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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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The Tide-Predicter

MR. EDWARD ROBERTS' letter in NATURE for April 14 contains statements giving an erroneous view of the origin of the tide-predicter. Any one who feels sufficient interest in the subject to derive full information will find it in my paper on "The Tide-Gauge, Tidal Harmonic Analyser, and Tide-Predicter," read before the Institution of Civil Engineers on March 1 and in the abstract of the discussion which followed it, to be published in the *Minutes of the Proceedings* of the Institution (vol. lxxv. sess. 1880-81, part iii.), and he will see that my letter in NATURE of March 31 is correct.

WILLIAM THOMSON

The University, Glasgow, April 16

Geological Relations of Gold in Nova Scotia

IN the notice of the report of Mr. Murray on the gold of Newfoundland (NATURE, vol. xxiii. p. 472) I observe a reference to my own opinion of the age of the gold of Nova Scotia which needs some correction. In the second edition of "Acadian Geology" (1868) the gold-bearing series is included in the Lower Silurian, but this referred to the larger sense of that term in which it was used to include the Cambrian as well. In the third edition (1878, Supplement, pp. 81, 85, 92) I have referred this formation, on the evidence of fossils and stratigraphical position, to the age of the Lower Cambrian or Longmynd series, thus placing it on a lower horizon than the fossiliferous Primordial of Eastern Newfoundland, which I suppose to be of the age of the Acadian or Menevian group. There is therefore little difference between Mr. Murray's estimate of the age of the gold-bearing rocks of Newfoundland and my own of that of the similar rocks in Nova Scotia, except that I presume he would classify the Newfoundland series as Upper Huronian rather than Lower Cambrian. With reference to this I have been disposed to regard Mr. Murray's *Aspidella* slates and the associated rocks as equivalents of the Kewenian or "Upper copper-bearing group" of the West, and probably Upper Huronian, in which case they might be a little below my Nova Scotia Lower Cambrian; but the precise age of both series is determined merely by the fact that they appear to belong to the period between the Huronian proper, or Lower Huronian, and the Acadian group, or Menevian (Etage C. of Barrande).

It is proper to add that in the third edition of "Acadian Geology" I have shown that the filling of the Nova Scotia gold veins is much more recent than the containing rocks, and belongs to the time intervening between the Upper Silurian and the Lower Carboniferous, the richer deposits also appearing to be related to the occurrence of intrusive granites of Devonian age. There is no reason, therefore, other than the mineral character of the containing beds, why such veins might not occur in any rocks older than the Devonian, and gold discoveries have been reported in localities where the rocks are supposed to be Huronian and Silurian; but I have had no opportunity of personally verifying these statements. Thus far the important gold veins are known only in that great series of slates and quartzites of the Atlantic coast which I have referred to the Lower Cambrian.

J. W. DAWSON

McGill College, Montreal, April 4

Symbolical Logic

PROF. JEVONS, in his criticism of my method in NATURE, vol. xxiii. p. 485, has stated the main points at issue between us so fully and clearly, and on the whole so fairly, that I need only say a very few words in reply.

As to the charge that my method is ante-Boolean or anti-Boolean, I do not seek to repel it; on the contrary, I maintain that my method is different from Boole's in principle, and very different indeed in its practical working. The really important questions to be settled are these:

1. Are the definitions which I give of my symbols clear and unambiguous?
2. Are the rules and formulæ which I derive from these definitions correct?
3. Are the innovations which I propose of any practical utility?

Now, I do not think that any one who has read my papers in the *Proceedings* of the London Mathematical Society and my articles in *Mind* and in the *Philosophical Magazine* will refuse to answer *Yes* to questions 1 and 2; and with regard to question

3 I can only say that any one who answers *No* is bound in fairness to prove the inutility of my innovations by solving one or two of my hardest problems without their aid, and in an equally clear and concise manner. My proposal of an amicable contest in the *Educational Times* means nothing more serious than this.

Some of my critics (not including Prof. Jevons however) seem anxious to magnify the points of resemblance between my method and its predecessors, especially Boole's, and to minimise the points of difference. It may be as well therefore to state briefly what characteristics distinguish my method, so far as I know, from all the methods which have preceded it, and what advantages, in my opinion, accompany these characteristics.

In the first place, then, every single letter in my notation, as well as every combination of letters, denotes a *statement*. By this simple device I gain the important advantages of generality of expression and uniformity of interpretation and treatment. It enables me to express many important logical laws in simple and symmetrical formulæ, as, for instance,

$$(A : a) (B : b) (C : c) : (A + B + C : a + b + c),$$

which otherwise could not be so expressed. To secure these advantages I sacrifice absolutely nothing. The relations of classes, including the ordinary syllogisms, I express by speaking throughout of *one individual*, just as mathematicians express the properties of curves, surfaces, and volumes, by speaking throughout of the varying distances of *one representative point*.

My claim to priority on this head has been called in question on the ground that Boole too, in his equations about "secondary propositions," denotes statements by single letters. The plain truth however is that Boole takes some pains to prevent his readers from imagining that he does anything of the kind. He says distinctly, and in perfect consistency with the whole tenor of his book, in which he describes his algebra of logic as a mere offshoot and part of the ordinary algebra of quantity, that in his equations any single letter, such as x , denotes the *portion of time* during which some proposition x is true, the whole universe of time to which the discourse refers being the unit (see "Laws of Thought," from p. 164 to p. 170). Neither will one find anywhere in Boole's work the idea (suggested to me by analytical geometry) of investigating the relations of different classes, while speaking only of *one individual*, and thus dispensing entirely with the quantitative words *all*, *some*, and *none*, which are so characteristic of the old logic.

Another peculiarity of my method is that my symbol of denial (an accent) is made repeatedly to apply to expressions of varying complexity, as, for instance, $(xy)'$, $(x + y)'$, $(x : y)'$, leading to rules and formulæ of operations, to which I find no parallel in any prior symbolic system with which I am acquainted.

Boole uses \bar{x} as an abbreviation for $1 - x$. Let those who insist that Boole's horizontal stroke is exactly equivalent to my accent express in his notation the complex equation

$$(x = y)' = (x : y)' + (y : x),$$

and explain its meaning clearly *without departing from Boole's quantitative interpretation of his symbols*.

Lastly, my symbol \vdash expresses *implication* or *inference*, and does not, therefore, exactly coincide in meaning with Prof. Peirce's symbol of inclusion \subset , as defined by him in his "Logic of Relatives," published in 1870. This symbol of inclusion, as I understand Prof. Peirce's definition of it, is simply equivalent to the words "is not greater than," and is therefore restricted to number and quantity. It is true that Prof. Peirce in his recent memoir on the "Algebra of Logic" extends the meaning of this symbol of inclusion, so as to make it also convey the same meaning as my symbol of implication; but as this memoir was published subsequently to my second and third papers in the *Proceedings* of the Mathematical Society, to which Prof. Peirce explicitly refers in his memoir and accompanying circular note, this later definition does not bear upon the point in discussion.

Prof. Jevons objects to my $\alpha : \beta$ as an abbreviation for $\alpha = \alpha\beta$, because he thinks it obscures the real nature of the reasoning operation. But one might with equal justice object on the same grounds to α^3 as an abbreviation for $\alpha\alpha\alpha$, or to the left side of the equation in the binomial theorem as an abbreviation for the right side. The symbol $\alpha : \beta$ is the exact equivalent of $\alpha = \alpha\beta$, just as $\alpha = \beta$ is the exact equivalent of $(\alpha : \beta) (\beta : \alpha)$, and I do not see that I create any obscurity by adopting in any investigation, and at any stage of the investigation, whatever form seems most suitable for the immediate purpose in view. But whether I am right or wrong in this opinion can only

be decided by actual examination of my published papers on symbolical logic, of which Prof. Jevons has very kindly given in NATURE a full and complete list.

HUGH MACCOLL

73, Rue Siblequin, Boulogne-sur Mer, April 7

Agricultural Communism in Greece

THE article in NATURE, vol. xxiii. p. 525, on Aryan villages and other Asiatic communities reminds me of what I saw in 1843 in the course of a journey through Greece. On St. George's Day, a high festival with the Greek peasants, when crossing the range of Mount Cithæron between Thebes and Eleusis, I saw my companion, who was about half a mile ahead, surrounded by a number of men, and then pulled from his horse. The man we had engaged as interpreter, guide, and protector, the "dragoman," bolted as a matter of course, thinking we had fallen upon a nest of brigands; but when I reached the scene of action I was surprised to find that the yelling and uproar heard in the distance were not murderous nor at all malignant, but purely hilarious. I was dragged from my horse also, and surrounded by about twenty young fellows with shaven heads and long scalp locks, half stripped, half drunk, and very dirty, but perfectly good-humoured.

We were presently made to join in a wild dance, a survival of the Pyrrhic dance of antiquity, which we improved very successfully; my companion, C. M. Clayton, from Delaware, doing a nigger break-down and I the sailor's hornpipe.

On the final arrival of our dragoman we learned that the twenty young men were brothers, and that the old man with long white beard who sat gravely looking on and playing a sort of tom-tom to tune the dance was their father. On our expressing surprise at so large a family of sons being so nearly of the same age he explained that $\delta\epsilon\lambda\phi\acute{o}\varsigma$ did not always signify a blood relation, and that these were merely *agricultural brethren*. They were the united proprietors or renters (I do not remember which) of the adjoining farmhouse and the surrounding land, which they cultivated under the direction of the old man whom they had selected as their father, who was entrusted with the custody and division of their capital and profits, who arbitrated in cases of quarrels, and was otherwise obeyed in most things.

Here was a patriarchal form of communism that we afterwards met with in several other instances, but in this and the other cases it was limited to young unmarried men. There were no women in the dance and none visible on this farm, which was some miles distant from the nearest village, Platea.

At that time the Klephts, or brigands, were united in similar communities, who sternly abjured all communication with the fair sex.

When we had finished our dance and paid for sufficient wine to go round the family circle we found that before going we must kiss all the brothers or give mortal and dangerous offence. Andrew, our dragoman, with the inventive facility of his nation, extricated us from this by solemnly stating that in England it was an established custom to show respect for a family by embracing the father only, and bowing separately to each of the sons.

I am unable to supply any further particulars concerning the internal economy of these communities, cannot say whether they prevail chiefly among the Greeks or the Albanians (the latter constitute a large proportion of the agricultural population of Greece), nor how they dissolve when the brothers become married or the father dies. I have met with no account of them in the course of my reading, but am not at all surprised at this, seeing how profound is our general ignorance of everything pertaining to Greece, an ignorance which is most glaringly displayed by political writers and others, who speak of Athens as though it were Greece, and of Athenian proceedings as though they were the action of the Greeks.

But for the accident of this rather startling festive encounter with these brethren on this particular holiday, we might have travelled for weeks without meeting any visible indications of such fraternities. We should have passed the brothers if they were working in the fields, and the patriarch had been sitting alone at the farmhouse door, without special notice. It was only after our curiosity had been excited that we discovered other patriarchs and other brethren by special inquiry where their existence was vaguely indicated.

Among the readers of NATURE there may be some who have sufficient acquaintance with the Greek people, outside of Athens, to be able to supply interesting particulars concerning these

curious communities. They may be survivals of our ancient communism, or a modern device for mutual protection forced upon the rural population by the absence of any enforcement of law and social order by those who consume the taxes in Athens.

W. MATTIEU WILLIAMS

Heat of Stellar Masses

I SEND you a working hypothesis which I think will well pay for its place in the world. It is as to the heat of large stellar masses; that the imperfect conduction of the kinetic force producing gravitation through large stellar masses causes heat in them.

The quantity of heat stored up may depend partly on the proportion of mass to radiating power, and partly, perhaps, on the condition of the mass for such conduction.

Washington, D. C., March 25

SAML. J. WALLACE

Shadows Cast by Venus

ON March 21 last, about 8 p.m., I was walking among some trees by a river's bank. The ground was covered with recently-fallen snow, and the shadows of the trees were unmistakably, though faintly, traceable on the white surface. The night was dark and the shadows were thrown by Venus, which was shining with unusual brilliancy. I believe this obvious form of the phenomenon is not a common one in our latitude.

CHAS. T. WHITMELL

31, Havelock Street, Sheffield, April 18

The Sparrow and Division of Labour

THE following curious fact may possibly interest your ornithological readers:—Last year and the year previous two pairs of swallows made their nests and successfully reared their broods under the eaves of my house. Within the past fortnight a brace of astute London sparrows have apparently recognised the principle of division of labour as applicable to their requirements in the art of nest-building. They have selected the largest and most substantial of the swallows' nests referred to; and, after devoting a day or two, on starting on their enterprise, to the enlargement of the entrance hole, which was probably too narrow for them, have constructed their bed within of bits of grass and feathers in the usual fashion. They are now enjoying their honeymoon in their new quarters.

G. C. WALLICH

3, Christchurch Road, Roupell Park, April 11

SIR PHILIP DE MALPAS GREY EGERTON, M.P., F.R.S.

IN Sir Philip Egerton geologists have lost one of that band of workers who placed their science upon the footing which it now occupies in this country. Unfortunately that band has been of late years greatly diminished by death. Born in 1807, Sir Philip Egerton with his old friend and fellow-worker, Lord Cole (now the Earl of Enniskillen), while still at Oxford commenced the collection of fossils, and very soon their attention was especially directed to fossil fish, of which but very little was at that time known. As specimens of this group of organisms often occur in duplicate, the individuals breaking across so that two opposite slabs each contain one-half, the two friends agreed to share their spoils, and thus both collections were enriched. When in 1840 Agassiz visited this country, intent upon his great ichthyological memoirs, he found in the museums of Sir Philip Egerton and Lord Cole an abundance of materials ready to his hand. The specimens were carefully figured, and descriptions of them included in the several great works which Agassiz successively issued. The original drawings by Dinkel are now among the archives of the Geological Society. But Sir Philip Egerton was by no means merely a collector of fossils, he was a very diligent and successful student of ichthyology. Many valuable papers on fossil fishes were written by him at different times, and a series