, or a little south of west, and, as it came on towards us, seemed to swallow up the earth, leaving it dark in its rear, until at the moment of totality it reached the sun. As it drew near him, a herd of oxen feeding behind us, with one or two exceptions, lay down. With the beginning of totality the air was colder than ever, and for about one minute's space, not more, there fell a small thin rain, which I fancy must have been the result of the condensation of the steamy mist which I have a little while ago described. Of totality itself, as a spectacle, I am almost afraid to speak. To endeavour to describe the inconceivable grandeur of the sight would be a hopeless task. I can only say that nothing will ever efface it from my memory. But if I cannot hope to give you any idea of the sublimity of the scene, at any rate I will do my best to state simply the appearances which I saw. Round the dark moon gleamed the luminous circle of the corona, shining with about half the radiance of an English sun upon a winter's afternoon; while there streamed forth from it in eight directions as many sets of brilliant rays. These "sets" of rays were composed of four sets in the position of a Greek cross, as in Fig. 2; with a St. Andrew's cross, as in Fig. 3, placed upon it, forming something similar to Fig. 4, Fig. 3 extending only about half as far as Fig. 2, which reached as far outwards as the apparent diameter of the sun.

I described the phenomenon to Mr. Ranyard as having struck me by its resemblance to the "glory" round the heads of statues of saints in Roman Catholic shrines.

Jarvis and Burgoyne also made sketches of the "rays" separately, and without consultation with me or with each other, at my request. The similarity of the three is

striking. Jarvis described the rays as resembling "the pipes of an organ."



As the moon passed off from the sun's face, and for some seconds after the contact had wholly ceased, the clouds in the S.E. were suffused with deep red copper colours, which gradually faded away as the sun regained his power. During totality I made the following observations (according to Mr. Ranyard's previous request) with a Nicol's prism with Savart's bands, in the use of which instrument Mr. Ranyard had instructed me, and with which I had constantly practised during our week's preliminary residence in camp at Agosta; viz., I determined the polarisation of the sky at two points: (1) high up on the sky to the S.E. of the sun; (2) under the sun; and at both these points I found the plane of polarisation to be vertical. Totality ceased while I was taking a third observation.

Before concluding these imperfect remarks, which I have only ventured to make public because I thought that they might be of some interest, from the fact of my having had the good fortune to be one of the very few who obtained a perfectly clear and distinct view of the Eclipse during totality, I should like to bear my testimony to the great kindness of Colonel Porter, R.E., in placing all the resources at his command at the service of our party, and to his care of our creature comforts during our ten days' "dwelling in tents" under his charge. It is but just also to mention the zeal and alacrity displayed by his party of Sappers, and their intelligence in mastering the details of duties which were certainly new to them. Nor will it be considered out of place if, in conclusion, I thank the authorities of Agosta, and the Italian astronomers of distinction who did so much, not only by giving us every assistance in their power to render our stay at Agosta so successful, but also by their hospitable attentions to make it as enjoyable as possible. For my own part I can only say that I shall always look back with feelings of pleasure to the Sicilian Eclipse Expedition of 1870.

HENRY SAMUELSON

NOTES

THE Royal Commission on Scientific Instruction and the Advancement of Science is now in full work. This week they meet three times, and last week they met twice.

It has been announced at the Royal Geographical Society that Livingstone has arrived at Ujiji on his return journey.

THE Hunterian Oration has been delivered this year by Sir W. Ferguson, who *inter alia*, according to the *Times* report, "playfully referred to the suggestion of a distinguished philosopher, whose views appeared in the columns of the *Times* last autumn, that when the microscope did not seem to give satisfaction in minute research, imagination might be substituted; and pointed out that this style of philosophy was not new, for it had been put into Hamlet's mouth by Shakespeare :—

Imperial Cæsar, dead, and turned to clay,  
Might stop a hole to keep the wind away."