nate variation is permitted. Thus, the selective premium upon variation 99 being no greater than that upon 98, 98 would have as good a chance of leaving offspring (which would inherit and transmit this variation) as would 99: similarly, 97 would have as good a chance as 98, and so on. Now there is thus a much greater chance of variations being perpetuated at or below 99, than at or above 100; for at 100 the hard line of Selection (or Economy) is fixed, while there is no corresponding line below 100. The consequence of free intercrossing would therefore be to reduce the average from 100 to 99. Simultaneously, however, with this reducing process, other variations would be surviving below 99, in greater numbers than above 99; consequently the average would next become reduced to 98. There would thus be "two operations going on side by side—the one ever destroying the symmetry of distribution" round the average, "and the other ever tending to restore it." It is evident, however, that the more the average is reduced by this process of indiscriminate variation, the less chance there remains for its further reduction. When, for instance, it falls to 90, there are (numerically, though not actually, because of Inheritance) 89 to 9 in favour of diminution; but, when it falls to 80, there are only 79 to 19 in such favour. Thus (theoretically) the average would continue to diminish at a slower and slower rate, until it comes to 50, where, the chances in favour of increase and of diminution being equal, it would remain stationary.

Having thus, for the sake of clearness, considered this principle apart, let us now observe the effect of superadding to it the influence of the Economy of Growth—a principle with which its action must always be associated. Briefly, as this influence would be that of continually favouring the variations on the side of diminution, the effect of its presence would be that of continuously preventing the average from becoming fixed at 50, 40, 30, &c. In other words, the "hard line of Selection," which was originally placed at 100, would now become progressively lowered through 90, 80, 70, &c.; always allowing indiscriminate variation below the barrier, but never above it.

It will be understood that by "cessation of selection from changed conditions of life" I mean a change of *any kind* which renders the affected organ superfluous. Take, for example, the exact converse of Mr. George Darwin's illustration, by supposing a herd of cattle to migrate from a small tract of poor pasture to a large tract of rich. Segregation would ensue, the law of battle would become less severe, while variation would be promoted in a cumulative manner by the increase of food. The young males with shorter horns would thus have as good a chance of leaving progeny as "their longer-horned brothers," and the average length would gradually diminish as in the other case. Of course, as the predisposing cause of impoverished nutrition would now be absent, the reducing process would take place at a slower rate. Moreover, it is to be remarked that this principle differs in an important particular from that enunciated by Mr. Darwin, in that it could never reduce an organ much below the point at which the Economy of Growth (together with Disuse) ceases to act. For, returning to our numerical illustration, suppose this point to be 6, the average would eventually become fixed at 3.

That the principle thus explained has a real existence we may safely conclude, theoretical considerations apart, from the analogy afforded by our domestic races; for nothing is more certain to breeders than the fact that neglect causes degeneration, even though the strain be kept isolated. It will be observed that, if this principle has a real existence, it is of considerable importance, theoretically, since it must act, to a greater or less extent, in all cases where Disuse and the Economy of Growth are in operation; and although in the initial stages of reduction, when the purchase, so to speak, of the last-named principle is great, its influence would be comparatively trivial, this influence would be more and more felt the smaller the organ became—i.e., the nearer the point at which the Economy of Growth ceases to act. The Cessation of Selection should therefore be regarded as a reducing cause, which co-operates with other reducing causes in all cases, and which is of special importance as an accelerating agent when the influence of the latter becomes feeble.

GEORGE J. ROMANES

Lakes with two Outfalls

ON June 22, 1863, the late Captain Speke published his map, giving (on native authority) four outlets from Lake Victoria Nyanza, converging to one valley or water-flow—the Nile.

On June 27 and on July 20 I wrote to the *Athenæum*:—"I think that this native information will prove to be erroneous;" that I thought "that no lake can have more than one outlet;" and I added, "May I lay the question as to the matter of fact before the readers of the *Athenæum*?" In reply, the Black Loch in Dumfriesshire was stated to have two outlets to two distinct valleys or water-flows—one to the Nith, the other to the Ayr. The Loch, however, has but one outlet, and that artificial. The water-parting has been cut through by man—a mill-lead made to Lord Bute's Borland mill, and the one outlet is an iron sluice in a stone dam. All this is beautifully shown in Sir Henry James's admirable 25-inch Ordnance Maps.

Dr. Bryce ("Geology of Arran," 3rd edition, p. 3) says that Loch-an-Davie has two outlets to two different valleys. It has, however, but one outlet, to the south—to Glen Iorsa, as I stated in the *Athenæum*, July 22, 1865. The new inch Ordnance Map of Arran gives one outlet, but unfortunately to the north, instead of to the south. I will not refer to my letter on the two outlets to two valleys from the Norwegian Lesjeskaugen Lake, which you did me the honour to publish last September, and with which Prof. Stanley Jevois agreed. But I quote the above cases to show that even the highest authorities make mistakes as regards lakes and their outlets. I cannot, however, suppose any mistake in Prof. Bell's account of the two outlets to two valleys from Shoal Lake, published in *NATURE*, vol. ix. p. 363, by Prof. Dawson. I would then, in deference to these authorities, modify my dictum by saying, that if by a rare possibility a lake may be found to exist on a water-parting having at opposite ends two outlets to two different valleys, I should still doubt the possibility of a lake at its one lower end having a multiplicity of outlets converging to one valley or water-flow, as in the case of the Victoria Nyanza. And this owing to the extreme improbability that the erosion at each outlet should continue at precisely the same rate.

The outlet of every lake in the wide, wide world is always being lowered from erosion, as are valleys themselves. Valleys exist only in the dissolution of hills. They are mere water-flows. They are the perpetually changing effects of atmospheric disintegration, and the erosion of rain and rivers, and consequently every water-parting is a valley-parting.

Alresford, March 14

GEORGE GREENWOOD

A Beech pierced by a Thorn Plant

ON the road from this to Belfast there is a thorn hedge with beech trees at intervals, and thorn plants have grown right through the middle of the trunks of two of the beeches. I do not know whether this is sufficiently uncommon to be worth mentioning in *NATURE*.

Old Forge, Dunmurry, co. Antrim

JOSEPH JOHN MURPHY

KINETIC THEORY OF THE DISSIPATION OF ENERGY

IN abstract dynamics an instantaneous reversal of the motion of every moving particle of a system causes the system to move backwards, each particle of it along its old path, and at the same speed as before when again in the same position—that is to say, in mathematical language, any solution remains a solution when t is changed into $-t$. In physical dynamics, this simple and perfect reversibility fails on account of forces depending on friction of solids; imperfect fluidity of fluids; imperfect elasticity of solids; inequalities of temperature and consequent conduction of heat produced by stresses in solids and fluids; imperfect magnetic retentiveness; residual electric polarisation of dielectrics; generation of heat by electric currents induced by motion; diffusion of fluids, solution of solids in fluids, and other chemical changes; and absorption of radiant heat and light. Consideration of these agencies in connection with the all-pervading law of the conservation of energy proved for them by Joule, led me twenty-three years ago to the theory of the dissipation of energy, which I communicated first to the Royal Society of Edinburgh in 1852, in a paper entitled