

conversely that every possible free motion about its centre of gravity of every such solid admits of being so represented.

To revert for an instant to the general question of the representative rolling ellipsoid, I think it must be admitted that the addition of the time element to the theory and the substitution of a second fixed plane in lieu of a fixed centre, considerably enhance the value and give an unexpected roundness and completeness to Poinso's image of the free motion of rotation of a rigid body, of which so much and not altogether undeservedly has been made. From an idea or shadow Poinso's representation has now become a corporeal fact and reality, as if, so to say, Ixion's cloud, in the moment of fruition, had substantiated into a living Juno. I heard the late Professor Donkin, of revered and ever-to-be-cherished memory, state that when as a referee of the Royal Society he first took in hand my paper on rotation, he did so with a conviction that all had already been said that could be said on the subject, and that it was a closed question; but that when he laid down the memoir he saw reason to change his opinion. I owe my thanks to M. Radau and the editors of the *Annals of the Ecole Normale Supérieure* for having been at the pains to disintomb the little-known conclusions therein contained from their honourable place of sepulture in the *Philosophical Transactions*.

J. J. SYLVESTER

K House, Woolwich Common, April 2

The Principle of the Conservation of Force and Mr. Mill's System of Logic

WILL you permit me briefly to point out, what has not, as far as I am aware, been yet noticed—the very important modifications of the logical theory of induction resulting from the consideration in reference thereto of the physical theory of the correlation of forces?

As I believe the subject is now more ripe for discussion than it was when, some dozen years ago, I first began to work out the bearings of the higher results of physical research on the general theory of causation, logical, and metaphysical; the following questions which, in the course of a correspondence on this subject, I submitted to Mr. Mill so long ago as 1863, may, perhaps, contain suggestions of thought not unwelcome to some students of NATURE.

"How then," I wrote, "do our new views of force affect the established theory of causation? Now I would rather, if you will allow me, submit the whole subject interrogatively to you, than give dogmatically my own thoughts. And, more particularly, allow me to submit to you these two questions—1st, Whether the physical theory of transformation (and identity) does not necessitate all such logical changes of expression, at least, as may be implied in the abolition of the conceptions of 'permanent causes,' and of 'kinds,' as real and absolute existences? And, 2ndly, whether—'if, as I have endeavoured to show, the inductive facts on which are based the principles of conservation and correlation lead to such a more general principle as may be thus expressed, *every existence has a determined and determining co-existence*—whether, I say, 'we are not justified in enunciating such a principle as the complement of that fundamental axiom of our present logic, 'every effect has a cause'?"

I believe I am at liberty to say that, though affirmative answers to these questions would necessitate very important changes in the "system of logic, inductive and ratiocinative," Mr. Mill, as to the first, admitted the necessity of certain changes of expression, at least, and generously encouraged me in the prosecution of the researches indicated by the second question.

Of the results of these researches I shall here only say that, as the axiom, "every effect has a cause," is the foundation of a logic which must be distinguished as a *logic of sequence*, the new axiom above stated may be shown to be the basis of a *logic of co-existence*, of which *Geometry* appears as an example. But as to this, as to the conception of force implied in this idea of co-existence, and as to the bearing of this new conception of force on the speculations with regard to space of a fourth dimension, perhaps I may have another opportunity of addressing you.

J. S. STUART GLENNIE

Athenæum Club, March 30

Dust and Germs of Life

PROF. TYNDALL'S exceedingly interesting article in No. 20 of NATURE seems to me to leave unexplained a fact very

familiar to naturalists. It is well known that collections of natural history, say a Herbarium or an Entomological cabinet, will, if left undisturbed for a number of years, and unpoisoned, become infested with animal life, chiefly Acari and larvæ of Coleoptera; and that the surest way of preventing such attacks is thorough ventilation. Now if the floating matter in the air settles so readily after only a few days' stillness, as Prof. Tyndall's experiments seem to indicate, and does not even enter into an uncorked flask, it is out of the question that it can penetrate through the keyholes or chinks of our cabinets. Setting aside the theory of spontaneous generation, we are then forced to the conclusion that this life must arise from germs already existing in the specimens when they are preserved, or in the very limited amount of atmosphere originally confined in the cabinet. Is either of these explanations tenable? A strong argument against the former alternative seems presented by the fact that, as far as I am aware, the same species of *Acarus* infests plants in a Herbarium brought from the most widely diverse localities, an inland meadow or the seashore, the plains of England or the Alps of Switzerland. Can any of your physiological readers throw light on this subject?

F. L. S.

Catkins of the Hazel

WHILE looking at some hazel bushes to-day, I noticed that where the red tuft of stigmas was protruded, the male catkins adjacent on the same twig were immature; while, on the other hand the stigmas had fallen, and the fruit was already swelling, where the scales of the male flowers were open to show the stamens.

A week or two back (in another locality) I could not find a single female catkin which had not lost its stigmas; while nearly all the male catkins had opened, and many had shed their pollen.

Is this always the case with the hazel? If so, it would be a striking illustration of Darwin's aphorism, "Nature abhors perpetual self-fertilisation."

I ought to add, that my observations are not confirmed by the illustrations in the books to which I have access, namely, Balfour's "Class Book," Lindley's "School Botany," and Lemaout and Decaisnes' "Traité de Botanique." In all these, a female catkin with its tuft of stigmas is represented on the same twig as a bunch of fully developed male catkins.

Will some one of greater experience inform me if I am in error as to the above facts?

MARCUS M. HARTOG

University College, London, March 24

ANCIENT BRITISH LONG BARROWS

II.

THE chambered long barrows of North Wilts, Somerset, and Gloucestershire differ, as a rule, but slightly in external form from the simple or unchambered long barrows of South Wilts and Dorset. They are, however, generally of somewhat smaller dimensions, being from about 120 to 200 feet in length and from 30 to 60 feet in breadth. The side ditches characteristic of the unchambered barrows are seldom to be met with, but the margin of the grave-mound is, or rather was, usually defined by a low wall, built of loose tile-shaped fragments of oolitic stone. In some cases, as at West Kennet (see fig. 1), there is good evidence that the mound was originally surrounded by a series of obelisks of sarsen stone, the intervals being filled up with the usual dry walling just described. Sometimes, too, large monoliths or triliths are found at the broad end of the tumulus. As regards orientation, or position in reference to the points of the compass, the direction of east and west commonly observed in the simple barrows prevails in four out of five cases with the chambered barrows; and as in the former class of monument the interments were at the eastern end, which is also the higher and broader, so likewise do we find that the stone chambers or cists occupy the same position in the chambered barrows.

In internal structure the chambered barrows exhibit many varieties, but three principal types are recognised by Dr. Thurnam, viz.—(1) those in which the chamber

opens into a central passage or covered way; (2) those with chambers opening externally; (3) those containing cists instead of chambers. The essential distinction between a chamber and a cist is, that the former is entered by a lateral aperture, whilst a cist can only be opened by removing the covering stone from above. The views and plan in figs. 4 and 5 of the chamber and gallery of the great tumulus at West Kennet already alluded to will show the reader at a glance the nature of the simpler specimens of the first and most characteristic type of structure. It is only necessary to add that the West Kennet chamber was covered by three very large blocks of sarsen stone, and that its dimensions were as follows: length 8 feet, breadth 9 feet, height 8 feet. Some of the barrows of the first type—as, for example, those of Stoney Littleton and Uley—are of much more complicated internal structure than that of West Kennet; but they all possess in some form or other the central gallery or avenue,

Every one familiar with the surface geology of the two districts will, however, at once admit the validity of Sir Richard Hoare's statement, that the absence of the stone structures in the South Wiltshire long barrows is simply due to the want of the necessary material. Referring in connection with this subject to the South Wiltshire Downs, Dr. Thurnam writes:—"Scattered blocks of silicious grit or sarsen stone are indeed found here and there on the surface, but they are neither numerous nor large enough for this purpose. In North Wiltshire and the adjacent part of Berkshire the case is different, and sarsen stones of large dimensions and in great numbers are found in the hollows of the higher chalk downs. From these were derived the immense stones of the circles and avenues of Avebury; and as most geologists and antiquaries believe, those out of which the great trilithons, and mortised uprights and imposts of Stonehenge itself, in South Wilts, were formed."

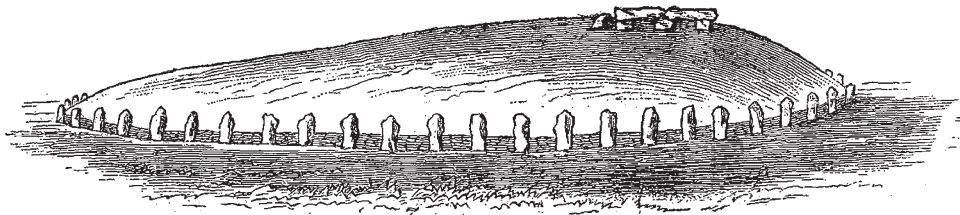


FIG. 1.—LONG BARROW AT WEST KENNET (PERISTALITHS AND WALLING RESTORED)

ingeniously supposed by Nilsson to be the homologue of the passages to the caverns which probably served as the first dwelling-places of man.

It must not be supposed that chambered barrows are confined to North Wilts, Somerset, and Gloucestershire; but those in distant counties appear to differ from

The implements and pottery of the chambered barrows agree very closely with the specimens derived from the simple earthen tumuli. The infrequency and rude character of these objects, especially when compared with the comparatively abundant and highly-finished weapons and tools yielded by the chambered tumuli of Scandinavia

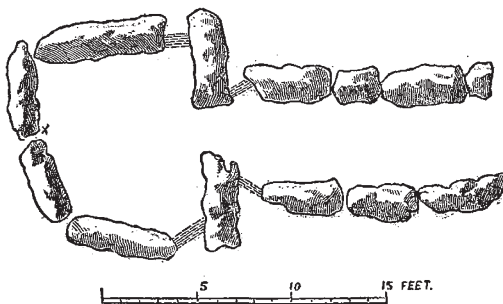


FIG. 2.—PLAN OF CHAMBER AND GALLERY

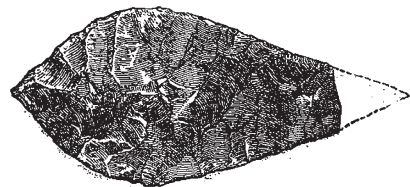


FIG. 3.—FROM FYFIELD LONG BARROW

those of the districts above referred to in certain respects, and especially in being usually circular in form. The sepulchral stone chamber, universally known under the name of "Wayland's Smithy," though situated in Berkshire, is close to the confines of North Wilts, and was originally covered by a true long barrow. Dr. Thurnam surmises that the barrow was removed, or at least the chamber disclosed, at an early date, as he finds that the name "Welandes Smiththan" was applied to it so long ago as the middle of the tenth century, a name very unlikely to have been used so long as the barrow was intact.

It might seem at first sight that the presence of megalithic chambers in the tumuli of North Wilts, Somerset, and Gloucestershire is a characteristic which entirely differentiates them from the simple earth mounds of South Wilts, and that we should be warranted in assigning the two classes of monuments to different peoples, or at all events to different stages in the history of the same people.

and Brittany, are sufficiently remarkable. Perhaps the fact that our chambered barrows have been so generally searched by treasure-hunters in various ages may serve to some extent to explain the almost entire absence of polished stone implements. Such objects would probably have attracted the attention of persons of that class; the ruder objects, having no value in their eyes, would be left in the tombs. The delicate leaf-shaped arrowheads alluded to in our former article as found in unchambered tumuli also occur, though rarely, in the chambered barrows. Fig. 3 will show that the manufacturers (whoever they may have been) of these weapons were possessed of no mean skill in the fashioning of flint; and it may perhaps be allowable to infer from the rarity and perfection of these objects, as contrasted with others obtained from long barrows, that they were obtained from tribes in a somewhat more advanced stage of civilisation. It is a singular circumstance that all the leaf-shaped arrowheads have

one or both ends broken off. The breaking of the point of the dead warrior's spear was probably a solemn ceremony, and contrasts agreeably with repulsive funereal practices to which we shall presently refer.

The bones and teeth of animals apparently used for food, are found in considerable numbers. The remains of *Bos longifrons* and *Cervus elaphus* are, however, less frequent than in the unchambered barrows, whilst those of the wild boar are much more abundant.

We have already in our first article alluded to the important evidence which the critical study of the human remains from the long barrows is calculated to afford us, but in our remarks thus far we have purposely refrained from entering into the details of this subject. Although certain of the chambered barrows have afforded numerous skeletons, these monuments have been so frequently disturbed by treasure-seekers in bygone times, that our information as to the mode of interment is not so satis-

endorses Mr. Greenwell's opinion on this point in the following words: "Altogether I see no difficulty in acceding to the conclusion of Mr. Greenwell, that in the disjointed, cleft, and broken condition of the human bones in many of the long barrows, and especially in those examined by him at Scamridge, near Eberstone, and near Rudstone, Yorkshire, we have indications of funereal feasts, where slaves, captives, and others were slain and eaten."

In a large proportion of the long barrows of the South-West of England, many of the skulls have been found to be split open apparently by some such weapon as a stone axe. The sharpness of the fracture seems to leave no doubt that the injuries were inflicted during life, or at all events before burial. It is inferred from the frequency of these cleft skulls, and the direction in which they are split, that they are those of victims immolated at the burial of a chief. Sometimes one skull is found uninjured



FIG. 4.—VIEW IN THE CHAMBER, LOOKING THROUGH THE ENTRANCE



FIG. 5.—GALLERY LOOKING TOWARDS THE CHAMBER

factory as could be wished. There seems, however, to be little doubt that the bodies were placed round the walls of the chambers in a crouching or squatting posture, a favourite attitude for the dead both among early races and existing savages. The primary interments in the simple unchambered barrows consist either of a single or two separate skeletons, or of a number of bones promiscuously interred. In the latter case the bones are frequently found huddled together in so narrow a compass as to preclude the idea of the corpses having been buried entire. This is most reasonably accounted for by the practice known to prevail among savage races of burying the dead in or near their huts, and subsequently disinterring the bones for the purpose of burying them in the cemetery of the tribe. Canon Greenwell, so well known for his explorations in the Wolds of Yorkshire, thinks that some of the bones from long barrows examined by him indicate the horrible practice of cannibalism. Dr. Thurnam

while all the others are injured. In the light of what has come down to us from classical writers of the customs of Western Europeans at the beginning of our era, we see no reason to doubt Dr. Thurnam's conclusions on this point, although we should have liked to have more precise information of the relative number of cleft and uninjured skulls in particular barrows.

The question how far the human remains, more especially the skulls, enable us to determine the race characters of the people or peoples who lie buried in the tumuli of Britain, has been discussed with great care and at considerable length in two papers by Dr. Thurnam, published in the *Memoirs of the Anthropological Society* for the years 1864 and 1870. In the first of these papers the conclusions, based on the examination of a very considerable number of skulls and limb bones, were maintained that the people whose remains are found in the long barrows were a short, long-

headed race, with small features, whilst those from the round barrow were a tall, short- or round-headed race, with larger and more prominent faces. There was nothing new in this statement that the skulls of the ancient Britons of the later or Bronze age were usually of rounded form; the chief novelty was the fact deduced by Dr. Thurnam from his explorations in the primeval long barrows, that the skulls from that form of tumulus are of extreme length, such as now prevails only in far distant lands, as for example in India, Africa, and Australia.

Dr. Thurnam's general conclusions as to the skull-forms from the barrows, were concisely expressed by him in the formula—"long barrows, long skulls: round barrows, round skulls." This coincidence between the form of the barrow and the shape of the skulls which it contained, appeared to be so strange to some minds that they hesitated to give full weight to the statistics brought forward in support of it. The unfavourable reception which Dr. Thurnam's conclusions met with in certain quarters, however disagreeable to him at the time, can now only be a subject of congratulation, as it no doubt served as a spur to further investigation, the results of which are most conclusive. In the paper published in the *Anthropological Memoirs* of 1870, Dr. Thurnam was enabled to discuss the character of as many as sixty-seven skulls from the two classes of long barrows, no fewer than twenty-seven of them being from simple barrows, although the first described skull from that class of tumulus was obtained so recently as 1863. The results of the measurements of these sixty-seven skulls, as contrasted with those derived from seventy skulls from the round barrows, may readily be made evident to those of our readers who are least acquainted with the technicalities of craniology. Skulls are now usually classed according to the form of the brain case, as "long," "short," and "intermediate," the limits of each class being accurately defined. Of these sixty-seven skulls from long barrows, then, it is found that eighty-two per cent. are technically long, and eighteen per cent. intermediate; not one technically short or round. On the other hand, of the seventy round barrow skulls, eighty-three per cent. are short, and seventeen per cent. intermediate; not one long. Bearing in mind that the archaeological evidence has satisfactorily established the superior antiquity of the long as compared with the round barrows, the conclusions here arrived at, based as they are upon a wide induction of instances derived from one district and one class of monuments, are a clear gain to science, and are not for one moment to be compared with such hypotheses as that of a primitive short-headed population, founded by Retzius upon the examination of isolated crania from various parts of Europe.

The question of the relation of the men of the long barrows to the existing people is one of great difficulty. It might seem natural to infer that the skulls recognised by some excellent observers, such as Dr. Beddoe, as Keltic skulls, are the modern representatives of the ancient long heads. They seem to us, however, to differ in many essential particulars, especially in the important element of height. Dr. Thurnam appears to have been impressed with certain historical evidence favourable to the notion of the Iberian origin of the long barrow people, and he has accordingly carefully studied the large series of Basque skulls in the museum of the *Anthropological Society* of Paris. The results of the comparison between the two classes of skulls do not, however, seem to go far towards supporting the Iberian theory. We are inclined to think that Dr. Thurnam should have turned to the north rather than to the south of Europe for the representatives of the primitive long-headed population of Britain. He readily allows that certain skulls obtained from ancient cemeteries (grave-rows) in northern Germany closely resemble those of the long barrow folk, but he seems to have been deterred

from following up the clue by the fact that these grave-row skulls are of the iron period, and probably of post-Roman date. Since the date of Dr. Thurnam's paper, however, skulls of the same long and high form have been found in Rheinessen, in graves assigned by the eminent archæologist Lindenschmidt to a date 500 years before Christ. Similar skulls have also been discovered in Bohemia with weapons of stone and bronze.

We have devoted so much space to the archæological and craniological portion of Dr. Thurnam's paper, that we are unable to notice in detail the admirable way in which the physical facts observed are reviewed in the light of historical evidence. It must suffice to say that the men of the long barrows are identified with those "described by Cæsar under the name of *Interiores Britanni*, as forming the aboriginal population," whilst those of the round barrows are inferred to be the Belgæ, who, according to Cæsar's account, passed over to Britain from the Continent, in immediately pre-Roman times, for the purpose of plunder and making war.

NOTES

WE are glad to be able to state that energetic steps are now being taken in the matter of the Expedition to view the approaching Eclipse of the Sun. We believe that Mr. Lassell, the President of the Royal Astronomical Society, will call attention to the subject at the meeting of the society to-morrow evening.

MR. LOCKYER, in his third lecture on the Sun, delivered at the Royal Institution on Saturday last, showed an interesting experiment with a candle, which gives a good general idea of the solar phenomena as observed by his new method. As round the sun Mr. Lockyer can spectroscopically detect an ordinarily invisible hydrogen envelope which is rendered evident by bright lines only as contrasted with the nearly continuous spectrum given by the white light of the surface of the sun, so also there is an ordinarily unnoticed envelope (of sodium vapour) round a common candle flame which gives a bright line spectrum as contrasted with the continuous spectrum of the flame itself. Mr. Lockyer also showed that some of the phenomena he has seen when watching a solar storm may be reproduced by disturbing a candle flame.

WE have heard so much recently of the long-delayed determination of Cambridge University to apply itself in earnest to the cultivation of Natural Science, that the information contained in the following paragraph must be a blow to those of its friends who hoped to see that it was entering on a new course:—"The Syndicate appointed to consider the means of raising the necessary funds for establishing a Professor and Demonstrator of Experimental Physics, and for providing buildings and apparatus required for that department of science, and other wants of the University, have made a report to the Senate, in which they state that they have addressed a communication to the several colleges of the University, to inquire whether they would be willing, under proper safeguards for the due appropriation of any moneys which might be entrusted to the University, to make contributions from their corporate funds for the above-mentioned objects. The answers of the several colleges, except that of King's, which has not yet been received, have been fully considered by the Syndicate. They indicated such a want of concurrence in any proposal to raise contributions from the corporate funds of colleges, by any kind of direct taxation, that the Syndicate felt obliged to abandon the notion of obtaining the necessary funds from this source, and accordingly to limit the number of objects which they should recommend the Senate to accomplish. They confined their attention, therefore, to the means of raising sufficient funds