metals, and concludes by dealing with the behaviour and action of the larger machine tools, including planing, shaping, and slotting machines, all of which are illustrated.

The following chapters go fully and minutely into the construction and working of the lathe, perhaps the most important of all the machines in a workshop; describe its various uses, both for hand-turning and wood, and the mechanical slide-rest for metals. A screw-cutting and surfacing lathe is illustrated, and all its different motions explained. It is impossible here to do justice to these chapters on the lathe and turning in general. The student will find the time well employed if he studies them carefully, the author evidently being well acquainted with the practical working of this all-important machine.

The remaining chapters are occupied with drilling, boring, and the necessary machines for carrying out the same; a variety of drills are shown, and their different uses explained. The drilling machine, its construction, and various arrangements of feed gear are illustrated and concisely shown.

The book concludes with shearing and punching machines. Various illustrations are given, including Whitworth's driving gear for the same, and an illustration of Tweddle's hydraulic shearing and punching machine.

As a treatise on cutting-tools, for wood and iron, this work will be found extremely useful to engineers generally; moreover, there is a good deal of original information that will be found interesting to experienced toolmakers. The classification of the machinery is decidedly good, and the descriptions are so simple as to be easily understood by the uninitiated. It is impossible to study the book without at once finding that the author is completely master of his subject. Of course there is no doubt that practical working is essential to perfection in any branch of engineering; yet the student who is unable to attain such practical knowledge will obtain a good insight into the construction and the uses of the various machines and tools in their connection.

The author certainly seems to have omitted a matter of great importance in tool-making, namely, that of tempering and hardening the cutting-tools. There is little doubt that most of the failures arising in wood and iron-working machinery are due to tools not being properly hardened. A chapter or two devoted to the subject would have been of great service.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Metamorphic Origin of Granite.—Prehistoric "Giants"

I HAVE for some time intended to send you a few notes on two matters, both connected with geology, though very different in kind. In NATURE, vol. xxvii. p. 121, there was an interesting paper by Mr. Geikie on the metamorphic origin of granite and on the crystalline schists. Last autumn I became satisfied of a conclusion which I had long suspected—that the large granitic district in the Ross of Mull, adjacent to the Island of Iona, is a great mass of granite formed by the metamorphism of an old stratified deposit belonging to crystalline schists. It is well known to geologists that the Isle of Mull consists almost entirely of the series of (Tertiary) volcanic rocks which have been admirably described by Prof. Judd. These traps, tuffs, and lavas rest in some places on chalk, and where the chalk had been previously denuded they rest on Oolitic and Liassic beds. Older rocks, belonging, I think, to the Cambrian series, appear at one place subjacent to the traps. But the limit of all these volcanic rocks to the south-west is sharply defined by the deep bay and harbour of Bunessan, called Loch Laigh. As we enter that loch in a boat, we have on our left the trap headland of Ardtun, where I found the Tertiary leaf-bed many years ago, and on the right a headland of massive red granite. But the shores at the end or head of the bay, including all the hills above the village of Bunessan, are neither trap nor granite, but are composed of the regular crystalline mica schists which constitute the great bulk of the county of Argyll. This is the only part of Mull, so far as I know, where these rocks appear. They stretch right across the long promontory of the Ross to the southern shore. At the head of Loch Laigh they are more highly crystalline than in most parts of the mainland of the county. Very fine crystals of tourmaline have been found above Bunessan, and the schists near the new pier are highly micaceous and in some places full of coarse garnets. These schists dip at a high angle, and indeed are in some places nearly perpendicular. On the southern coast of the promontory (which is here very narrow) they occupy a considerable space between the traps which terminate on the farm of Scoor, and the granite which begins on the farm of Ardalanish. The point of contact between these schists and the granite is obscured at the head of Loch Laigh, and I have not visited it on the southern shore. But the point of most interest will be found in the granitic headland which forms the south-western shore of Loch Laigh. Along part of this shore the granitic masses at the top of the hill have all the appearance of standing upon legs. These legs at a little distance seem granitic, and although they have a suspicious appearance of tilted strata, I had passed them over and over again under a general impression that they were nothing but granite divided by unusually narrow lines of cleavage. On examining them, however, carefully, in August, 1882, I found that they are (in my judgment) beyond all doubt crystalline bedded schists exhibiting the phenomena of metamorphism in the most curious and instructive form. The metamorphic action has often segregated the mineral constituents of the old sedimentary rock in bands transverse to the line of bedding, so that in one stratum we have bands of pure quartzite and of hornblende gneiss, between bands of granitoid and of pure granitic composition. These beds pass up without a break into the amorphous granite of the great bulk of the hill; and how pure and typical that granite will be acknowledged when I add that the columns of the memorial to the Prince Consort in Hyde Park are made of it. Since discovering this passage I have found some other spots on the coast where the relation of the two rocks to each other is well seen. The best is on the deeply indented shore of the farm of *Knockvoligan*, behind the Island of "Gilan Giraid," on which the Northern Light Commissioners have placed their establishment in the Sound of Iona. Boats can be hired at Iona, and at high tide there is a beautiful passage behind Gilan Giraid to the shore I refer to. There a dark hornblendic gneiss will be seen underlying, involved in, and passing into granite in every form of complication and variety. An interesting question arises as to the horizon to which this hornblendic rock belongs. As Iona belongs unquestionably, as I believe, to the Laurentian series, and the Bunessan schists to the metamorphosed Silurian, the sub-granite gneiss which intervenes may be assigned to either the one or the other. My impression is that it represents some of those gneissose beds of the Silurian series which are highly developed in Sutherland, and lie high above the "fundamental" or Laurentian gneiss, so well known in that county. I should be very glad if some competent geologist could investigate this district of the Ross of Mull, and could confirm or check my observations.

Turning now to the other subject, I have been surprised to see in the English scientific journals no notice taken of the very remarkable discovery reported from the Californian Academy of Science in a paper communicated to that body by Charles Drayton Gibbs, C.E., on the discovery of a great number of (apparently) human footprints of a gigantic size in the State of Nevada. It appears that in building the State Prison, near Carson City, the capital of that State, there was occasion to cut into a rock composed of alternate layers of sandstone and clay.

On several of the clay floors exposed in this operation great numbers of tracks of all sorts of animals have been exposed. These tracks include footprints of the mammoth or of some animal like it, of some smaller quadrupeds apparently canine and feline, and of numerous birds. Associated with these are repeated tracks of footsteps, which all who have seen are agreed can

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be the footsteps of no other animal than man, and the engravings and photographs which accompany the paper leave no doubt on the mind of any one who sees them. The most remarkable circumstance characterising them is their great size. In one case there are thirteen footprints measuring 19 inches in length by 8 inches wide at the ball, and 6 inches at the heel. In another case the footprints are 21 inches long by 7 inches wide. There are others of a smaller size, possibly those of women. One track has fourteen footprints 18 inches long. The distance between the footprints constituting a "step" varies from 3 feet 3 inches to 2 feet 3 inches and 2 feet 8 inches, whilst the distance between the consecutive prints of the *same foot* constituting a "pace" varies from 6 feet 6 inches to 4 feet 6 inches. In none of the footprints of the deposit are the toes or claws of animals marked. As regards the beasts, this is probably due to the "slushy" state of the mud when the tracks were made. But in the case of the human footprints it is probably due to the use of some kind of shoe or mocassin.

I need not say that so far as the geological horizon is concerned this discovery does not carry the existence of man beyond the Quaternary Mammalia, with which it has long been pretty clear that he was associated in prehistoric times. Nevertheless it is, if confirmed, a highly remarkable discovery, especially as connected with the curious intimation so concisely made in the Jewish Scriptures, "And there were giants in those days." Hitherto, so far as I know, the remains of prehistoric man, so far as hitherto discovered, have not revealed anything abnormal in point of size. It is just possible that the slippery and yielding nature of the muddy lacustrine shore on which the tracks were made may have partly occasioned the apparent size. But the photographs and engravings exhibit them as very sharp and "clean cut." Professional Indian trackers have been employed to examine the tracks, and none of them seem to have the smallest doubt as to the footprints being human. ARGYLL

Cannes, April 14

P.S.—The paper was sent to me by my son, the Governor-General of Canada, a few weeks ago.

"The Ether and its Functions"

IN NATURE, vol. xxvii. pp. 304, 328, is a reprint of a lecture delivered by Dr. Oliver Lodge in December 28, 1882, at the London Institution, on "The Ether and its Functions." As this happens to be a subject to which I have devoted special attention, I would beg to offer a few remarks, also as my name is alluded to in the article.

The repudiation of the assumption of "action at a distance" in the first part of the lecture, coupled with the ingenious arguments by which its baselessness is exhibited, will no doubt be encouraging to all those who favour the advance of knowledge. But that portion of the lecture dealing with the constitution of the ether (and which assumes it to be non-molecular) is to my mind disappointing, as it looks like a step backwards to suppose the ether to be something essentially different from ordinary matter, while on all sides the simple opinion of the "unity of matter" has been making progress. I will quote the passage more especially relating to this point, viz. :—

"As far as we know, it (the ether) appears to be a perfectly homogeneous incompressible continuous body, incapable of being resolved into simple elements or atoms; it is in fact continuous, not molecular. There is no other body of which we can say this, and hence the properties of ether must be somewhat different from those of ordinary matter" (p. 305).

It will be admitted that clearness is a first desideratum in a theory. It appears difficult to see how an "*incompressible*" body is to transmit waves.[1] A remark of Maxwell's in his paper "On the Dynamical Theory of Gases" has some bearing on this point, viz. : "The properties of a body supposed to be a uniform plenum [*i.e.* not molecular] may be affirmed dogmatically, but cannot be explained mathematically" (*Phil. Trans.*, 1867, p. 49). Moreover, it seems hard to reconcile the fact that Sir W. Thomson's theory of the constitution of matter is apparently adopted or favoured in the lecture, and yet at the same time the molecular or atomic nature of the ether is repudiated. But is not Sir W. Thomson's theory of matter essentially an atomic theory? The incompressible fluid outside the vortex atoms cannot serve as the ether, or this seems an impossibility. Maxwell, for example, remarks in relation to this point, viz. : "The primitive fluid [*i.e.* the fluid exterior to the atoms] entirely eludes our perceptions"[1] (see "Encyc. Brit.," article "Atom," p. 45). The ether, however, does not entirely elude our perceptions, but is very distinctly felt in the beating of the waves of light upon the eye. It appears, therefore, that if the ether is to affect the senses at all it must consist of atoms or molecules (doubtless very much smaller than those of gross matter, a difference in *degree* but not a difference in *kind*). It may be noted in passing here how often notoriously has the error of mistaking a mere difference in *degree* for a difference in *kind or essence* been made in the history of science, and the correction of this error with the correlation and simplication of views attendant on its removal marks one of the chief stages of our progress. The theory of evolution abolished this error in regard to the animal world; its abolition in regard to the universe of matter is equally demanded. One satisfaction that Sir W. Thomson's theory of matter brings, consists perhaps in the fact that it does not overthrow our old conceptions as to the atomic constitution of matter so firmly built up by the able reasoners of the past, including Lucretius and Newton—and which has produced such great results for science. The Thomsonian view goes rather to confirm the atomic theory and to establish its truth by explaining in addition how an atom can be *elastic* and yet indestructible. Let us not deviate from the well-tried ground of the atomic constitution of matter, already won with so much labour, unless we are forced to do so, and let us work towards the great generalisation of the Unity of Matter and of Energy.

London, April S. TOLVER PRESTON

P.S.—My views regarding the Matter of Space (the result of many years of thought and study) are contained in various scattered papers, references to the chief of which may be conveniently given here, viz. *Philosophical Magazine*, September and November, 1877, February, 1878; NATURE, January 15,[2] 1880; March 17, 1881; March 20, 1879; *Philosophical Magazine*, August, 1879, November, 1880; April and May, 1880, &c., &c. Also a little book, "Physics of the Ether" (E. and F. N. Spon), was published in 1875 as a first imperfect essay on the subject. The above papers include an atomic theory of the ether, capable of affording a simple and natural explanation of gravitation without the aid of "ultramundane corpuscules" [*i.e.* without the supply of any energy or matter at all from outside the bounds of the visible universe]. Dr. Lodge seems to admit that his premises cannot explain gravitation. But is not the elucidation of gravitation (which may be called the primary physical effect in the universe) one of the first requirements of any theory of the constitution of the Matter of Space? A more concise summary of my views (with additions and developments, the work of recent years) regarding the relations of the Matter of Space to ordinary matter and to the local fluctuating changes taking place in the universe, may be found in the forthcoming volume of the *Transactions of the Vienna Academy of Sciences*, to which they have been communicated by Prof. Ludwig Boltzmann of Graz.

"Krao"

SOME two months ago there appeared in NATURE (vol. xxvii. p. 245) certain statements about "Krao," the Siamese hairy child, which with your leave I would venture to correct. Krao's parents are both Siamese, not Laos; they are both still living in this city; neither of them presents any special peculiarity; they have other children still living, and also showing no special peculiarities; Krao, it is true, was not born in Bangkok, but in a village between this and the sea, her parents having a little time before her birth run away from their master, but coming back after the event. Siamese is of course Krao's native language;

[1] For it seems apparent that an incompressible, non-molecular, "frictionless" liquid could not have wave-energy imparted to it at all, or a hot substance could not emit light or heat in such a medium. Moreover let us (in a spirit of fair argument) take a representation of one of the most commonplace effects in physics, say an explosion of gunpowder. Then the assumption of "action at a distance" being rejected, there is (admittedly) no more playful building of castles in the air out of "force," or no store of phantom energy to get the motion ("explosion") from. The motion therefore must inevitably come from the matter of space, or from a set of particles or atoms already in motion in space in their normal state. How is a non-molecular, *frictionless* liquid to lay hold (as it were) or act upon the molecules of gunpowder and put them in motion? Is not the objection conclusive though elementary?

[1] A clear and able exposition of the relation of Sir W. Thomson's theory of matter to the old-established atomic theory may be found in a paper on "The Atomic Theory of Lucretius," by an anonymous author in the *North British Review* for March, 1868.

[2] This paper includes a corpuscular theory of light consistent with the main principles of the undulatory theory—*not* therefore an *emission* theory.

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