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PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY.

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VOLUME IV.—1859-68.





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PROCEEDINGS

OF THE

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G E O L O G I C A L

AND

P O L Y T E C H N I C S O C I E T Y

OF THE

WEST RIDING OF YORKSHIRE.

1859—68.

VOLUME IV.

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# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-SECOND MEETING, HELD IN THE  
GUILDHALL, DONCASTER, ON FRIDAY, JULY 1ST, 1859,  
AT TWELVE O'CLOCK AT NOON.

---

JAMES BROWN, Esq., M.P., in the Chair.

The following gentlemen were elected Members of the Society:—Rear Admiral Sir James Clark Ross, F.R.S., W. B. Wrightson, Esq., M.P., of Cusworth, J. W. Childers, Esq., of Cantley, James Brown, Esq., M.P., of Rossington, and E. Sewell, Esq., of Fulneck.

The Chairman having read letters of apology from the President, the Earl of Ripon; and also from the Earl of Dartmouth, and Earl Fitzwilliam, for not being able to preside at the meeting, called upon the Rev. W. Thorp, Vicar of Misson, to read the first Paper:—

ON THE GEOLOGICAL EVIDENCE OF THE SECULAR EXPANSION  
OF THE CRUST OF THE EARTH, THE INCREASE OF ITS  
ORBIT, AND THE EFFECTS PRODUCED THEREBY, AS  
PROPOUNDED BY CAPTAIN DRAYSON, R.A. BY THE  
REV. W. THORP, VICAR OF MISSION, NOTIS.

Geology is closely allied with nearly all the sister sciences: with botany, enabling her to decipher the fossil flora; with

zoology, as teaching the affinities of her fossil fauna ; with chemistry, as determining the constituents of her minerals, earths, and salts ; while hitherto she has had little connection with astronomy. It may be, however, that the new light thrown on astronomy by Captain Drayson, in his published book "The Earth we Inhabit," may enable us to unravel many of the mysteries connected with the early history of this planet ; for if Captain Drayson's theory explain the origin of the magnificent flora of the carboniferous era and its extension to Melville Island,—a gradually decreasing climate through the immense periods of the Permian, Saliferous, Oolitic, and Cretaceous systems up to the Tertiary—the reasons why probably the solar year has been formerly shorter ; and also if it explains the presence in our island of large icebergs and an arctic climate, then this theory must inevitably have also an important bearing on practical astronomy ; for, if in this northern hemisphere the expansion of the earth's crust is causing land to recede from the equator, it must be causing the *latitudes of places*, as measured by the stars, to periodically vary, and this is the case. Thus, between the years 1845 and 1858 (13 years) the Observatory of Durham moved 290 yards ; that of Oxford 133 yards ; between 1827 and 1858 (31 years) that of Edinburgh moved 1,373 yards ; and that of Cambridge 300 yards ; between 1845 and 1858 (13 years) that of Berlin moved one mile and 100 yards (1,893 yards) ; that of Christiana travelled north 3,600 feet during 12 years, (1,200 yards.)

Then, also, if the earth's orbit is increasing, the sun will not continually appear in the same constellation, and there will be, as it is called, a *precession of the equinoxes*, so that after a lapse of years there will be a difference of at least several days in the year. Thus in the year 1582 Pope Gregory found the vernal equinox, which in the year 325 fell on the 21st of March, then fell on the 11th of March, therefore in



1257 years the earth's orbit had increased by a ten days' journey round the sun, explained by annexed figures from Captain Drayson's Book (*"The Earth we Inhabit,"* p. 50). By the addition of a day to the year of every leap year, and the precession of the equinox, the increase of the earth's orbit is not noticed, otherwise in the course of years, Christmas would occur in July.\* (*See Plate I, Fig. 1.*)

*The acceleration of the Moon's mean time,* or that the Moon's motion has been growing swifter from century to century, is very simply explained by Captain Drayson. While Sir J. Herschel says "This remarkable fact had long been the subject of toilsome investigation to geometers. Indeed, so difficult did it appear to render any account of, that some were on the point of again declaring the theory of gravity inadequate to its explanation; others were for rejecting altogether the evidence on which it rested, although quite as satisfactory as that on which most historical events are credited." This, however, is readily explained by the accompanying diagram. (*See Plate I, Fig. 2.*)

*In the measurements of distances* of the earth's surface, such as *base lines*, the later admeasurements are always the greater, *i.e.*, with the best instruments and by such men as Colonels Colby, Mudge, Snell, &c. (*See pp. 20, 68, and 90.*)

*Differences of latitudes of places as determined by astronomical observation* and by *admeasurement* do not agree. Latitude of Pisa by measurements from Florence  $43^{\circ} 43' 19''$ , 4, ditto by observation of 504 stars,  $43^{\circ} 43' 11''$ , 7, or  $7''$ , 6 less by

\* For the earth moves through  $360^{\circ}$  in 365 days,  $\therefore 59' 1''$  per day. If, therefore, the precession of the equinox =  $50''$  annually, the earth does not complete its annual revolution around the sun by about 20 minutes of time, this would cause about one day's difference in 72 years, when the precession ceased.

the stars, proving the declination of the stars less than it ought to be.

Let us, however, examine the proofs of the earth's expansion, and the increase of its orbit. La Place says "It is impossible not to be struck with the extraordinary circumstance that the motions of all the planets and satellites take place from west to east, and very nearly in the same plane; that the motions of rotation on their respective axes are all in the direction, and nearly in the plane of their motions of projection. These coincidences, to which we may add the small eccentricity of all the planetary orbits, are too extraordinary to be the result of chance. They evidently depend upon some common cause which determined the motions of the respective bodies at their formation."

I may also add as another bond of connection that their *densities* decrease with their distances from the sun.\* Thus the density of

Density.	Distances. Miles.
Mercury is 2,585 (of lead) and its distance from the sun . . . . .	37,000,000
Venus . . . . 1,025 . . . . .	69,000,000
Earth . . . . 1,000 (5 times of water) . . . . .	95,000,000
Mars . . . . 656 (3 and 2-7th times of water) . .	145,000,000
Jupiter . . 201 (a little more than water) . . .	494,000,000
Saturn . . . 103 (of cork) . . . . .	907,000,000

These distances of the respective planets from the sun and their densities (as deduced from their masses and volume)

\* See History of Astronomy, p. 53. (Library of Useful Knowledge.)

*Density* of a body is as the *mass* directly, and the volume inversely. Hence

$$\text{density of } \odot : \text{density of } \oplus :: \frac{354,936 \text{ (mass)}}{1,384,472 \text{ (bulk)}} : 1 : 0.2543.$$

(Herschel, Lardner's, p. 239.)

are in accordance with a corollary of Kepler's third law, viz., "*that the masses of the planets vary as the square roots of the distances.*"\* If, therefore, the density of the earth can be proved to have been considerably greater, it follows that the earth's orbit must have been less, and have had a corresponding nearer proximity to the sun.

The density of the rocky crust of the earth is two-and-a-half times that of water, while the mean density of the whole earth, according to Maskelyne, is five times the density of water; and it is calculated that if gravitation exert itself uniformly towards the centre of the earth, water, at 362 miles from the surface, would be as heavy as quicksilver; air as heavy as water at 34 miles; while, at the centre, the weight of marble would be increased 119 times!

Now it is certain that the pressure upon these central masses and their condensation has been, before the expansions and elevations of the crust of the earth, enormously greater than at the present time. In fact, to whatever amount, portions of the earth's crust have been raised, to the

\* History of Astronomy, p. 53. (Library of Useful Knowledge.)

He (Kepler) supposed the sun to be a centre of attractive force which diminished as the distance from that body increased; again, the magnitude of the orbit increased as the distance. From these two causes combined, he concluded that the periodic time varied inversely as the square of the distances. But in the epitome of the Copernican system (Book iv, c. 4) he modified his theory by introducing the consideration of the *mass and of the volume* of the planet. His reasoning on this head is very curious. There are four causes on which the length of the periodic time depends:—

1. Length of the path described.
2. The mass of the body to be transported.
3. The strength of the moving force.
4. The volume under a given mass of the body to be moved.

According to Kepler there is an exact compensation between these two last causes, so that the orbit depends really upon the first. Now he conceived that he had established a law showing that the *masses of the planets varied as the square root of the distances*, and the circular paths of the planets were certainly in the simple proportion of these distances. Compounding, then, these two ratios, he found "the squares of the periodic times to vary as the cube of the distances."

same amount has the interior pressure and density been relieved and lessened. Suppose, for instance, that one-fourth part of the surface of the globe is land which has been raised from the bosom of the deep, say to the amount of 1,000 feet from a depth of 160 miles, leaving the emptied space hollow, or filled with expanded gases; to the same amount would the density or *vis inertiae* of the earth be decreased. And, therefore, if the origin of the third law of Kepler be true, then must the earth's orbit have been nearer the sun, and to have reached its present position, been secularly increasing. The density has been decreasing also by irruptions of melted matter out of its interior from volcanos and eruptions of gases, &c., and the consumption annually of 62,000,000 tons of coals in Great Britain alone.

Let us, however, examine what geological evidence there is of the diminished density of the earth. Professor Phillips (Lardner's Cyclop., vol. I, p. 120) speaking of the primary strata and *on the gneiss and mica schist series*, says, "To describe the extent of country covered by "gneiss and mica schist on the continent of Europe would "perhaps be impracticable. The Pyrenees, the Alps, and "the great chains of Bohemia and Scandinavia are full of "these rocks, which have much the same characters as the "Grampians and Connemara, rest in the same way on "granite. . . . and are equally deficient of organic remains. "Most of the great mountain chains of the world contain "these rocks, and they may be considered as the most "nearly universal strata we are acquainted with." Speaking of the origin and formation of the gneiss and mica schist beds, he says, "There is no proof, nor any high degree of probability, that organic beings had been created—*no proof of "the emergence of land* (implying that the expansion of the "crust had not then commenced) but evidence of watery

“movements, different from the agitation of currents or  
“the tide.” p. 145.

*On the close of the primary period* he says again,  
“There is almost a total absence of proof in the mineral  
“composition and organic remains of the primary strata of  
“*the contemporary existence of dry land*, for all the early  
“periods, at least, the absence of land plants, and the non-  
“occurrence of conglomerates, seem to justify a doubt  
“whether the sea of that period was subject to anything of  
“the nature of land flood or littoral agitation. In the slate  
“and Silurian systems the marks of agitation in the sea  
“become more distinct, and from land plants in the  
“grauwacke rocks of the Rhine, and from North Devon,  
“*the proof of upraised land is conclusive*,” p. 146. “There is  
“nothing to contradict the assumption that till the close of  
“the primary period nearly all the strata of the British Isles  
“and the continent of Europe were covered by the sea in  
“which they were formed, and it is doubted whether any  
“certain proof can be shown that any part of the European  
“region was subjected to any great displacement during the  
“primary period.”

If, therefore, at this early period of the earth's history,  
there had been as yet no elevation of land or breakage of its  
crust, the pressure upon the internal and central parts of the  
globe must have been at its *maximum*.

The density of the planet Mercury is 2,585, while that of  
the earth at the present time is 1,000, therefore that of Mer-  
cury is two-and-a-half times that of the earth. It may be,  
however, that at the end of the primary period the densities  
of both planets were nearly equal, and therefore, according  
to Kepler's laws, their orbits could not have been very dis-  
similar.

The primary strata, above the gneiss and mica schist,  
contain marine fossils, proving their aqueous origin; these

are of great thickness, and are now elevated by the earth's expansion into lofty mountains ; consequently the thickness of these above the level of the sea will afford a *minimum* amount of the earth's expansion, those beneath the surface not being reckoned since they are not visible. These primary systems are the Cumbrian (grauwacke), and the Silurian (Welsh).

Ascending from the primary strata up to the *secondary series*, are there any traces of the expansion of the earth's crust, or the increase of its orbit? The lowest portions of the secondary strata are 1st:—Old red sandstone. 2nd. Mountain or carboniferous limestone. 3rd. Millstone grit. 4th. Coal beds.

A. *The old red sandstone* by its thick beds of conglomerates, consisting of rounded pebbles, boulders, and coarse sandstone, prove that decided upward movements from the bottom of the ocean had then commenced, (Phillips, vol. I, p. 175.) “The Northern Ocean was then studded with islands, bounded by shores, supplied by inundations from extended land ; the amount of these is demonstrated by the abundance of arenaceous and clay sediments, plants, and thin beds of coal.” The old red sandstone is of great thickness in Devonshire and in Scotland ; the three systems called the Cumbrian, Silurian, and Devonian (collectively the Palæozoic rocks) are of vast thickness, not less in England than 30,000 feet, so that even before the mountain limestone we have indubitable evidence of six miles expansion, or at least 10,000 yards.

B. *The mountain limestone* was formed in the deeper waters of the ocean as a chemical precipitate, and Professor Phillips, in his quarto work on the geology of Yorkshire, asks “By what agency was this limestone formed? By some liquid or gaseous substance generated in the bowels of the earth, and diffused by many openings on its bed.” Here then is

an example of the internal pressure, and hence the density of the earth, being relieved, and this to the enormous amount of the mountain limestone, extending as it does to the Arctic Circle.\* I may remark that through the same openings, trap rocks, as the toadstone of Derbyshire, were emitted, and have become interstratified with the limestone beds, so as to have igneous rocks and chemically formed rocks in alternate succession.

c. Passing over the *millstone grit*, we now come to the *beds of coal*, of which I shall take the description from Hugh Miller's "Testimony of the Rocks," p. 135:—"That which distinguishes this period," says he, "is its gorgeous flora. It was emphatically the period of plants, of herbs yielding seed after their kind. In no other age did the world ever witness such a flora; the youth of the earth was peculiarly a green and umbrageous youth, a youth of tangled and dusky forests, of huge pines and stately araucarians, of the reed-like calamite, the tall tree-fern, the sculptured sigillaria, and the hirsute lepidodendron. Wherever dry land, or shallow lake, or running stream appeared, from where Melville Island now spreads out its wastes under the star of the pole, to where the arid plains of Australia lie solitary beneath the bright sun of the south (and I may add of New South Wales) a rank and luxuriant herbage cumbered every foot breadth of the soil, and even to distant planets our earth must have shone through the enveloping clouds with a green and delicate ray." Again, he says, p. 151, "the American coal fields have been carefully explored, and what is the result? The geologist has come to know that even the mighty forests

\* Dr. Richardson, under the command of Captain Franklin, between the parallels of 60 to 70 N. Lat. found a calcareous formation stretching from the mouth of Mackenzie River, in which were corallines, productæ, and terebratulæ, the same in generic character to those of our mountain limestone. (Lyell, vol. I, p. 188.)

“of America are inconsiderable when compared with its  
 “deposits of coal; nay, that all the forests gathered into one  
 “heap would fail to furnish the materials of a single coal-  
 “seam equal to that of Pittsburg, and that for centuries  
 “America will continue to derive its commercial greatness  
 “from the unprecedented luxuriant flora of the old carboni-  
 “ferous ages. Truly, very wonderful are the coal fields of  
 “North America! What shall be said of the flora which  
 “originated the coal deposits of Nova Scotia and the  
 “United States—deposits *twenty times as great* as all those  
 “of all Europe put together.”\*

In the Edinburgh Cabinet Library, edited by Professors Leslie, Jamieson, and Hugh Murray, “Discovery and Adventure in the Polar Seas and Regions,” respecting the geology of *Spitzbergen*. “In the year 1826 sea-horse fishers  
 “from Finmark brought sixty tons of coal from Ice Sound, in  
 “north latitude 78°, to Hammerfest, in Norway, and we are  
 “informed by Scoresby that the coal is so easily procured,  
 “that many of the Dutch fishers, a few years ago, were in the  
 “habit of laying in a stock for fuel on the passage homewards.  
 “The coal of Spitzbergen extends beyond N. L. 79°, and  
 “resembles in some places Cannel-coal, in others it is Brown  
 “coal, or lignite.”

The coal formation was met with in *Greenland* for the first time by Scoresby (on the east coast). “It is the same formation,” says he, “as that which abounds all round Edinburgh, in short it is that important deposit in which are situated all the great coal mines in Scotland and England. This formation always contains impressions and casts of plants which have a tropical aspect—a circumstance of high interest when combined with the Arctic situation of the

\* The Pittsburg seam is ten feet thick of solid good coal, extending 225 miles in length, and about 100 miles in breadth. (Lyell's Travels in America, p. 27.)



“ coal. The coal formation in Melville Island, in north latitude  $75^{\circ}$ , where the summer lasts but a few weeks, I found on examining a series of specimens to contain various tropical-looking fossil plants, resembling those met with in the coal fields of Great Britain; and as the same formation occurs in Jamieson’s Land, in N. L.  $71^{\circ}$ , it is very probable that future naturalists will detect in its strata plants of a similar nature. Remains of plants with tropical characters, evidently in their native place of growth, under  $75^{\circ}$  N. L., is a fact which naturally leads to very interesting discussions as to the former state of climate, &c.”

Brongniart states that the study of the botany of the ancient coal deposits has yielded the strongest evidence possible of an extremely hot climate; that there existed at that epoch Equiseta upwards of ten feet high, and five or six inches in diameter; tree ferns, or plants allied to them, 40 to 50 feet in height; and arborescent Lycopodiaceæ, 60 to 70 feet high; that the development of these plants, EVEN IN THE HOTTEST PARTS OF THE GLOBE, is inferior to that of the COAL FORMATION. (Consid. Générales sur la Nature de la Vegetation. Ann. des Sci. Nat., Nov., 1828.)

To account for this extraordinary temperature of the earth extending within  $15^{\circ}$  or  $20^{\circ}$  of the north pole, and  $35^{\circ}$  of the south pole, various hypotheses, both astronomical and geological, have been suggested. Lyell supposes that a large continent formerly extended northwards to within the arctic circle; but it is highly probable, if not certain, that there exists now a larger area of land in the northern hemisphere than at any former period. Professor Phillips supposes that the atmosphere contained a larger dose of carbonic acid, and the temperature was increased by subterranean heat. Cordier gives the results of his experiments and observations on the temperature of the interior of the earth, that the heat increases rapidly with the depth, but the increase does not

follow the same law over the whole earth, *being twice or three times as much in one country as another*: these differences not being in constant relation either with the latitudes or longitudes of places. In fact, they are variations of volcanic heat, and change their position as the scenes of volcanic action undergo change. Again, if subterraneous heat continued through a polar winter of two or three months' darkness, plants would be destroyed. Mr. R. Hunt, in recent experiments on the action of the sun in the growth of plants, proves that the fixation of carbon is due to the *actinic rays*, and therefore the growth of plants is in proportion to the quantity of light. He informs Captain Drayson that he tried during nine years, and could not, without the light of the sun, produce by heat any of the tropical plants. Professor Lindley dwells upon this point as one of great difficulty, and supposes that the earth's axis of rotation has been changed. "Plants," he affirms, "cannot be retained in darkness, even for a week, without serious injury, *unless in a torpid state, (i.e. from cold)* and if exposed to heat and moisture they cannot remain torpid, but will grow, and therefore must perish. If then (says he) a high temperature and consequent humidity prevailed at that period, when we know the arctic seas were filled with corals and large multilocular shells, how could plants of tropical forms have flourished? *Is not the bright light of equatorial regions as indispensable a condition of their well-being, as the sultry heat of the same countries?*"\* Lyell, in answer, says that all astronomers are agreed that speculations on the change in the axis of rotation of the earth are inadmissible, but I reply that a change *in the direction* of the axis is not. Brongniart asserts that the light and heat now enjoyed by the equator, or *"the hottest parts of the globe,"* are inadequate and insufficient for the production of the enormous size, as well as

\* Lindley's Lectures IV. on Fossil flora.

quantity, of the coal plants; so that in fact there is to be explained not only an *extra-tropical climate* extending up to Melville Island, but a universal greater quantity of light and heat extending over the whole globe, especially over the whole northern hemisphere.

Now to account for the sun's reaching the polar regions so as to be vertical or nearly so over Spitzbergen, Melville Island, &c., Captain Drayson will demonstrate that there is a movement of the earth which has hitherto not been fully understood. This movement being a slow secular inversion of the poles, which after a series of years brings the polar regions immediately under the sun. Thus, in the time of Hipparchus, 99 years before Christ, the present pole star in his catalogue was  $12^\circ$  from the pole, while now it is only  $1^\circ 27'$ , so that there has been a variation in the direction of the earth's axis since his time of ten degrees, thirty-three minutes.

And that this change in the position of the earth's axis is a probable one, is proved by the positions of the axes in the other planets, e.g., in *Mercury* the sun is directly over his polar regions, the very position of the earth's axis at the time required for the production of the coal flora. In *Uranus* the north pole is turned completely away from the sun, and hence his satellites appear to retrograde, while in reality they revolve round their planet in a similar direction to the other satellites. I would ask any one to carefully examine the positions of the planets as above sketched out, (*Plate II.*) and he will perceive at once that *Mercury* with the north pole pointed directly to the sun,—or even that *Venus*, within  $15^\circ$  of the tropics, at her poles,—would derive a full and sufficient quantity of heat and light for all the purposes demanded; while the *Earth*, or *Mars*, or *Jupiter*, with their polar axes in their present positions, would have little heat and light in their polar circles; while the south poles of *Uranus*

and also of Saturn are receiving more light and heat than their northern poles and hemispheres.

When, therefore, the tropics (by the movement of the earth's axis) extended to the polar regions, the sun would be one quarter of the year (whatever its length) always above the horizon in the northern portion of the northern hemisphere; and even at midnight would be  $14^{\circ}$  above the horizon, and there would be no real night during the summer. Spring and autumn would be as at the present, containing days of equal length and equal nights, but winter would have been very severe, and hence vegetation would be dormant, the sun during *one-fourth* of the year being below the horizon; and thus, during the summer months, the tropical flora would grow with wonderful rapidity, they would during the winter be frozen and entombed in snow of great depth, which on the return of spring would, by rapid thaws and land floods, be carried away into the adjoining lakes of fresh water and embedded as coal seams.

It can also be proved that without some alteration in the direction of the earth's axis, sufficient heat and light could not have been afforded to the arctic circle to enable that region to produce the carboniferous flora. For the mean temperature of different parallels of latitude is equal to *the sine* of twice their latitude, therefore the temperature now enjoyed between the latitudes  $70^{\circ}$  and  $80^{\circ}$  is only  $35\frac{1}{2}^{\circ}$  of Fahrenheit, while that of the equator is  $84^{\circ}$ ; but suppose the Earth had double its present heat, or that of Venus, then the heat would be raised for those latitudes to  $71^{\circ}$ , while Brongniart maintains that the heat of our tropics,  $84^{\circ}$ , is insufficient. Suppose, also, that the earth enjoyed double the quantity of *heat and light*, with the poles in their present position, the arctic circle would still have only a summer of a few weeks' duration, not at all adequate to the growth of the huge fossil flora found there, and therefore under any supposed conditions

whatever, with the pole of the earth in its present position, a sufficiency of light and heat at Spitzbergen could not possibly have been received from the sun.

But there is another bond of union between the different planets; and that is, the nearer each is to the sun the shorter is its year. The first calendar of which we have record gives the year as 304 days. Mercury performs his periodical revolution in about 88 days—Venus in 224 days, so that if the earth's orbit has been nearer the sun, and the tropics at the pole, we have at once the heat required by Brongniart, the year also proportionably shorter (and it may have been considerably shorter), and therefore these long periods of time indulged in by geologists may have consisted of years of not more than 200 or 230 days, and thus the frequent reappearance of the sun in these northern regions would as frequently reproduce the numerous coal seams of our coal districts, and especially those double, or even many beds of coal one placed above the other; as in the Barnsley seam, there are five different beds, total nine feet thick, representing five different qualities, and could only have been grown in different years. In the Yorkshire coal field there are about fifty different beds, whose total thickness is 84 feet, containing above 100,000 tons per acre where the coal district is in its full thickness, having all the 50 seams *in situ*.

Ascending to the *Permian system* of Murchison, so well developed around Doncaster,—the cutting in the South Yorkshire Railway to Conisbro' Castle from Hexthorp, being the best section in England,—what marks are there of expansion or increase in the earth's orbit?

The Permian beds consist of—

1. Rothe todte liegendie, of Conisbro' Castle.
2. Magnesian limestone, of Levitt Hagg.
3. Red marl and gypsum, in the cutting opposite Warmsworth.

4. Upper slaty limestone.

5. Red marl seen at Hexthorp.

The most extensive movements in the earth's crust now took place at this period. Professor Phillips says, "Every coal field in these islands is remarkably dislocated by faults, often traversed by trap dykes." . . . One of the most remarkable great faults or dislocations yet known in the world belongs to this period, viz., the great and continuous fracture of the earth's crust from Cullercoats, near Newcastle, westward along the Tyne valley to Brampton, thence southward to Brough, Kirby-Stephen, Dent, and Kirby-Lonsdale, a distance of 110 miles. One portion is elevated above the other from 1,200 to 4,000 feet. I may add that the same disturbance is prolonged southwards to near Derby, so that the whole area of the Yorkshire coal field is elevated above that of Lancashire 3,000 or 4,000 feet. Both sides are in fact elevated, but the Yorkshire side more so. Other elevations and expansions of the crust are seen in particular localities. In the valley of the Don, between Rotherham and Sheffield, is an example of an enormous fracture. At Keppel's Column is a known coal seam called the Park Gate Bed, near the surface; one mile south this same seam, instead of being near the surface, is 700 yards deep, so that both the sides of the valley being elevated, yet the Wentworth House side is raised more so to the before-mentioned amount. There is some little dispute among geologists as to the exact date of these movements, whether they occurred before or after the deposition of the permian system, but a study of the geology of the country around Doncaster, by Wadworth, Conisbro', &c., will show that the magnesian limestone has been greatly disturbed, and that the same dislocations range westward, and are connected with those of the Don.

The expansions of the crust of the earth which occurred at this period, appear to have been much more abrupt and violent than any that either preceded or succeeded them. The total thickness of the expanded earth's crust, above the old red sandstone to the permian inclusive, is about as follows :—

	800	yards	mountain	limestone.
	1,000	„	millstone	grit.
	1,500	„	coal	measures.
	<hr/>			
	3,300	„		
	100	„	permian.	
	<hr/>			
	3,400	„	or about	two miles.

Proceeding upwards there is the *new red sandstone* upon which Doncaster stands. I may remark that the ordnance survey is mapping down all the beds before-named in the permian system, and have divided the new red sandstone into—1. Lower Bunter sandstone; 2. Middle Bunter; and 3. Lower Keuper; upon which is the fourth member of the series—4. Upper Keuper.

Spread over so immense a space in England the new red sandstone system never rises to elevations above 800 feet, a circumstance, remarks Professor Phillips, due to some law of physical geology yet unexplained. We can only conjecture that it is connected with the repose of the subterranean forces, which prevailed after the violent commotions of the coal strata over nearly all Europe till the tertiary epoch. “The red sandstone area,” says he, “seems to be like (which no doubt it really is) the large and uplifted bed of a shallow sea, full of rocky islands, and bounded by bold promontories.”

It was upon this ancient sea bottom, studded with lakes, that we find the remains of those gigantic reptiles beginning to appear in the lias, about which Hugh Miller says, “And

“certainly very wonderful was the development which it  
 “then did receive ; reptiles became everywhere the lords and  
 “masters of this lower world, taking possession of all the  
 “three old terrestrial elements, earth, air, and water,  
 “enaliosauri, plesiosauri, pterodactyli ; the lakes and rivers  
 “abounded in crocodiles and fresh water tortoises of ancient  
 “type and fashion ; and its woods and plains were the  
 “haunts of a strange reptilian fauna, of what has been  
 “termed ‘fearfully great lizards,’ some of which, as the  
 “iguanodon, rivalled the largest elephant in height, and  
 “greatly more than rivalled him in length and bulk. It  
 “seems not improbable that the reptiles of the oolitic period  
 “consisted of as many genera and species as the class mam-  
 “malia of the present time.”

I would merely add that the abundance of reptile life  
 displayed at this period, and through the whole of the oolite  
 period, affords full proof of the existence of a tropical climate  
 throughout the whole epoch, since these cold-blooded animals  
 have little power of generating heat in their own bodies.  
 Hence the magnitude, variety, and activity of reptile life now  
 under the tropics—hence the smallness, feebleness, summer  
 life, and winter sleep of the very few species in our northern  
 regions,—and hence the earth’s nearer proximity to the sun.

Ascending from the *new red sandstone*, through the *oolite* up  
 to the *chalk*, there is the same evidence of the gradually  
 decreasing temperature of the earth’s climate, and also a  
 gradually expanding crust of the earth. The difference of  
 quantity between the few oolitic plants and the vast heaps of  
 vegetable reliquiæ in the older coal strata, is one great proof  
 and very important. “During the oolitic period,” says  
 Phillips, “the arctic land was covered by plants like those of  
 “hot regions, whose vegetable ruins have locally generated  
 “coal beds, adorned by coleopterous, neuropterous insects,  
 “among which the flying lizard (*pterodactylus*) spread his



“filmy wings. The rivers and shores were tenanted by saurians more or less amphibious, while the sea was full of forms of zoophyta, mollusca, articularia, and fishes; undoubtedly the general impression gathered from all those monuments of earlier creations is that they lived in a warm climate.”

The limestone rocks of these periods are supposed by Dr. Forchhammer to owe their origin to ancient submarine springs of great force, yielding mingled carbonates of lime and magnesia, which were afterwards consolidated together, or separately deposited. Hence, also, again was the internal density of the earth being relieved and lessened.

With the *chalk* ends the long series of deposits ranked as *secondary strata*. “From the mountain limestone to the chalk,” says Phillips, “it is impossible not to recognise, on a great scale, the gradual change of the physical conditions of the globe which took place during this period. Two very different assemblages of terrestrial plants had flourished and become extinct. The ancient and abundant flora of the carboniferous era, with its lepidodendra, sigillaria, and calamites, had been replaced by new races of *Zamia* and *Cycadeæ*, which both in their turn vanished from the northern zones of the earth before the completion of the cretaceous system. The marine zoophyta were changed. Two large assemblages of fishes had vanished, and the gigantic reptile forms had come into being, reproduced themselves to a marvellous extent, and then all perished with the close of the chalk, or the secondary period.”\*

\* The inversion of the pole at the time of the carboniferous era would, as the sun left the northern hemisphere, leave the flora of this epoch to perish for want of heat.

Another inversion would, at the termination of the Chalk period, by its severe winters (see p. 15) destroy not only the *Zamia*, *Cycadeæ*, but the whole marine animal life of the northern hemisphere, as well as the numerous Reptilia of that period.

Immediately after the completion of the chalk there is evidence to show a *general movement upwards*, since what had been deep sea was converted to shallow water and subject to inundations from land; all tending to prove not only a decrease of temperature, but also an expansion of the crust. The internal density of the earth was also relieved at this period. In Ireland a very large tract of basaltic rocks occupies the country of Lough Neagh, and near Coleraine the thickness of these rocks is 1,000 feet, their superficial area 800 miles.

Therefore we may conclude that the thickness of the expanded earth's crust from the Permian to the bottom of the Tertiary, computed by Sir H. de la Beche, is 1,750 yards=one mile; from the Permian to the Old Red Sandstone, two miles; Palæozoic, as before, six miles; total thickness of elevated rocks to the Tertiary, nine or ten miles.

*The tertiary series.* The *eocene*, *miocene*, and *pleistocene* periods. Between the chalk and these tertiary beds is a remarkable discordance as to organic remains, none being common to both. Lyell says this abrupt transition from one set of fossils to another is also accompanied by evident signs of a change of climate, the eocene tertiary fossils having a far less tropical aspect than those of the chalk.

There are also signs of a great increase of land in European latitudes, by reference to the map of Lyell, which shows the immense area converted from sea into dry land, and in some cases from deep sea into mountains of great altitude, especially of chalk. The secondary beds below the chalk are exclusively marine, while the tertiary contain lacustrine, fresh water, and marine beds, alternating.

The map (Bouës) demonstrates that about two-thirds of the present European lands have emerged since the earliest tertiary beds originated, the change of climate and increase

of surface both demonstrating the expansion of the earth's crust and the increase of its orbit.\*

*Old coast lines, and raised beaches* running round the shores of Great Britain and Ireland are flat-terraces, backed by slight escarpments. No geologist doubts but the escarpment was at one time the coast line of the island. But above this ancient sea line are *raised beaches* 200 feet above the sea, containing the same fossils as exist in the sea adjoining them. To give examples of these beaches on the coasts of Great Britain, there are the valleys of the Forth and the Clyde, where are low terraces much above the actual reach of the tide—on the coast of Lancashire, at Preston—at the base of the Forest Hills, in Cheshire—again near Shrewsbury—on the Mersey, at Runcorn—on Moel Tryvaen, near Caernarvon, 1,450 feet above the sea—on the Baltic and the Atlantic coasts of Scandinavia are phenomena of the same nature. Mr. Lyell also found raised beaches *in Sweden, near Stockholm, 50 to 100 feet high. In one of these are shells in abundance, such as now live in the Baltic.* Even in Nottinghamshire, twenty miles inland, are shells to be found identical with those now living in the German Ocean. Innumerable facts, fully proving the theory of Captain Drayson, of the growth and expansion in the crust of the earth—even up to the present time. In fine, to conclude this part of the subject in the words of Lyell, p. 187, vol. I,

\* More remote than the period of the *old coast lines*, the northern mammoth lived in great abundance; also two northern species of rhinoceros ceased to exist. In the tertiary period *beasts* were wonderfully developed, mammoths, mastodons, rhinoceri, hippopotami, dinotherium, megatherium. Dug out of the *Pleistocene* are *Bos longifrons*, *B. primigenius*, *megaceros Hibernicus*, 10 feet 4 inches high. There existed in the forests of *Pleistocene* the cave-hyæna, the cave-tiger, and the cave-bear.

This ancient elephant (*elephas primigenius*) the remains of which occur all round the globe in a belt extended from 40° to 70° of N. L. There now exists two species of elephant, *elephas Africanus*, and *elephas Indicus*. Six species of rhinoceri:—*Rhinoc. Indicus*, *Javanus*, *Sumatiensis*, *Africanus*, *Sinus*, *Ketloa*, now existing, all very different from the extinct species.

“there is scarcely any land hitherto examined in *Europe*, “*Northern Asia*, or *North America*, which has not been raised “from the bosom of the deep since the origin of the carboniferous rocks, or which if previously raised, has not subsequently acquired additional altitude, and if we were to “submerge again all the marine strata from the most recent “shelly beds to the transition limestone, only the summits of “some primary mountains would be above the waters.”

*Recent expansions and elevations of the earth's crust.*—One of the best examples of the *effects* of a wide-spread elevation is the Cumberland drift, so well exhibited in the north parts of Yorkshire. Fragments of rocks now *in situ* in Cumberland, as the Shap Fell granite, are dispersed, *first*, on the west side of the chain of hills separating Lancashire and Yorkshire, as far south as the Severn, *i.e.*, by Castle Eden, Preston, Lancaster, Manchester, Trent Valley, and over the plains of Cheshire and into North Wales; then, on the east side, these Cumberland boulders, having passed over Stainmoor Forest, 1,400 feet above the sea, cover the plain of York from the Tees to the Humber; thence they have gone by the aid of icebergs over the oolite hills, 1,500 feet, down to the east coast in Holderness. This diluvium consists of an upper and lower deposit; the lower of clay mixed with boulders, which are scratched on their longer axes—marine shells belonging to the Arctic Sea are found in a broken state, laying above the bones of the mammalia. It is a little singular that Cumming, Trimmer, and others should have come to the following conclusions:—

1. That a great current from the Northern Seas had set in upon the north-west shores of Great Britain and Ireland, with the climate of an Arctic character.
2. That a gradual *submergence* of the British Isles took place to at least 1,600 feet.
3. A gradual *emergence*, the climate becoming again genial.

4. That during the uprising, boulders were dropped by the grounding and melting of ice, while the scratching and grooving action of littoral ice ceased.

But no submergence or emergence are required. The phenomena are readily explained by the gradual expansion and elevation of a tract of land covered by sea, filled with ice and icebergs, being drifted into Scotland, the lake districts, and other parts of the British Isles, covering them temporarily to the depth of 500 yards. Thus every Highland valley has its glacier and its moraine.

The marine shells pholodadiæ (boring shells), serpula, nuliporate encrustaceæ (H. M. 313) embedded in this drift are not now found in the British seas, but in seas 10° northwards. The group of animals which inhabited then this country were—the great elephant, two species of rhinoceros, hippopotamus, hyæna, a tiger and monkey, all different from the intertropical species, more so (says Owen) “than the ass from the horse, or the wolf from the dog.” The animal remains found in the mammiferous crag are all belonging to Europe, and are entirely different from the intertropical species, as proved by Professor Owen, and were natives of the country where their remains are now found.\* Great Britain had then her native elephant, rhinoceros, tiger, and hyæna, and it is a significant fact that the remains of these bones in the diluvium are mixed with species more northern still, viz., the remains of the red deer, reindeer, Lithuanian aurock, European wolf, wild cat, fox, and otter, all tending to prove that by the growth and uprising of submerged lands in Spitzbergen, Iceland, or the west coasts of Scandinavia, the retiring waters, with their contained ice and icebergs, and the marine shells peculiar to them, were driven southwards across the British Isles, lowering the temperature of the country, and carrying down the lines

\* See note page 21.

and valleys of the natural drainage masses of detritus and gravels from the rocks over which they had passed.\* For the proof of this elevation of course we ought to look to the arctic regions, and on reading the *Geology of the Polar Regions*, by Professor Jamieson, I read that Professor Keilhau found in Spitzbergen an interesting deposit of *shell clay*, containing the bones of whales and shells identical with those in the adjoining sea. This *shell clay* extends in Spitzbergen  $9\frac{1}{2}$  miles inland, and rises 100 feet above the level of the sea. A similar shell clay, in which the same kind of fossil shells are found, is to be seen *on the southern coasts of Norway*. "Are we to infer," says Professor Keilhau, "from the situation of this modern clay that Spitzbergen has risen from the bottom of the sea at a comparatively recent period?" (P. 402, Edin. Cab. Library, Polar regions.)

I answer, that a tract of land extending  $9\frac{1}{2}$  miles inland, raised 100 feet high, covered with a deep sea containing icebergs, to say nothing of the coasts of Norway expanding at the same time, are sufficient to account for all the phenomena of the drift of Cumberland. It is very evident that the whole diluvium has been thrown down from a violent rush and the tumultuous action of the water.

*Other recent expansions* might be named. In 1822 a tract of country, between the foot of the Andes and the Pacific, of a larger area than all Great Britain, was elevated from two to seven feet over its former level. In Chili the land is now rising, although the fishermen believe the ocean is only retreating. But let any one read the paper of Charles Darwin, Esq., in the *Geological Transactions* for 1840, "On the Formation of Mountain Chains in South America," and he will see that there exists the strongest proof that the whole west coast of South America, 800 miles in length, has

\* The earthquake at Lisbon, in 1755, threw on the coast of Madrid a wave 60 feet high, and on Madeira one of 18 feet high.

been elevated within a period geologically modern ; and Mr. Darwin states, "that there is little hazard in assuming that "this large portion of the earth's crust floats on a sea of "molten rock." And it is not so very improbable that the two continents of America and Africa, as suggested by Professor Jamieson, may not once have been united. The north-east shores of Sweden are rising about (according to Lyell) four feet vertically per century. In other parts of Scandinavia (see Lyell) the coast is now rising ; and so uncertain is it that Great Britain is not partaking of this upward movement, that in 1833 the British Association had a level line measured or laid down from the British Channel to the English Channel, under the direction of Professor Whewell.\*

*Fissures and joints. Hade in throws. Origin of mineral veins.*—Professor Phillips, in his quarto volume on the Geology of Yorkshire, has devoted one chapter to the "Symmetrical structures of Rocks." The thick massive beds of sandstone (says he) are irregularly *cracked* rather than fissured,—the limestones are locally cracked, always fissured and jointed. The laminated lias clays are regularly jointed. Conglomerates of all kinds have little symmetry, but are transversed by great fissures. Every sandstone quarry, whatever its geological age, is traversed by cracks, larger or smaller, and the upper limestone over large tracts from Knottingley to Ferrybridge has large openings 15 to 20 yards in width, into which the subjacent red marl is squeezed up, and there is no doubt that with the exception of the jointed structure in the very compact crystallised limestones, *all the above-named cracks or fissures are only the effects of the expansion of the crust of the earth.*

\* If there be a gradual expansion from within, sea and earth will both arise, and a level line would show no change, although the earth might have expanded some 100 feet in diameter. The *earth* portion would probably arise more than the water ; but a visible rise of only four feet in the land might be caused by 400 feet in diameter of the earth.

The "*Hade*" in throws, as to its origin has been a great puzzle, especially to mining men, and especially why the hade is never found under the upcast side. The whole is readily explained as *the effect of a movement upwards of the whole area*, and that it is so, is proved by the fact of always finding the strata rising at the same angle on both sides of the fault. If the hade inclined under the "upcast" side, the earth's crust would have *contracted*, and not as is always the case, expanded. In fact, the fissures in rocks and dislocations of strata are all the effects of one cause, viz:—the expansion of the crust; only in *dislocations* one side is elevated a little beyond the other, in perpendicular height. (See *Plate III.*)

*Mineral veins.*—Nothing in Geology has given rise to a greater variety of opinions and conjectures than the origin of metalliferous veins; these also are readily explained by expansions of the crust. It is not a little singular that Werner, Carne, Fox, &c., espoused this notion—That the bearing veins, or "*right running*" veins and the "*cross*" veins *gave indications of successive rents in the same general direction.* The fissures, in fact, which contain the minerals, are the effects of one upward movement—this being the origin of the fissures. The filling of the fissures with carbonate of lime, sulphate of barytes, sulphuret of iron, blende, &c., transferred probably by voltaic electricity, *is a subsequent operation*; then these veins have lastly, as in some disturbed districts, afterwards been displaced by later subsequent movements upwards. (See section A, Cornwall mine.) See *Plate III.*

It is also a question whether the *Seasons* are not secularly getting colder. Mëyen says, (Botanical Geography, p. 373) "We learn from history that there were vineyards, but now "deserted 300 years ago, and the vine was much cultivated "around Telsit, Elbing, Thorn, and other places; and the



“question has been asked, Why the culture of the vine has disappeared in these districts, and whether there has been a gradual diminution of the heat of the atmosphere since that time? The Potsdam wine is now sour. Yet the culture of the vine is carried above Königsberg. (54. 42 N.L.)” At any rate, it is certain that no part of the earth’s surface possesses now, under the equator, a climate at all adequate to the production of either the size or quantity of the coal flora. These facts are, therefore, unaccountable, unless we admit that the tropics did once extend far to the North. Grant this one fact, a fact which is demonstrable, and not only are the tropical remains in Hyperborean regions at once accounted for, but also the mysterious statements in ancient history, the intricate problems in astronomy, and many other unaccountable facts are immediately explained,—as also in Nature each step is simple, and as this theory is simple, so we have harmony between the two. For well may we remark

“How unlike the complex works of Man,  
Is Heaven’s simple unincumbered plan.”

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In continuation,—CAPTAIN DRAYSON, R.A., ASTRONOMER, ETC.,  
AT THE ROYAL MILITARY ACADEMY, WOOLWICH, READ THE  
FOLLOWING ASTRONOMICAL EVIDENCE:—

In the commencement of Mr. Thorp’s interesting paper, he states that as yet there has been no aid derived by geology from astronomy. Mr. Thorp very truly says that the botanist, the naturalist, and the chemist, have each given their assistance, but that astronomy has hitherto stood alone.

When, however, we astronomers stand alone, it is quite within the bounds of possibility, that we may ere long be left alone, and the crowd which was once behind us, may soon be before us.

Geology, which is comparatively quite a modern science, has made more rapid progress than probably any similar

science during the same time. And this must be the case with all those sciences, the foundation of which is firm, and where stubborn facts take the place of what we may term questionable theories.

No lengthy mathematical formula can stand against the testimony of the hard granite rocks, of the coal beds, and of the remains of animals and vegetables, whose habitat is now only within those bounds of the earth known as the tropics.

Here, then, is a science, formed upon granite, supported by slate, and bearing above it the evidences which could not be contradicted.

There are in Great Britain, in Northern Europe, and in America, indisputable evidences that vast animals and vegetables did once exist in those localities, and that they could not have existed had the climate of the northern hemisphere been what it is now.

The coal beds of England would alone prove this, but when in addition there are found nearly the entire remains of vast ferns of club mosses, some of which have been discovered with stems forty feet in length, and thirteen feet in diameter at the base, as was the case in the Jarrow Colliery, and when the examination of the flora, co-existent with the coal, shows that the cacti, euphorbia, and other tropical plants were those which then grew in our northern regions; and when the bones and sometimes the entire remains of vast elephants, rhinoceros, hippopotami, alligators, and other heat-loving animals are found in latitudes far to the north of Great Britain, it does appear most unreasonable to deny that this portion of the globe had a much higher temperature in former times than it has at the present day. Here, then, was a fact, which had to be accounted for. But the matter appeared to be so beset with difficulties that a solution had never yet been given.

“If,” says the Rev. Thos. Milner, “we embrace the idea of a warmer climate prevailing in the northern regions, when these animals tenanted them, it is necessary to suppose an immediate reduction of the temperature to have been coincident with their destruction. For, had not the mammoth been at once frozen, and enclosed in its icy sepulchre, the carcass must have perished from the decomposing action of the elements.” “The subject,” he says, “is beset with difficulties, whatever view is taken of it, which defy intelligence to remove.”

We have then, not only to show cause for a far greater heat, but also for a far greater cold in northern regions, before our facts can be explained.

Now where are we to look for aid when we require an explanation with regard to heat and cold? Chemistry is the science at once suggested to us. But chemistry is an experimental science, and it is impossible to experiment upon a climate which existed 6,000 or 7,000 years past. Besides, great as have been the discoveries of chemists, still their science has not yet been able to show the true *cause* of heat and cold in the atmosphere. The observer of these changes registers facts, but does not always show *causes*. Such must have been the state of the climate, says the chemist, but what produced that climate I know not.

Sun-light and sun-heat have been found essential to the growth of these plants.\* It would appear then that, unless by a miracle, the facts brought forward by geologists cannot be accounted for, unless we admit that there was more *sun-light* and more *sun-heat* in northern regions when coal beds were formed, than there is at the present time. Mr. Thorp has remarked that astronomy has not yet aided geology, but he appears to have overlooked an important preliminary consideration, viz., whether astronomy were yet

\* Experiments of Robert Hunt, Esq., F.R.S., &c.

capable of aiding geology. But, because the celestial science has not condescended to aid the terrestrial, there is no reason why the terrestrial should not aid the celestial; and geologists might therefore, without much presumption, tell the astronomers that the sun must once have done more in the north than it now does, and that they must examine their A, B, C, lest some slight facts should have escaped them, and their mathematical conclusions, built upon imperfect foundations, be consequently erroneous.

This we would remark, would not be presumptuous, for it is merely geological *facts versus* astronomical *theories*.

When we reflect upon the difficulty which astronomers have to encounter, not only with regard to their instruments, but also with the state of the weather, the refraction of the atmosphere, personal error of observation, and many other causes, it is most creditable to them to find, in spite of these drawbacks, how accurate have been their observations; and that within the last twenty years they have been able to decide upon the latitude of their observatories to within six or seven seconds. (Vide Nautical Almanacs, 1845—1859.)

There are, however, two points upon which astronomers appear to be at least forming conclusions without evidence. These two points we may call theories. The first theory is, that astronomy is now the most complete, perfect, and accurate of sciences, and that in it, *all* has now been discovered. The second theory is, that all observers, in nearly all times, must have been most completely wrong if their observations do not agree with the present accepted *theories*. This latter theory is one which is so generally accepted, that it is not unusual to find modern astronomers, not only rejecting the observations of ancient astronomers, but actually ridiculing these observations, and citing them as proofs of the folly of ancient times.

When an individual is perfectly satisfied with his own knowledge, it is not unusual, if we examine closely, to discover that in some elementary matters he may have been somewhat careless; consequently, as we know that there are facts in geology which are not explained by astronomy, and as there are facts in astronomy (*viz.*, the retrograde movement of the satellites of Uranus for instance, and even the daily rotation of the earth on its axis) unexplained by any theory, it is not utterly impossible that we may, if we examine carefully, find that there is some trifling item in astronomy which has either been overlooked or misinterpreted,—some little circumstance probably, which, from its very simplicity, has not been worthy of attention, and which consequently may fall to the share of some humble, persevering, common-sense individual, who is content with the crumbs which fall from his master's table.

We will first examine what conclusions have been arrived at with regard to the tropical remains in northern regions. From experiment, and the simple method of proceeding, which we observe in all the works of nature, it appears almost certain that the tropics must have once extended as far, if not farther, than Melville Island, rather than that some spasmodic convulsion took place in our earth.

If the tropics extended far to the north of England, then would the sun be twice in each year directly over head in England, and during the English winter it would be directly over the southern hemisphere, as far as Australia, and even the south pole.

Then also in England the sun would remain one-third of the year always above the horizon, not near the horizon as is now the case in the far north, but directly over head or nearly so—thus producing a heat far more intense than that which now pervades the tropics, and, in fact, forming a climate exactly suitable to the production of those magnificent flora which are found among our coal.

Such would be the summer climate, the spring and autumn would be similar to our present spring and autumn, but the winter would be very severe. During the winter the sun would quit us for a period equal to that which he had passed entirely above the horizon in England. Our plants would then be frozen, and would either fall to the ground and be covered with deep snow, or remain, as does our holly, &c., until next summer revived them. As, however, most of the coal flora are large succulent plants, it is more probable that they would fall and die than that they would stand the severe winter. Covered with snow, which the next summer would melt, their seed would again spring up and luxuriance would prevail. It has been decided by nearly all the authorities, that an extra-tropical heat was necessary to form the coal plants. The tropics extending to the poles will give this great heat. It has also been decided that water and an exclusion of air was necessary to form the coal. The fall and melting of snow when the tropics extended to the poles will also grant this. Thus then, if the tropics did ever extend to the poles, the mystery of coal beds in England, America, Australia, &c., at once vanishes. The tropical remains in northern regions is no longer puzzling; and a simple solution of a great paradox is at once given. These evidences are *facts* which cannot be denied, but which have scarcely been spoken about or explained; they have in reality been rather kept back because inexplicable. If the tropics had ever extended far to the north and south, there ought to be probably other evidences of such an important matter besides even those convincing ones which have already been mentioned. History, surely, would have referred to it. And is it not so? Yes, truly, in ancient history the fact is recorded over and over again; the wise men of the East, who built a city vast and grand as that of Babylon, who raised the Pyramids, and who transported vast blocks of stone which would defeat the

skill of our present engineers, if unaided by the hydraulic press, were not those ignorant, imbecile men that modern arrogance has delighted to assume. They were men well skilled in science, unacquainted with steam, electricity, and photography, the discoveries of only the last fifty years, but otherwise they were wise for their day; so much so, in fact, that as though well acquainted with the law that the present usually discredits the past, and if possible destroys or perverts the records of the past, they therefore actually engraved upon granite the facts with which they were acquainted. Thus scarcely an ancient temple in Egypt, Persia, or Greece, but bears upon it the record of the fact that the tropics *did* extend to the poles. In the "*Recherches sur les Astronomiques des Egyptiens*," and in the "*Memoire sur le Zodiac de Denderah*," it is shown that the sculptures represent the tropics at the poles of the earth; a circumstance, remarks the self-sufficient commentator, which "shows how very ignorant these men were, and how very wise we are."

Again, in that magnificent building, the Temple of the Sun, at Palmyra, there is a representation which declares the same fact. Plato relates that in the time of Atreus such a change *did* take place. Once, and once only, viz., when the earth was traversing a certain part of its orbit, would the sun be situated at the prolongation of the axis of the earth, when the tropics were at the poles. Thus for a day or so the sun would occupy the position which the pole star now does; and to an observer south of Gibeon, the sun would appear *over* Gibeon, and would *stand still for about the space of one day*. Is there no record of this fact?—(See Joshua, chap. x.) But it is useless to multiply evidence. There is no ancient book, no ancient sculpture in which the fact is omitted; by Herodotus, by Plato, and by many other old writers the fact is mentioned. We are not therefore dependent upon our

coal flora, or upon our tropical animals, but we have plenty of evidence in every ancient record.

But this is not all. We observe in the whole of Nature's works, an analogy. We see that all the planets are spherical, or nearly so; that they all move around the sun; that they all rotate upon their axis; that they are, in fact, like one family. If, then, the tropics ever extended to the northern and southern portions of the earth, should we not find some other planets in a similar state now. Surely we might expect such a circumstance; and we have but to examine for ourselves if we doubt the observations of other astronomers, and we shall see, as is even now well known, that in Mercury the tropics do at the present time extend to within a very few degrees of his poles. In Venus the tropics are now within  $15^{\circ}$  of her poles. In the Earth  $23^{\circ} 27'$  from her equator, whilst in Uranus the tropics again it is supposed extend to her poles. (*See Plate II.*)

Thus we have our tropical remains, the records of men who lived on earth when such facts existed, and the whole analogy of the solar system, to prove that the tropics did once extend to the poles.

And what have we to disprove the fact? Well may we ask what; there is really nothing save the superstitious belief that every fact in astronomy was long ago discovered, and that since the days of Newton, nothing can be wrong. For a very long period there was popery in religion, let us beware lest superstition lead us to popery in science—a much more retarding proceeding.

It can now be shown, that the variation which has taken place in the position of the fixed stars since the time of Hipparchus, which variation still continues, and is accurately recorded in the Nautical Almanac, as well as the precession of the equinox, shows that the third movement of the earth is, A SLOW INVERSION OF ITS POLES IN A PLANE WHICH IS



ALWAYS PARALLEL TO ITSELF. This plane passes through the stars which have 0 and 12 hours right ascension. This movement of the earth produces no apparent change in the seasons, or in the length of the year, until the summer position of the earth lies in this plane. Then the tropics will extend north and south. The year will increase, and all the changes will be apparent.

This third movement has been called a motion of the axis round the poles of the ecliptic,—a theory which recorded observations contradict, which explains nothing in the past, which therefore had better be discarded by all those who prefer truth to a blind following of old Aristotelian theories. The cause of this third movement is the cause of the expansion of the crust of the earth, the geological evidence of which has been given by Mr. Thorp; also of a planet's daily rotation on its axis, a fact, which although it is popularly believed that everything has been discovered, yet remains without a cause.

It is true that theorists go as far as to explain matters up to when the earth was first *launched in space*; but how this launching was effected is not stated. Great difference of opinion exists whether the earth was rubbed off the sun by a comet, or whether it was flung into its present position by Divine energy. (sic!)

If either fact be granted we are not much nearer our mark, for we may then ask *where the sun was rubbed off*, and what flung the comet at the sun?

The Hindoo Priests explain the movements of the earth in a not very dissimilar manner. They state that the earth rests upon the back of an elephant, that the elephant stands upon a tortoise, but they do not explain what the tortoise stands upon; but they suppose it was placed "*there!*" by Mahomet.

If we are content to take such arguments as sound and logical, we may depend that, wise as we suppose we are, the

future and the present generation will before long make a laughing stock of us, and will talk about the superstitious bigotry of the astronomers of 1859.

NOTE.—Captain Drayson has just published a second work upon the above subject, explaining in detail the third movement of the earth. As the Diagrams in this book cannot be published in the Society's papers, the readers are referred to Captain Drayson's book, which can be obtained from Jackson, Green's End, Woolwich. The Title is as follows:—"Great Britain has been and will be again within the Tropics: or, a simple solution of the following mysterious facts, namely, the Tropical remains in Hyperborean Regions, the Sun standing still, the Moon staying, the Shadow returning Ten Degrees, the Retrograde movement of the Satellites of Uranus, the Precession of the Equinox," &c., &c., &c.

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## EXPLANATION OF PLATE I.

Fig. 1, shews *the precession of the Equinoxes*.

1. Let E be the earth, and S the sun; then the sun is at the first point of Aries; if the earth go on revolving in the smaller orbit it will on the same day of the next year be again at E, and the sun will also again be at the first point of Aries. But if the orbit become enlarged to D D D the earth will fall short of E, or eventually to D and to T, so that the sun will be then at the first point of *Pisces*—and if this be on the 21st March, the equinoctial point will have receded, and properly speaking there is a recession of the equinoxes of 50" annually.

2. *The acceleration of the Moon's mean time.* In fig. 2, let S be the sun, E the earth, P the moon. Let the earth's orbit, as in fig. 3, be enlarged; the earth after the same lapse of time will only reach the point E', whilst the moon during the same time will have performed the same number of revolutions and will have arrived at P', but in fact she will eclipse the earth before arriving at P', and therefore her motion will appear to have accelerated, independent of allowance for precession.



FIG. 1.

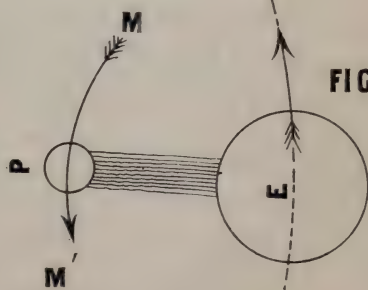


FIG. 2.

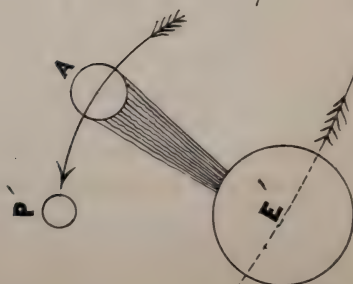
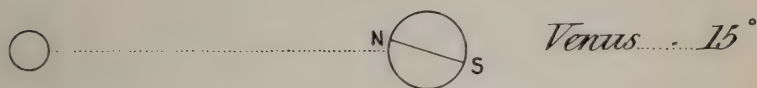
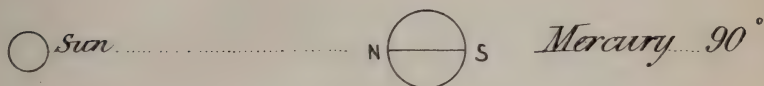


FIG. 3.



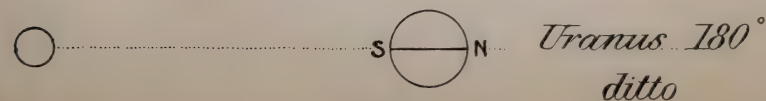
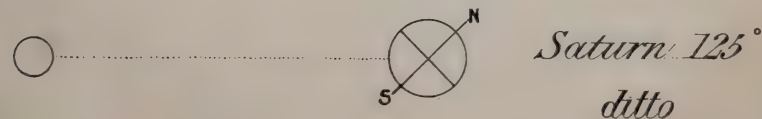
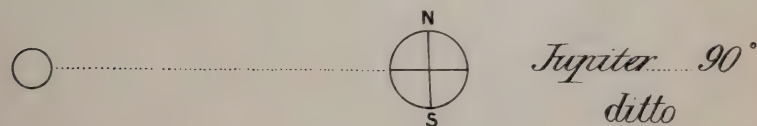
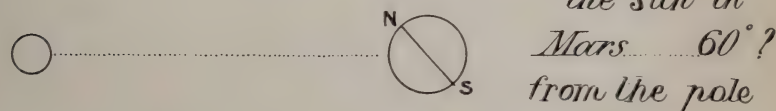
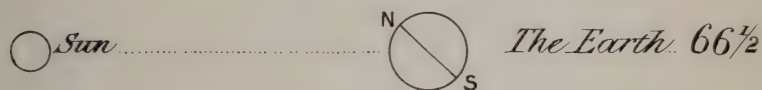
## PLATE 2.

**SHEWING THE POSITION OF THE NORTH POLE OF THE PLANETS  
WITH REGARD TO THE SUN.**



*In Venus as above, the sun is only  $15^\circ$   
from her north pole.*

*In the Earth, as below, the sun is  $66\frac{1}{2}^\circ$   
from her pole.*





MADE IN THROWS.

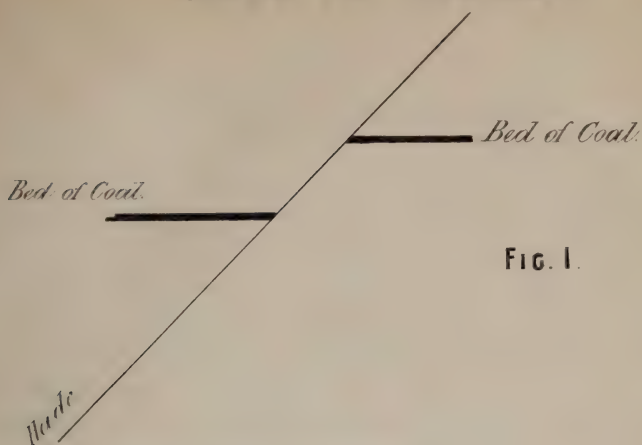
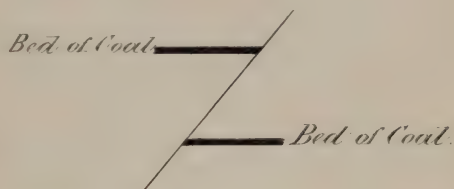


FIG. 1.

Never in this manner:—



Since this would require and imply a contraction of the Earth.

MINERAL VEINS.

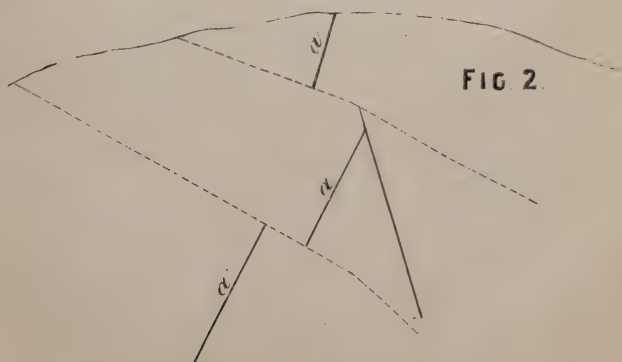


FIG 2.

All to be explained by upward movements in the Earth's crust.





A SHORT ACCOUNT OF THE TUMULUS OPENED AT THORPARCH,  
IN MARCH, 1859. BY F. B. CARROLL, ESQ., OF BOSTON SPA.

On the summit of a small hill, from which there is a somewhat extensive view, adjoining the Walton and Wetherby road, partly on the road and partly in the field, about a mile to the west of Walton Church, stood a conical hill eight feet in height, and rather over 200 feet in circumference.

It is situated in the parish of Thorparch, and about 200 yards to the southern side of the Harrogate and Church Fenton Railway. The centre of this hill was found to be a large heap of boulder and other stones of very various sizes, some of considerable dimensions, and all in a rough state and unhewn.

The Cairn itself was five feet in height, and twenty-four feet in diameter, and contained at least fifty cart loads of stones. The top of the Cairn was formed in the shape of a basin, and at the bottom of this basin or hollow were found about two hands-full of apparently *charred bones*, amongst which were small fragments of bronze or rather oxide, no doubt the remains of some coin or ornament, but so far gone as to render it perfectly impossible to ascertain anything definite as to its original shape or use.

From observations made during the removal of the stones, the tumulus appeared to have been made thus:—On the surface of the ground at the summit of the hill, a cavity had been formed one foot in depth, and three feet in diameter, in which were found a considerable quantity of charred bones, in small fragments, mixed with burnt earth and charcoal, but no remains of bronze and stone. Several pieces of flint were found, but if any of them were arrow-heads or other stone instruments, they were certainly of the rudest kind. Above this deposit, a platform of earth had then been raised,

two feet in height, and upon this platform a heap of stones piled, leaving a second hollow basin-like cavity at the top of the Cairn, one foot in depth and three feet in diameter. In this also occurred bones, &c., placed on a large stone of a flinty nature. Several pieces of flint were found, but no arrow-heads or other instruments. The largest stones were found about the centre of the Cairn and around the base; possibly a circle of large stones had been first formed, and the other stones subsequently built upon it. The Cairn itself was covered with earth to the depth of two feet above its summit, as also the bones in its centre. The quantity of bones discovered in the two deposits were unequal. That in the lower much greater than the deposit at the summit, and from being quite distinct from each other it is possible there were two distinct burials in the tumulus.

My opinion of the matter is, that the body was burned on the summit of the hill, and after the cremation, what bones remained unconsumed were collected for burial. The platform of earth was then raised on the spot where the body had been burned, the Cairn placed upon it, the bones placed in the basin before-mentioned, and the whole covered with earth. Clay is usually found in tumuli, but there was none in this. Cairns are sometimes strongly marked by fire, but there were no indications in this instance of the action of fire.

No fragment of pottery, either modern or antique, was found in the removal of this hill, or any sign whatever of civilisation, which tends to show its vast antiquity.

A gentleman who has had great experience in such matters, pronounces it to be decidedly of *early British construction*, and for the purpose of burial.

Three miles to the N.W. of it stands the vast tumulus at North Deighton, which is about 500 feet in circumference at the base, with an ascent of seventy feet.

Mr. Tindall, of Bridlington, with whom I have corresponded on the subject, says:—"There seems to be a striking resemblance in the discoveries you have made, to some that were made by myself in 1857, and last year. On the whole, there are circumstances connected with it which, on a closer examination, will prove more interesting than at first appears. The fact of the scattered charcoal being found under the platform, shows that cremation had taken place *before burial*, and not after, as is the case in some instances, both in Yorkshire and the neighbouring counties, as also in Ireland."

I have been informed that there are people in the neighbourhood who would not, on any account, pass this mound after dark; but I do not hear that any apparition has been reported to have been seen by any one. From this it might be supposed that the country people had always been aware that this mound was a place of burial; but, till it was opened, I believe none of those who express these fears had the least idea that it was so, yet this fear appears to be very similar to that of passing a lonely church-yard at *night*.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-THIRD MEETING, HELD IN THE  
CUTLER'S HALL, SHEFFIELD, ON WEDNESDAY, DECEMBER 14TH, 1859,  
AT TWELVE O'CLOCK AT NOON.

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EARL FITZWILLIAM, Vice-President, in the Chair.

The following noblemen and gentlemen were elected Members of the Society:—His Grace the Duke of Leeds, Viscount Milton, Sir J. W. Ramsden, Bart, M.P., Robert John Bentley, Esq., Finningley Park, Uriah Tinker, Esq., of Holmfirth, and Thomas Shaw Tinker, Esq., of Holmfirth.

On the motion of Thomas Wilson, Esq., V.P., seconded by H. C. Sorby, Esq., F.R.S., it was resolved, "That the Geological and Polytechnic Society do join the proposed union of the Yorkshire Philosophical and Literary Societies."

The Chairman called upon Henry Clifton Sorby, Esq., F.R.S., to read the first Paper:—

ON THE TEMPERATURE OF THE SPRINGS IN THE NEIGHBOURHOOD OF SHEFFIELD. BY H. C. SORBY, ESQ., F.R.S., &c.

My principal object in writing the following Paper is to show what is the mean annual temperature at various elevations in the neighbourhood of Sheffield, as ascertained from

the temperature of the springs, and also to show that some of them have, to a certain extent, the character of warm springs.

As is well known, the diurnal and annual variations in the temperature of the air only influence that of the ground and subjacent rocks to a moderate depth. Near the surface the temperature of the soil of course varies much from winter to summer, but in penetrating to a greater depth the amount of this difference gradually decreases, so that at a depth of from 50 to 100 feet the temperature is the same at all seasons of the year, and in this part of the globe corresponds very closely with the mean annual temperature of the locality. On proceeding to greater depths the temperature continues uniform at all seasons of the year, but gradually increases with the depth, on account of our approaching the more highly heated interior of the globe. Such being the facts of the case, it necessarily follows that, if the water of a spring has only percolated through the mere surface of the ground, its winter and summer temperature would differ considerably. If, however, it proceeds from a moderate depth, it would have nearly the same temperature at all seasons of the year, only a small variation being caused by the passage of the water to the surface. A careful determination of the temperature of springs may therefore furnish us with a very good approximation to the mean annual temperature of the localities where they occur. It is, however, necessary to proceed with caution. If the temperature of any spring in winter differs considerably from that in summer, it would not be safe to place much reliance on the mean of the two, since the same circumstances which cause this difference might also cause each of the determinations to differ much from the truth. On the contrary, if the temperature after exposure to the cold weather of winter corresponds within a degree or two with that after the hot weather of

summer, the mean would agree very closely with the mean annual temperature of the rocks at some distance from the surface. On this account I shall take no notice of springs whose summer and winter temperatures differ more than  $5^{\circ}$  Fahrenheit, which removes a great number from our further consideration. Confining, then, our attention to those whose temperature does not vary more than  $5^{\circ}$ , we must expect to meet with some having the same mean annual temperature as the rocks at a moderate depth, which would correspond sufficiently closely with the mean annual temperature of the air at each locality, and also to find others having a somewhat higher temperature, either because they come from a very considerable depth, or on account of some other more local and special cause.

Proceeding now to particular examples, I must say that the number of those which I have been able to observe in a satisfactory manner is more limited than I could wish, partly because so many of the springs have not a sufficiently uniform temperature, and partly from want of the requisite observations; for it is only at particular seasons of the year that they can be of value, and those are periods when I have seldom had the opportunity of studying the subject. Still, however, the number is I think sufficient to establish all the leading conclusions that we could expect to deduce. I may here remark that I have confined myself to springs situated quite in the country, so as to run no risk of their temperature being modified by artificial conditions, and that all might stand on the same footing, and be perfectly fit for comparison with each other. The thermometer employed was prepared for such purposes by Messrs. Nagretti and Zambra, and cannot, I believe, vary materially from the truth. I here subjoin a list which shows the locality of the spring; the elevation of the locality, derived in most cases from the contoured six-inch-to-mile ordnance map of Yorkshire; the

temperature after the hot weather of summer and after the cold of winter; the difference between these, and finally the mean temperature.

## ORDINARY SPRINGS.

Locality.	Elevation. Feet.	Summer. Deg. F.	Winter. Deg.	Difference. Deg.	Mean. Temp. Deg.
Spring at Lower Heeley.....	250	51	47	4	49
Well at Upper Heeley .....	350	50	47	3	48½
Spring at Loxley.....	475	50½	46½	3½	48½
Spring near Fox House.....	1050	46	45½	½	45½
Well at Ringinglow .....	1075	47	44	3	45½
Spring on Higgaw Tor .....	1225	47	43½	3½	45½
Spring near Upper Burbage Bridge	1275	47½	43	4½	45½

## CHALYBEATE SPRINGS.

Spring near Fulwood Mill.....	650	51½	50½	1½	50½
Spring below Loxley Edge.....	775	48½	48	½	48½
Spring near Myers Lane, No. 1 ..	775	48	47	1	} 47½
Ditto Ditto No. 2 ..	775	49	47½	1½	
Ditto Ditto No. 3 ..	775	48	47	1	

From these data we may, I think, draw the following conclusions:—The difference between the highest and lowest temperature of some of the springs is very small, being occasionally as little as  $\frac{1}{2}^{\circ}$ , though the observations were made after a very hot summer and a very cold winter, viz., in the autumn and in the spring of 1854. Such water of course appears to be very cold in summer, and comparatively warm in winter. It is extremely probable that the mean annual temperature of springs may in some cases vary according as the ground is exposed to the sun, or shaded from it by steep hills; but none of those given in the table appear to be materially affected by this source of error, all being very similarly circumstanced in this respect.

The springs which rise in the lower parts of the valleys west of Sheffield, at elevations varying from 250 to 500 feet, have a mean annual temperature of  $48\frac{1}{2}^{\circ}$  or  $49^{\circ}$ . I am not aware that the true mean annual temperature at Sheffield has been determined with great accuracy from any long series of

observations, but the mean of the mean annual temperatures of York, Manchester, and Derby is about  $48\frac{3}{4}^{\circ}$ ; and hence the temperature of the springs rising at a low level corresponds very closely with the mean annual temperature of the air at a similar level.

On ascending from the valleys to the upper parts of the higher hills, at elevations varying from about 1,000 to 1,300 feet, the general mean temperature of the springs varies from  $45\frac{1}{8}^{\circ}$  to  $45\frac{3}{4}^{\circ}$ , being on an average about  $45\frac{1}{2}^{\circ}$ . We may therefore, I think, conclude that the mean annual temperature on the higher hills is  $3^{\circ}$  or  $3\frac{1}{2}^{\circ}$  less than in the valleys. This difference appears more striking when we reflect that, according to Dove's treatise "On the Distribution of Heat over the Surface of the Globe," to arrive at the same low annual temperature as occurs on the hills, we must proceed somewhat farther north than the Orkney Islands. It may also be concluded that, on rising from the valleys to the tops of the hills, there is a diminution of about  $\frac{1}{2}^{\circ}$  in the mean annual temperature for each 100 feet of elevation. This, however, does not invariably hold good, for the shelter of the hills compensates so much for the greater elevation, that the temperature in the lower parts of the more elevated valleys west of Sheffield is much the same as that of the more open country, at a level of fully 200 feet lower, as is also well shown by the manner in which the snow often lies in winter.

Many springs in the neighbourhood of Sheffield are strong chalybeates. Several of the more remarkable were described upwards of a hundred years ago, in the very complete work by Dr. Short, of Sheffield, "On the History of the Mineral Waters of Derbyshire, Lincolnshire, and Yorkshire." As a general rule, there is only a small variation between the summer and winter temperature of chalybeate springs, which clearly points to their deep-seated origin; and we may, perhaps, consider that this conclusion is still further established



by the fact of their temperature being some few degrees higher than that of ordinary springs under similar circumstances. A spring near Fullwood is a good illustration of this fact. It is, I presume, that described at page 271 of Dr. Short's work, under the name of Fullwood Spa; though we cannot now say that it lies "on the north side of a most desert, heathy, mossy mountain," being surrounded with cultivated fields. Its mean temperature is about  $50\frac{7}{8}^{\circ}$ , though situated at the bottom of the valley, 650 feet above the sea, and it is therefore about  $2^{\circ}$  warmer than ordinary springs whose elevation is 200 or 300 feet less. Much the same remarks would apply in the case of the other chalybeate springs mentioned in the list, and we must therefore conclude either that they proceed from a sufficiently great depth to exhibit slightly the warming effects of the interior of the globe, or else that their temperature is somewhat raised by the oxidization of the pyrites of the subjacent strata, to which no doubt their chalybeate character is due. Both these causes are so very probable, that I feel strongly inclined to refer the relative warmth of these springs to their combined action.

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ON THE GEOLOGICAL AND ARCHÆOLOGICAL CONTENTS OF THE  
VICTORIA AND DOWKABOTTOM CAVES IN CRAVEN. BY  
MR. HENRY DENNY, A.L.S., &c.

The magnificent range of rocks extending through Craven belonging to the lower scar limestone of Phillips, contains numerous caverns or fissures of considerable extent, which have probably been caused by volcanic agency on the one hand, or by the action of currents of water on the other.

Those who have stood in the awfully sublime portals of Gordale, will not soon forget the feelings with which they

were suddenly impressed, as they gazed upwards at the riven sides of that stupendous gorge—contemplated the abrupt and giddy escarpments of Kilnsey—or the vast Cove of Malham—each and all geological monuments of the first class, perhaps unequalled in Europe; while the stalactitic galleries of Ingleborough exhibit a fine example of the latter.\*

To the eastward of Settle, and also near Arncliffe, caves have long been known and visited; but only as subterranean wonders, without any consideration as to their former occupants, or the period at which they were the abodes of men and other animals. Though dates in these cases are only conjectural, some approximation may be arrived at by examining such “foot-prints in the sands of time” as they contain, of the former inhabitants of the hills and valleys of Yorkshire; and these are not a few.

Mr. O’Callaghan and myself having ascertained that some interesting geological and archæological discoveries had been made at different times in some of these caves, by Mr. Jackson, of Settle, I applied to him for such information as his intimate knowledge of the localities enabled him to supply.

\* Whitaker thus describes Gordale and Malham Cove, p. 267.—“The approach to Gordale, on the east side of the village, happily remains what nature left it, a stony and desolate valley, without a single object to divert the eye from the scene before it. This is a solid mass of limestone, cleft asunder by some great convulsion of nature, and opening “its ponderous and marble jaws,” on the right and left. The sensation of horror on approaching it, is increased by the projection of either side from its base, so that the two connivent rocks, though considerably distant at the bottom, admit only a narrow line of day-light from above. At the very entrance, you turn a little to the right, and are struck by a yawning mouth in the face of the opposite crag, whence the torrent, pent up beyond, suddenly forced a passage within the memory of man, which at every swell continues to spout out one of the boldest and most beautiful cataracts that can be conceived. Bishop Poccocke, who had seen all that was great and striking in the rocks of Arabia and Judea, declared that he had *never seen anything comparable to this place.*”

“Malham Cove is an immense crag of limestone, 286 feet high, stretched in the shape of the segment of a large circle across the whole valley, and forming a termination at once so august and tremendous, that the imagination can scarcely figure any form or scale of rock within the bounds of probability that shall go beyond it.”

This was most obligingly communicated, accompanied by an invitation to examine his collection of specimens obtained from thence, and also the offer of his services as guide, if we wished to visit the caves in his neighbourhood. This offer we most gladly accepted, and went over to Settle on the 22nd of August last. After inspecting, with much interest, Mr. Jackson's collection of personal ornaments, coins, pottery, and mammalian remains, we proceeded to that series of caves in the immediate vicinity, at King's Scar, which are all situated in the side of a lofty precipitous cliff, at the elevation of about 1,460 feet above the level of the sea, and 900 feet above the town of Settle. The approach to which is somewhat toilsome from the nature of the ground, covered over, as it is, with fragments of rocks, and huge blocks of trap, the wreck of countless centuries.

“Craggs, knolls, and mounds confusedly hurled,  
The fragments of an earlier world.”

The most accessible is the Victoria Cave. This had probably three entrances, two of which are now partially closed by the debris of the superincumbent precipitous rock. The descent into this cave is rather difficult: entering by a steep fissure you have to crawl through a low and narrow passage into a cave in which you can scarcely stand upright; then through a second contracted aperture into a lofty cavern. The floor is covered with stalagmite and clay, and strewn over with blocks of limestone which have fallen from the roof; hence, by a third and nearly closed passage, you enter another large compartment. Besides these caves there are lateral fissures, whose terminations are not known. So small indeed are some of the apertures through which we had to pass, that it was necessary to take off our coats and hats, and in this *lizard-like* mode of progression, Mr. O'Callaghan left his *shirt studs* in the cave. These, when discovered by some future archæologist, will probably form the subject for a

learned (?) and critical essay on the *extraordinary* similitude of *pre-historic and modern* metallic articles of decorative art.

The Kelko Cave, near Giggleswick, which has only been partially explored, rewarded Mr. Jackson's labours by similar relics of ancient art as the Victoria, though fewer in number.

The Dowkabottom Cave or Caves, near Arncliffe, are not situated like those near Settle, on the sides of a precipice, but on a lofty plateau of the rocky crags of the Kilnsey range, 1,250 feet above the sea, from which you descend into a lofty chamber, from whose roof hang ponderous masses of stalactite. Turning by a narrow passage to the left, you enter a larger and very much loftier cave, a considerable portion of the floor of which is covered with stalagmite, owing to the constant flow of a rapid stream of water through it, from the extreme end of a narrow gallery of considerable extent.\*

The greater part of the floor of the first cave is covered with loam, charcoal ashes, clay, and soft stalagmite, of

\* Whitaker, in his History of Craven, thus describes it:—"Dowkabottom Hole is about two miles north from Kilnsey Crag, high up in the hills, and surrounded by cliffs of limestone. The entrance is an oblong chasm in the surface, overhung with ivy and fern. At the south end is a narrow but lofty opening into a cavern of no great extent. The view downward from the north is tremendous. On this side it is very lofty, and extends to a considerable distance. The rocks at the top, and particularly near the entrance, hang down in the most picturesque shapes, and both these and the sides are covered with petrified moss, richly tinted. The bottom, at first, is rugged, but afterwards changes to a brown clay, which has been found to answer the end of Fuller's earth, and is in some places petrified in masses as hard as marble, with a pellucid stream running over it, from which this deposit is formed. A sudden turn to the left at once changes the scene; the cavern now becoming very spacious, and forming a set of magnificent Gothic arches, composed of petrified matter, white as new-fallen snow. After gaining a rugged ascent, the incrustations on the sides continue, but the roof changes to a flat ceiling of dark blue rock with white seams, from which depend stalactites of various hues, rugged all over, and sharp as the points of lances. Beyond, the rocky ascent leads to a narrower part of the cavern, where the water becomes too deep to admit of any farther progress. When Bishop Pocke had seen Dowkabottom, he exclaimed,—'This is Antiparos in miniature, and except that cavern, I have never seen its equal.'"—*Whitaker's Craven*, p. 492.

variable depth from the surface, as also in the succession of deposits. Mr. Jackson found them in the following order:—

1. Loose stones and loamy soil.
2. Charcoal ashes mixed with bones, antiquarian relics, and earth.
3. Clay.
4. Stalagmite.
5. Clay.
6. Rock.

In some parts, stalagmite forms the first layer, and then immediately beneath occurs the clay, with bones and relics; in other parts, the loamy clay mixed with charcoal ashes, containing bones, pottery, and other ancient remains resting upon the solid limestone floor. In an examination of the cave which I made last September, (by direction of the Council of the Leeds Philosophical and Literary Society, and with the kind permission of the proprietor, J. R. Tennant, Esq., of Kildwick Hall,) in consequence of the superficial deposits of charcoal and soil having been disturbed by previous explorers, I excavated a fresh trench beneath the above, and passed through the following deposits:—

1. A crust of stalagmite, two inches thick.
2. Loose soil and fragments of limestone, one foot.
3. Stiff red clay, two feet.
4. Decomposed stalagmite or soft lime, from one to six feet, resting upon the rocky floor.

At another part, hard stalagmite occurred between these deposits and the solid stone floor. In the first chamber of the Dowkabottom Cave some very large stones were observed by Mr. Jackson, placed on the surface as if to mark the spot for some particular purpose. Upon the removal of these he found in a layer of charcoal ashes, nearly two feet in thickness, only a fragment of a bronze fibula, and gave up the search. Subsequently, however, Mr. Hodgson, who was excavating the same spot for James Farrer, Esq., M.P., of Inglebro' House, discovered the remains of three human skeletons laid in the bed of clay about a foot deep. Under this deposit a layer of soft stalagmite was found, and underneath all, several skulls

and bones of the wolf and goat, and also horns of the deer. On the first examination of these different caves by Mr. Jackson, the bones and teeth of animals were found with relics of human art scattered indiscriminately over the floor, or just below the surface in the charcoal ashes previously alluded to, and the first collection of specimens obtained from thence, consisting of various articles of supposed British and Roman art, coins, bones and teeth of the tiger, hyæna, bear, and wild boar, (which had been identified by the late Dr. Buckland,) were deposited in the British Museum, and a description of the antiquities was brought before the Society of Antiquaries of London, by Mr. Charles Roach Smith, the eminent archæologist, and since published in his *Collectanea Antiqua*. The result of Mr. Jackson's subsequent explorations I now venture to bring before this society as a subject of local interest, and also as a record of the important services which the unaided labours of one individual have been the means of accomplishing; as to Mr. Jackson belongs the merit of first excavating and collecting the various objects of interest from these caves.

That these several caves were for a considerable period the abode of human beings, is evident from the number of personal ornaments and implements of various kinds which have been found by Mr. Jackson, independent of numerous specimens obtained by Mr. Hodgson for Mr. Farrer. Those at present in the possession of the former gentleman consist of about twenty-four fibulæ of bronze and five of iron of various sizes and patterns, many in fine preservation and elegant ornamentation, some having apparently been plated with silver; two bronze armlets and four fragments of others; two rings, one of which has had a signet of red enamel, the other plain; bronze articles like studs; one long comb, probably for the back of the head, and fragment of another ornamented; portions of two others in form like an ordinary small-tooth.

comb, all made of bone;\* six bronze pins, one pin four inches in length, with a flat head the size of a shilling, and plated; two bone needles, six bone spoons, and several fragments of others, the handles rudely carved and the bowls having a hole in the centre as if to allow the escape of fluids; remains of two knives, one key, pieces of bronze in a half-finished state for a fibula, two bone arrow heads, a bone implement, probably the guard from the handle of a dagger; the head of an adze of trap precisely similar in form and size to one in the Museum of the Leeds Philosophical and Literary Society, brought from Tahiti;† the canine teeth of an animal, probably a wolf, perforated, as I presume, for a necklace, bracelet, or charm;‡ as also shells of *Nerita littoralis*, and *Turbo littoreus*, perforated for a similar purpose; a single valve of a species of *Cardium*, probably a worn specimen of *muricatum*;|| various articles in bronze and bone, the uses of which are unknown; fragments of glass of different qualities, glass rings, probably armlets, glass and jet beads, pottery of the ordinary Roman coarse ware, and the red or Samian ware ornamented with various devices of birds, fish, &c., two

\* A specimen, precisely similar to the first of these combs, in the possession of Edward Hailstone, Esq., F. S. A., of Horton Hall, was found amongst the accumulated stones and rubbish in St. Leonard's Priory, York, and pronounced by Warsaae, the eminent Danish archæologist, to be a *Norse comb*. For figures of these, and various other articles, see Plates 1 and 2.

+ This was exhibited by Mr. O'Callaghan at the Meeting of the British Association at Aberdeen, and excited much interest.

‡ Bruce, in his History of the Roman Wall from the Tyne to the Solway, figures a fine canine tooth of the bear, perforated in a similar manner, found amongst other antiquities during the excavations.

|| Personal ornaments made of the same objects from Africa and Tahiti, are in the museum of the Leeds Philosophical and Literary Society, and it is worth bearing in mind as connected with the circumstance of the occurrence of the shells, that with the skeleton of a female found in Paviland Cave numerous shells of the same species were observed; and also that Sir Richard Colt Hoare, discovered in a Barrow, near Warminster, the shell of a nerite, and ivory beads laid by the side of the skeletons of an infant, and an adult female presumed to be its mother.

perfectly round stones, probably intended for a sling, pieces of stone which have the appearance of having been used as whet stones, pieces of flint of an ill-defined wedge shape, but as no flint is found in the neighbourhood, these have doubtless been intended for some implements, several coins, including a large brass and silver denarius of Trajan, and small brass of Constantine and Constantius. On a former occasion the coins found were of Nerva, Nero, Gallienus, Claudius Gothicus, Victorinus, Aurelianus, and Maximus; most of the small brass are base imitations, probably by early forgers. There were also several small coins weighing only two grains each, which I have not had an opportunity of examining. From the various articles of human construction just enumerated, it becomes an interesting subject of ethnological inquiry, to ascertain who were their original possessors. That most of the relics bear the stamp of Roman art is true, but, when the peculiar locality of their deposit is taken into consideration, they point to a somewhat different conclusion, making them probably, Romano-British, rather than purely Roman; for although a Roman camp is supposed to have been at Settle, or in its immediate neighbourhood, there is no indication which would lead us to suppose that the various articles found in the caves had belonged to the soldiers of the Roman Legions, as they exhibit little or nothing of a military character. On the contrary, nearly all appear to indicate the possessors as peaceful and domestic in their habits, though not plebeian, as from the number of personal ornaments it would lead to the supposition they were above that class. The nearest Roman roads were those from Overborough, (*Bremetonacæ*), through Bolland Forest to Ribchester, (*Coccium*), and from hence to Ilkley, (*Olicana*), at each of which places there was a Roman station. The locality of the caves, however, is wide of each of these roads, especially Dowkabottom, and all in the fastnesses of the hills, as if for security, making it



appear that the occupants were not belonging to the Roman legions, but fugitives, probably the wives and families of a persecuted or conquered people, who had fled from the fury of an invading army to these hills for refuge. The question hence arises, Who were they, and to what period must we refer for their history? My friend Mr. John Dixon, a zealous antiquary, who first called my attention to these caves, has so concisely traced the circumstances under which it is probable the various articles were deposited, that I cannot do better than quote his own words:—"From the great quantities of bones, charcoal, fragments of pottery, &c., discovered, the Craven caves would seem to have been occupied for a considerable length of time by a numerous family, who have left unmistakable proofs of their acquaintance with Roman luxury and some of the civilized arts. To such a class, these wet dreary places, hemmed in on nearly all sides by a rough barren country, could not have formed very comfortable homes; and that they were entered upon from urgent necessity and not as matter of choice, seems indisputable. That they were occupied up to very near the close of the Roman dominion in Britain, is at once evidenced by the occurrence of many coins of Constantine and Constantius. Let us inquire what was the state of Britain during Constantine's reign. From what we are permitted to gather from the scanty records of that period, the whole country seems to have been smiling under the influence of a profound peace. The Emperor died in 337, and the sun of tranquillity still shone down upon his more immediate successors. The decline of Roman power had begun; Byzantium had sprung up; but the end of Roman Britain was yet somewhat distant. The Roman and Briton were as one family. The old Sixth Legion which came over with Hadrian about a century and a-half before, and who made

“ York their head quarters, had put by their swords and  
 “ were practising the arts of peace. About this period, then,  
 “ we have little or no cause for surmising that any rupture  
 “ occurred calculated to drive a large body of people to the  
 “ necessity of seeking a lengthened refuge in mountain  
 “ fastnesses. There was a dark cloud, however, gathering in  
 “ the north and full soon it burst. In the year 360, hordes of  
 “ Picts and Scots crossed the Roman barrier, and descended  
 “ upon the civilized provinces. The already weakened  
 “ Roman forces gave way before them, and the whole  
 “ country, as far as London, became one scene of devastation.  
 “ The barbarians were driven back only to renew their  
 “ attacks with more certain success. Tyrants sprung up, and  
 “ were as quickly put down ; and the end of Roman Britain  
 “ followed. The Anglo-Saxon Chronicle tells us, that in the  
 “ year 418 the Romans collected all their treasures, and some  
 “ they hid in the earth, so that no one has since been able to  
 “ find them, and some they carried with them into Gaul.  
 “ Then came the fearful times chronicled by Gildas. De-  
 “ prived of the Roman legions, deprived of the bravest of her  
 “ sons, Britain is no longer able to resist the ruthless attacks  
 “ of the northern invaders, who once more pour over the  
 “ barrier, and in the words of Goldsmith, ‘having then  
 “ ‘opened to themselves a passage, they ravaged the whole  
 “ ‘country with impunity ; while the Britons sought preca-  
 “ ‘rious shelter in their woods and mountains.’ If we want  
 “ confirmatory evidence of the historian’s words, is it not  
 “ furnished by these records, disintombed from the solitary  
 “ recesses of the mountains ? Do they not tell a tale of a  
 “ persecuted band fleeing from some common danger, as truly  
 “ as if we could summon living evidence from beneath that  
 “ green mound where the old Britons’ bones lie mouldering  
 “ with the parent earth ? And is our setting down these  
 “ relics as pertaining to the dark days that closed the *fourth*

“century, and which cast a still murkier shadow upon the “dawning of the *fifth*, very questionable?”

Dr. Whitaker says, “several of the caves appear to have “been the haunts of ancient banditti, or perhaps the retreats “of the first inhabitants.”

Amongst the articles to which I have alluded, found in the caves, some appertain to the personal ornaments and implements of uncivilized nations, as the tooth and shell necklace, bone fish-hook, and adze heads of stone; while others shew a great advance in the arts of civilized life, as the bronze and silver fibulæ of elegant form and ornamentation, rings, castings in bronze, coins, &c., which either imply that they have been inhabited by two different races of people, or that they were in a state of transition, as we might expect the Romanized Britons would be; and who would, in that case, naturally have retained some of their primæval and rude productions; in either case it is a point of considerable importance to bear in mind.

Mr. Roach Smith, I believe, endeavours to account for the articles of human construction deposited in these caves by supposing the latter to have been used as places of sepulture by the Romanized Britons, and that the charcoal ashes may have been derived from the fires used for the cremation of the dead bodies, whose ashes were subsequently placed in the urns, together with the coins and other articles belonging to the deceased. Had this been the case, however, surely some of the earthen vessels would have been found entire by the first explorers, which has not been the case; but, on the contrary, they were invariably in fragments, and with the various other articles scattered indiscriminately over the floor, and in the most unlikely places, just as they had been left by their owners, and as would be the case now by any people living for a length of time in a cave, leaving behind them the broken earthenware vessels and articles of domestic use

strewn about the floor—some probably the result of accident, and others that of conflict and sudden retreat. And further, had the caves been used for the purposes of burial without cremation, which is the most probable, we ought, in that case, to find more human bones to account for, or correspond with, the number of personal ornaments, unless the former have been destroyed by the carnivorous quadrupeds who subsequently inhabited the caves, which is not an unreasonable supposition.

Another conjecture which might be hazarded is this: that as we know the Romans worked the lead mines in Yorkshire during the first century, pigs of lead having been found in this county inscribed (with the Emperor Domitian's name) IMP. CAES. DOMITIANO. AVG. COS. VII., might not the human relics have belonged to some of these people, who made the caves their temporary places of abode, and some of which probably died therein? Rings, armlets, fibulæ, and other objects of a decorative nature, however, appear ill-suited to persons following such menial occupations at that period. I therefore consider Mr. Dixon's suggestion as far the most likely, under all circumstances, to account for the occurrence of the remains of man and his works in these caves.

In the exploration of the Dowkabottom Cave already alluded to, I found in the loamy soil fragments of skulls, jaws and bones of the short-horned ox, sheep, and goat. The Molar teeth, metatarsal, metacarpal, and coronary bones of the horse; skulls and jaws of the wild boar; portions of the horns of the red deer, one of which is the base of a shed horn, the frontal bone of a human skull, the upper extremities of a human femur, tibia, and fibula, the right side of a human pelvis, a spear head 10 inches in length, two pieces of iron much corroded, two specimens of the upper half of the spherical head of the femur of some animal cut off perfectly smooth

and perforated,\* a bone pin formed from the radius of some quadruped, fragments of Roman Samian ware, a dark-coloured ware marked with a lozenge-shaped pattern, and also a coarser unglazed kind, but marked by the potter's wheel, and the half of a large amber ring. In the clay, numerous bones, jaws, and skulls of a canine animal, smaller than the wolf, but having similar characters. In the soft stalagmite, more skulls and jaws of the above animal, skull of the fox, the jaw, femur, humerus, and atlas of a wolf of large size and mature growth, and beneath all the above, and resting upon the floor of the cave, the parietal bones of a human skull!

The exhumation of such a number of bones of different animals from these caves, suggests two questions of some interest. By what means were they deposited? And what is the probable age of the remains? With respect to the first point, two different causes present themselves,—

1st. That they have been washed into the caves by some violent flood.

2nd. That the carnivorous species inhabited the caves, and carried the remains of other animals into them for food.

The first suggestion appears to me improbable for two reasons. First, from the elevated situation of some of the caves, nearly 1,300 feet above the level of the sea, it is unlikely that any temporary flood could have risen so high during historic times as to submerge the lofty range of hills in which they occur. And secondly, even supposing this possible, the fissures, in some instances, are not sufficiently large to allow animals of the magnitude of the horse, ox, and red deer, to be floated into the innermost recesses of

\* Worsaae figures (page 93) the same object under the name of *Dambrick bone* or *Draftsman*. Edward Hailstone, Esq., of Horton Hall, has kindly called my attention to similar bone and clay articles figured in Bryan Faussett's *Inventorium Sepulchrale*, (p. xl., 59, 69, 81,) found in the Saxon graves of women in Kent, and which Akerman thinks with good reason, may have been the whirls of spindles.

the caves, unless they were larger at former periods than at present.

The second suggestion, however, is reasonable and substantiated by similar occurrences in various parts of England. We know that Yorkshire was inhabited at remote periods by the hyæna, bear, tiger, and wolf. That not only do such animals always reside in caves, but that their remains have always been found in cavernous fissures in a fossil state, as at Kirkdale, Oreston, Kent's Hole, Paviland, Brixham, &c. And as such habits appertain to the above animals in a wild state, where could they be so likely to seek a retreat when roaming over the hills and dales of the West Riding of Yorkshire, as in the various limestone fissures of Craven. And into these recesses the remains of the herbivorous quadrupeds might be carried to be devoured at leisure; and here also the carnivorous species would live and die, for a long succession of years, until they became exterminated by the hand of man, and other local causes.

This conjecture is also rendered probable from the fact, that when the caves were first discovered, the skulls and bones of various animals were strewed over the floor in considerable numbers. One person collected as many skulls as he could grasp with his two arms. As the bones, however, were not considered of value in comparison with the relics of human art, they were trodden underfoot, crushed, and destroyed. From the communications of Mr. Jackson, and from my own identification of teeth and bones, the following appears to be a list of the mammalian remains exhumed:—

**CAVE TIGER.** (*Felis Spelæa.*) A canine tooth, recognized by the late Dr. Buckland, and now in the British Museum.—Victoria Cave.

**EUROPEAN BEAR.** (*Ursus Arctos.*) I have seen in Mr. Jackson's possession a fine canine tooth, the second molar, and a portion of the radius of a bear,

much too small for the *Ursus Speleus*, and too large for the *Ursus Priscus*. Upon comparing these teeth with those of a specimen of *Ursus Arctos*, they perfectly correspond in size and character, and only differ in colour. Although the remains of this bear have hitherto been found only in the fen lands of Cambridgeshire, I have no hesitation in referring the above specimens to this species, found in the Victoria cave on the surface of the floor.

**BADGER.** (*Meles taxus.*) Jaws and teeth in the Victoria and Dowkabottom caves.

**HYÆNA.** (*Hyaena spelæa.*) A fine jaw with teeth was found in the clay in the Victoria cave, and deposited in the British Museum.

**WOLF.** (*Canis lupus.*) The left side of a magnificent lower jaw of a mature animal, and the right side of one more aged; as also bones of the extremities were found by me in Dowkabottom. Skulls have also been found, I believe, by Messrs. Jackson and Hodgson.

**WILD DOG.** (*Canis primævus.*) Nine skulls, twenty-five lower jaws, (one of which is interesting as exhibiting a compound fracture and natural restoration during the lifetime of the animal,) the scapulæ, ribs, and bones of the extremities of this animal were found by me in Dowkabottom cave.

**FOX.** (*Canis vulpes.*) Portions of the skull, jaws and bones of the extremities.—Victoria and Dowkabottom.

**HARE.** (*Lepus timidus.*) Lower jaw and teeth.—Victoria.

**WATER RAT.** (*Arvicola amphibius.*) Molar and incisor teeth.—Victoria and Dowkabottom.

**WILD BOAR.** (*Sus scrofa.*) Several portions of skulls, jaws, tusks, and molar teeth.—Victoria and Dowkabottom.

RED DEER. (*Cervus elephas.*) Fragments of horns and teeth.—Dowkabottom.

SHEEP. (*Ovis aries.*) Skulls, jaws, and various bones.—Dowkabottom.

GOAT. (*Capra hircus.*) Skulls, jaws, and bony cores of horns.—Dowkabottom.

SHORT-HORNED OX. (*Bos Taurus.*) Skulls, jaws, and various bones.—Victoria and Dowkabottom.

HORSE. (*Equus caballus.*) Molar and incisor teeth, coronary, metacarpal, and other bones. The lower jaw, with teeth, of a foal under four days old.—Victoria and Dowkabottom.

Various bones of birds, as goose, partridge, thrush.—Dowkabottom.

With respect to the antiquity of the mammalian remains from these caves, it is a question which cannot be hastily decided, as it is somewhat remarkable that although situated upon the same range of hills, and only a few miles apart, they do not both contain the bones of the same species of carnivorous animals. In the Victoria cave, for instance, we have the tiger, hyæna, and bear; while in the Dowkabottom cave, the only animals of this order are the wolf, wild dog, and fox; the first two of which have not occurred in the former cave. This circumstance might suggest the inference that they were not deposits of the same age, the former being the most ancient. A singular occurrence, though perhaps quite accidental, appears to prove the very opposite to have been the fact. In the Victoria cave, containing the bones of the supposed primæval quadrupeds, were found coins of Gallienus, Victorinus, Claudius Gothicus, Constantine, and Constantius, extending down to the Fourth century. While in Dowkabottom, in which more recent quadrupeds predominate, occurred silver and large brass coins of Trajan, belonging to the First century, A.D. 98. As, however, the



other articles of Roman art were similar in both caves, I consider the evidence which the coins afford no reliable indication of age unless we take them as a whole; when the most recent will be probably those of contemporary date, the coins of preceding Emperors passing current as lawful money long after the death of the individuals in whose reigns they were struck. In all investigations of this kind we must not overlook any circumstance, however trivial, but view it under all its bearings. For instance, the tiger and hyæna are generally supposed to be pre-historic; but associated with these we find the bear, which we know has been a native of Britain during historic times, though the precise period of its extirpation is not known. In Scotland it survived as late as the year 1057, when one of the Gordon family was directed by the King (Malcolm III.) to carry three bears' heads on his banner as a reward for his valour in slaying a fierce bear. The wild boar occurs in both caves, the last specimens of which are stated by Lord Macaulay to have been destroyed during the civil wars under Charles I. That this animal was a well known native of the Yorkshire hills, is probable from the fact of Wild Boar Fell being still the name of one locality in the West Riding, doubtless derived from wild boars frequenting the spot. Therefore, though we are not able to explain the cause of the apparent isolation of the tiger and hyæna above alluded to, yet when we find them associated with the bear and wild boar, and the latter occurring again with the wolf at Dowk-bottom, are we not justified in supposing that as species they existed contemporaneously, though the periods of their final extinction might be somewhat distant? That the latter animal, the wolf, was formerly abundant throughout this country, may be inferred from the circumstance that, in the Tenth century, King Edgar commuted the punishment for certain offences into a requisition of a certain number of

wolves' tongues from each criminal. Camden tells us that Lulwell, one of the Welsh princes, had to pay an annual tribute of 300 wolves' heads, which he paid for three years, but discontinued it on the fourth, probably because they were becoming nearly extinct. According to tradition, the last wolf killed near Leeds, was by John of Gaunt, Duke of Lancaster, in 1306, in the parish of Rothwell; and that the Inn now known under the sign of John of Gaunt marks the spot. The last specimen of this animal killed in Scotland, is recorded to have been slain at Lochabar, by Sir Ewen Cameron, of Lochiel, about the close of the reign of Charles II.

At what period, however, the wolf became extinct in England is not known; but in the notes to an edition of Somerville's Chase, by Topham, it is stated that it was in the Wolds of Yorkshire where a price was last set upon a wolf's head, but no date is attached. Therefore, though we are not able to assign the year when such a proceeding was considered necessary, we may venture to state that in all probability the Yorkshire hills were the last residence of the wolf in England. In Ireland, the last presentment for killing wolves was in the county of Cork, in 1710. Although we can trace the existence of the wolf in Britain down to this late period, it is very probable that the animal had been gradually becoming scarce long anterior to this date, as no royal edict is on record to destroy the wolf since the reign of Edward I., in the Thirteenth century, though the limestone caves of Yorkshire and Devonshire might afford them an asylum for many years subsequently.

I wish here to offer a few remarks upon the smaller species of canine animal already alluded to, whose bones occurred with those of the wolf, in the Dowkabottom cave; as in the estimation of some persons these may materially affect the question as to the relative age of the other remains. In

consequence of the diversity of opinion as to the specific identity of the wolf and the dog, I am not able to assign the above skulls, jaws, and other bones to either of these animals with certainty. They are too small for a mature wolf of the ordinary size, and we know they cannot have been immature, as the teeth leave no doubt of their having belonged to adult animals. The molar teeth especially, and the low contracted character of the forehead closely resemble the wolf; but when placed beside the remains of a wolf found in the same cave, the contrast in size is very obvious. The inference appears to be that the canine remains belonged either to a smaller species of wolf, (which has been hitherto undescribed) or to a wolf-like variety of dog, equally unknown, named by me provisionally, *Canis primævus*, which existed in Britain contemporaneously with the former, and from which it is not possible to distinguish it by the bones alone. If the dog is only the domesticated progeny of the wolf, as some writers believe, it might, *a priori*, be imagined that the numerous bones found were simply the remains of dogs belonging to the ancient human inmates of the caves which had been kept to hunt down the wild animals of the district for food, who had died in the cave, and became gradually buried up. This conjecture, however, appears liable to serious objections; for, although unquestionably contemporary with man, it is not so certain that they were co-tenants of the cave at the same period; as, in the first place, these bones occur below the mass of articles of human construction and human remains, except in the one startling instance of the parietal bones at the bottom of the stalagmite. And again, the human bones are so few as to suggest the probability of their having been carried to the cave as food by the carnivorous quadrupeds, rather than that the latter were the servants of the primæval human occupants, who would scarcely have allowed the decomposing bodies of

so many animals to remain in their place of abode. I therefore infer that the quadrupeds, whatever they might have been, were wild, and resorted to the caves for shelter, as is the habit of similar species in a wild state at the present day. Animals never (as far as I am aware) degenerate in a state of nature; and as we find the dog depicted on the monuments of Egypt and Nimroud in a domestic state, and known and referred to as such, during the sojourn of the Israelites in Egypt, and as in the most ancient languages, as also in every modern dialect, the dog is known by a distinctive appellation, instead of being the descendant of the wolf, the supposition arises that it was originally specifically distinct, and very early subject to man's use. At all events, the period of its domestication is lost in the lapse of ages, or not alluded to in the earliest of human records. And independently of the circumstance that the dog, as a species, is found in every region of the globe where man is resident, there is some reason for believing that it may be an earlier inhabitant of this planet than man himself; in support of which I may adduce the fine skull exhumed from the gravel in Norwich, and presented to the Museum of the Leeds Philosophical and Literary Society, by Mr. O'Callaghan, which has been pronounced by Professor Owen to be that of a dog; and also that the evidence in favour of the dingo of Australia having existed in that country prior to the Aborigines, is supplied by the discovery of a skeleton of that animal at Warnamboil, beneath a bed of volcanic ashes; and further, that in the museum at Melbourne there is a fossil skull of a dog found in a cave at Mount Macedon, with other animal remains, by Mr. Selwyn, the Government Geological Surveyor of Victoria, which skull is stated on the authority of Professor M'Coy, to be identical with that of the dingo of the present day. Whether,

however, we consider the canine remains to be those of wolves or dogs, we must not, in either case, assign them to a recent deposit, as the absorbent condition of the bones leaves no doubt of their antiquity. If any additional evidence is required to substantiate the probable age of the mammalian reliquæ from the Victoria and Dowkabottom caves, it is furnished by the fact that Dr. Buckland found in the Kirkdale cave (also in Yorkshire) the bones of all the animals I have enumerated, with the exception of the wolf-like dog, associated with those of the elephant, rhinoceros, and hippopotamus, and must therefore all have been contemporaneous.

From the occurrence of the remains of man and his works in these caves, apparently mixed with the bones of extinct animals, it brings the oft-contested point before us—Were they contemporaneous in this instance? That this is a question of extreme difficulty to determine I am fully aware, and have elsewhere endeavoured to prove, from the numerous instances which are on record of their association under circumstances so apparently conclusive, that we are justified in either extending the epoch of man's advent, or bringing the life periods of the extinct mammalia down to a more recent age, when the last of the latter might be coeval with the first of the former. I need not now refer to the various localities in which the remains of man and extinct animals have been discovered both in Britain and on the Continent, as all such occurrences have been invariably negatived at the outset by geologists, apparently from a pre-determination not to allow of their having been of the same age, however conclusive the evidence they adduce. Instances, nevertheless, continue to occur in spite of these geological edicts, which are of such a character as to render it almost impossible to doubt or disprove them. I here allude to the discovery in the Brixham cave, of flint implements of human construction, with bones of the cave bear, hyæna, cave lion, cave tiger, elephant, rhinoceros,

hippopotamus, giant deer, and other extinct animals, by Dr. Falconer, who has also lately observed a similar deposit of flint and agate knives with extinct animals in the Grotta di Maccagnone, near Palermo; and more especially Mr. Prestwich's communication to the Royal Society,\* of the occurrence of several hundreds of flint axes and arrow-heads, in undisturbed gravel, with bones of the elephant, rhinoceros, hippopotamus, &c., at Abbeville, and Amiens, in the north of France, which has been corroborated by Sir Charles Lyell, who, in his eloquent address to the British Association at Aberdeen, observes:—"No subject has lately excited more curiosity and general interest among geologists and the public, than the question of the antiquity of the human race: whether or no we have sufficient evidence to prove the former co-existence of Man with certain extinct mammalia in caves, or in the superficial deposits commonly called drift or 'diluvium?' For the last quarter of a century the occasional occurrence in various parts of Europe of the bones of man, or the works of his hands, in cave breccias and stalactites, associated with the remains of the extinct hyæna, bear, elephant, or rhinoceros, have given rise to a suspicion that the date of man must be carried further back than we had heretofore imagined. On the other hand, extreme reluctance was naturally felt on the part of scientific reasoners, to admit the validity of such evidence, seeing that so many caves have been inhabited by a succession of tenants, and have been selected by man as a place, not only of domicile, but of sepulture; while some caves have also served as the channels through which the waters of flooded rivers have flowed, so that the remains of living beings which have peopled the district at more than one era, may have subsequently been mingled in such caverns, and confounded together in one and the same

\* See Annals of Natural History, September, 1859, p. 230.

“deposit. The facts, however, recently brought to light  
 “during the systematic investigation, as reported on by  
 “Dr. Falconer, of the Brixham cave, must, I think, have  
 “prepared you to admit that scepticism in regard to the  
 “cave-evidence in favour of the antiquity of man, had  
 “previously been pushed to an extreme. To escape from  
 “what I now consider was a legitimate deduction from the  
 “facts already accumulated, we were obliged to resort to  
 “hypotheses requiring great changes in the relative levels  
 “and drainage of valleys, and, in short, the whole physical  
 “geography of the respective regions where the caves are  
 “situated,—changes that would alone imply a remote  
 “antiquity for the human fossil remains, and make it  
 “probable that man was old enough to have co-existed at  
 “least with the Siberian mammoth ; but in the course of the  
 “last fifteen years another class of proofs has been advanced  
 “in France in confirmation of man’s antiquity, into two of  
 “which I have personally examined in the course of the  
 “present summer ; and I am fully prepared to corroborate  
 “the conclusions which have been recently laid before the  
 “Royal Society by Mr. Prestwich.”

After the testimony, therefore, of such a man as Sir Charles  
 Lyell, whose profound researches as a geologist, and extensive  
 knowledge of all the collateral branches of science are of  
 European recognition, surely this highly important subject  
 ought to be finally settled ; more especially as his conviction  
 is the result of a careful and minute investigation on the  
 spot, by one who formerly held a different opinion. To  
 those who yet remain sceptical, I would observe that the  
 subject appears to be reduced to very narrow limits, inasmuch  
 as when we find the remains of man, his works, and extinct  
 animals in a deposit of clay or gravel, which afford the most  
 indubitable evidence of never having been disturbed since its  
 deposition, we ought at once to admit equality of age, and,

in instances like that in the north of France and elsewhere, we are driven to adopt one of two inferences which doubters may suggest. Are the flint implements of man's construction, or are they extraordinary natural or accidental formations of silex? This latter is so absurd as not to deserve a moment's consideration, and therefore no other rational conclusion can be arrived at than that of Sir Charles Lyell's, that they are of human construction, and were deposited at a period coeval with the remains of the extinct pachyderms with which they are now found associated.

If it is still urged that no human bones have yet been found in such situations as fully to establish the remote antiquity of the human race, or the co-existence of man himself with the larger pachyderms, I would refer to the female skeleton found by Dr. Buckland, in the Paviland cave, which lay extended in the usual position of burial. By the side of the thigh bone, where the pocket is worn, was found about two handfuls of shells of the *nerita littoralis* in a state of complete decay. At another part of the skeleton, in contact with the ribs, were from forty to fifty fragments of small cylindrical ivory rods about four inches in length, also portions of ivory rings, and pieces of ivory in process of manufacture into some articles, which had been cut by a rude instrument, the marks of which remained on the surface. Now Dr. Buckland considered this skeleton as coeval with, if not anterior to, the Roman invasion of this country; but not antediluvian, as he believed the bones of the elephant, rhinoceros, bear, hyæna, and wolf to be, which were found in the same cave. When, however, we bear in mind that most of the ivory articles were so much decayed as to split longitudinally by the separation of the laminæ of the tusk out of which they were made, and that they were most undoubtedly manufactured when the tusk of the elephant was firm and hard, as also the decayed state of the shells,



additional proof is afforded not only of the very high antiquity of these relics, but also of the individual to whom they belonged. For if we find tusks of elephants in a cave, the ivory of which exhibits little or no indications of decay, (and these are unhesitatingly allowed to be of a very remote date,) by what process of reasoning can we refer articles made of ivory, decomposing from the effects of time, and associated with the former, to a later or more recent date?

Again, I might refer to the extraordinary discovery by Messrs. Dickeson and Brown, in New Orleans, of a deposit of ten forests of cypress trunks of the same species which still exists in the locality, many of them of very great diameter, arranged vertically above each other, and separated by layers of earth. Above the most recent of these beds now grows a forest of evergreen oaks, the age of which alone is estimated at 1,500 years. At sixteen feet below the soil, and in the fourth of these beds from the surface, was found a well-preserved human skull, corresponding perfectly in its form with the skulls of the actual Aborigines of America, and accompanied by the remains of burnt wood, from which we must conclude that this country was inhabited ages ago by men of the American race, who have left in their burial mounds flint arrow and spear heads, and stone adzes, similar to those found in Europe. And further, these rude weapons have been found associated with the bones of the mastodon. In a conversation I had with Catlin, the American traveller, he informed me that Koch, who exhumed and brought to England the fine skeleton of the mastodon which is now in the British Museum, stated to him that with the bones of the above animal he found several flint arrow-heads; and that one of these weapons had penetrated some depth into the substance of a leg bone. Poor Koch was much annoyed that his testimony upon this point was doubted, simply because it was heterodox and militated against the generally received

opinion. As connected with the above skeleton, Mr. Catlin related to me a remarkable fact, which almost implies that the former existence of the mastodon had been handed down by tradition amongst the Indians. When he was in the locality where the bones were subsequently exhumed by Koch, the Indians told him that there were several large bones buried at a particular spot, by some trees. Catlin said "How do you know?" They replied, their fathers had told them so. He again inquired, "Have you seen them, or has any one else?" "No; but we can shew you the spot, and they are very deep," was the reply. Some fur traders had commenced a search for the treasure, but gave it up as fruitless, which also deterred Catlin, who then left for the Rocky Mountains. Koch next visited the district, when the Indians told him the same story. He expended all his cash in the search, and at the depth of twenty-five feet in drift and gravel, he found the bones of the mastodon, as well as a quantity of charcoal, and the above flint arrow-heads, &c. Now if the tradition as related by the Indians is doubted, by what means could they be cognizant of the fact that bones were buried at this spot? it could not have arisen from previous diggings, as they do not disinter such remains. The Maories of New Zealand are aware of the existence of the bones of the moa and dinornis, but entertain a superstitious regard for them, as belonging to their ancestors, and under this idea, will not allow of their removal. We must, therefore, either believe the testimony of the natives as regards the tradition, or suppose that, as in Ireland, the localities where the bones of the giant deer are buried, are indicated by peculiarities of surface and vegetation. Mr. Glennon, of Dublin, a most successful discoverer of bones of the megaceros, informed me that in riding through the country he could always point out a spot likely to contain such remains by the peculiar appearance of the ground. As the natives, however, have

no inducement to collect such objects, the latter supposition is improbable, as it could only be acquired by long experience in searching for such relics, which they have not had.

In conclusion, however, I am not prepared to assert that the question of contemporaneity is fully established by the contents of these caves, though they certainly furnish facts which lead to such a conclusion. We find the bones of the tiger, hyæna, bear, wolf, wild boar, &c., occurring with various articles of human construction and in certain instances human bones, in some cases above the stalagmite, in others underneath it. Who is to decide which of the two is the most ancient? In a letter from Mr. Jackson respecting the Victoria cave, he says: "The bones and teeth I have found have always been, "with the antiquities, strewed all over the place; but there "were bones both above and below the other things. In "all cases where I have broken up the stalagmite with no "deposit of earth upon it, the antiquities were underneath." On the first discovery of these caves the floor was strewn over with cart loads of skulls and bones of animals, which would imply a long period of occupancy; beneath these occurred man's bones and the works of his hands. In the Victoria cave, where the greatest number of works of early art were found, only two human teeth were identified. Where were the other portions of the skeletons? It would almost suggest the idea that some of the carnivorous quadrupeds had frequented the cave subsequent to man having made it his place of abode, for it seems very unlikely as I have already observed, that so many human beings as the personal ornaments must have belonged to would have resided in the cave while it presented so much the character of a charnel house! If we allow the above to have been the case, and also connect with it the circumstance that all the remains of pottery were fragmentary, might not this arise from the natural propensity of some of the animals to search

for and devour such human bones as they could disinter, and in so doing scatter the various ornaments and portions of earthen vessels which the former occupants had left with their own remains on the floor of the cave? I may be told this reasoning would bring the life periods of the extinct mammalia down to too recent a date, as the coins suggest, that towards the close of the Roman occupation of Britain, or the latter part of the Fourth century. At all events this period is not too recent for the bear, wolf, and wild boar, which I have shown are of comparative late extirpation, and therefore might have frequented the caves long subsequent to man; and the supposition that a solitary straggler of the tiger, whose remains are of rare occurrence, might have resorted to the cave subsequent to man's occupancy, is not so improbable as at first it might appear, from two circumstances. In the first place Mr. Jackson found the tooth of the tiger, and the teeth and bones of the bear, on the surface of the floor, near a place where a small stream of water had washed away the soil, and the jaw of the hyæna was in the clay just underneath. And, secondly, from the fact of my finding the parietal bones of a human skull below the clay, soft stalagmite, and bones of the wolf, resting upon the rocky floor of the cave, which would at least imply that the human and canine remains were coeval; and as we know the wolf existed at the same period with the hyæna, tiger, bear, hippopotamus, rhinoceros, and elephant, we may reasonably infer that man was also contemporary with the latter animals, which inference I consider further strengthened by the circumstance that in this very neighbourhood the works of his hands were found in close approximation to the bones of the hippopotamus, elephant, and urus, in the brick-clay at Wortley, during 1852. This, however, does not necessarily imply that the Romanized Britons were the people contemporary with all the extinct animals enumerated, for, besides the various

bronze and other articles of this era, I have also alluded to implements of a rude and primitive type, fewer in number, and if I may judge from what specimens were exhumed in my presence, all occurring beneath the bronze ornaments; and lastly the remains of a human skull, considerably lower still. These must point to a period long anterior to the Fourth century, which was in all probability the last time when these caves formed the places of abode of a half-civilized race of people, while the former may appertain to a pre-historic age.

Thinking that the formation of the skull might afford some indication as to this early race of man, Mr. O'Callaghan and myself carefully compared the parietal bones with those in the skulls of an ancient Egyptian, a Mexican from the burial-ground of Cuzco, the ancient capital of Peru, a Roman disinterred near York, and a modern European, and found that the situation of the lambdoidal suture did not correspond with that in any of these; and what was more remarkable, the right side was considerably less in size and much more flattened than the left, but whether this is an accidental malformation, or the effects of artificial pressure, cannot be determined. Mr. Farrer informs me that the skulls obtained by him from the same cave were all considered as early British. I am not aware, however, whether these exhibited the same peculiarity, or that any indications of such a custom having been practised by these people has been discovered, which would point to a remote or aboriginal race. The Caribs compressed the frontal bone, while the early Mexicans produced deformity on the back part of the head, by pressing the occipital bone, the lambdoidal suture, and the adjoining portions of the parietal bones, sometimes to the right, and sometimes to the left, so as to cause one side of the head to be much higher than the other. This deeply interesting physical peculiarity may be

more satisfactorily examined, and further evidence procured on future explorations of this cave, which are to be soon undertaken by Mr. Farrer.

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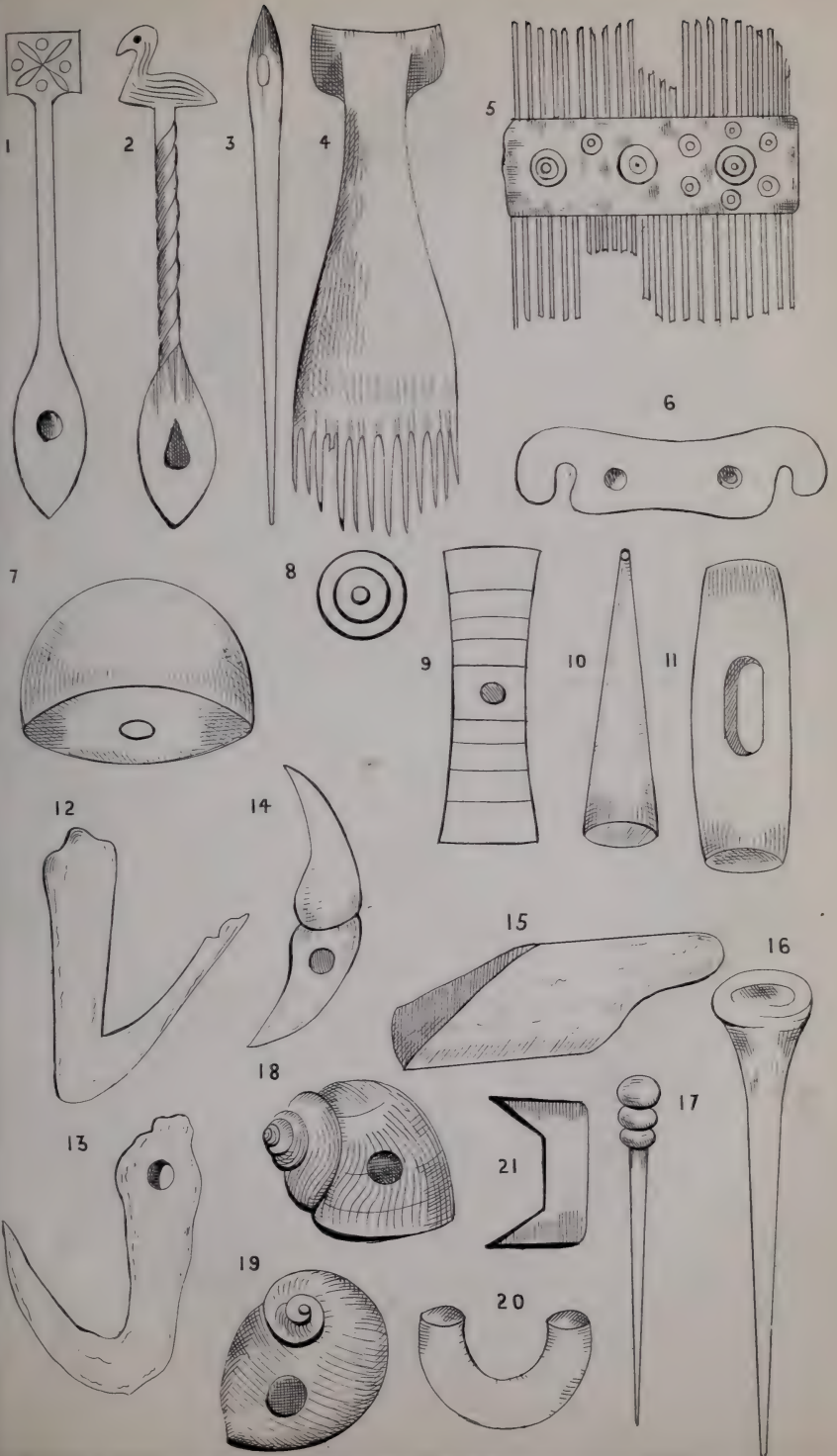
## EXPLANATION OF THE PLATES.

### PLATE 1.

- 1 and 2 Bone Spoons.
- 3 Bone Needle.
- 4 and 5 Bone Combs.
- 6 Bone Implement, unknown.
- 7 Bone Implement, supposed whirl of a spindle.
- 8 Bronze Ornament.
- 9 Bone Article, use unknown.
- 10 Bone Arrow-head.
- 11 Bone Implement, supposed to be the guard of a dagger.
- 12 and 13 Bone Fishhooks.
- 14 Canine Tooth of a Wolf, perforated.
- 15 Stone Adze.
- 16 Bone Pin or Skewer.
- 17 Bone Pin.
- 18 *Turbo littoreus*, perforated.
- 19 *Nerita littoralis*, perforated.
- 20 Portion of an Amber Ring.
- 21 Bone Article, use unknown.

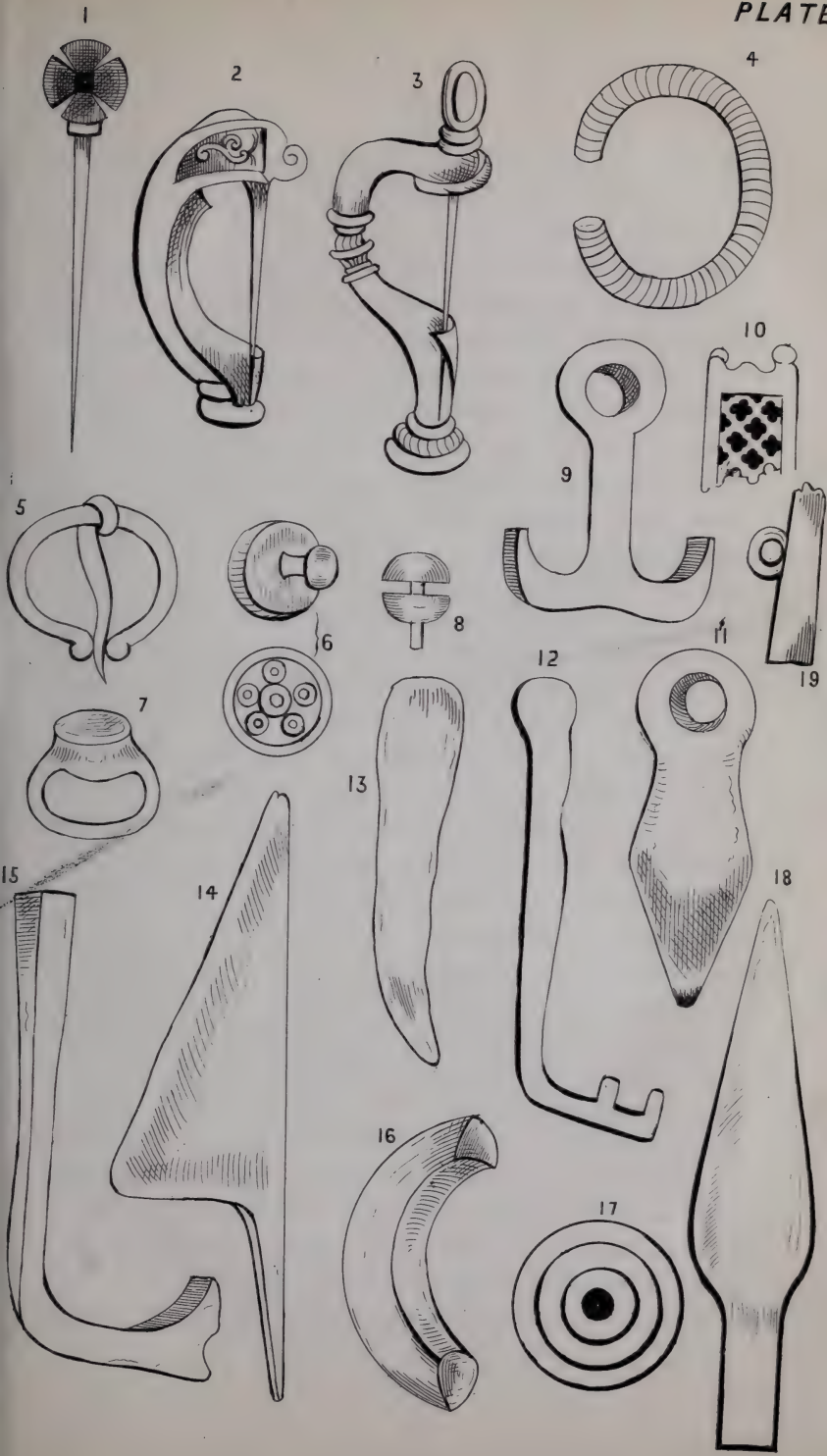
### PLATE 2.

- 1 Bronze Pin, with silver head.
- 2 and 3 Bronze fibulæ.
- 4 Bronze Bracelet or Armlet.
- 5 Bronze Buckle.
- 6 Two Views of a Bronze Stud.
- 7 Bronze Ring, with red enamel signet.
- 8 Bronze Article, unknown.
- 9 Iron Hook.
- 10 Bronze Ornament.
- 11 Iron Hammer Head.
- 12 Iron Key.
- 13 Remains of a Knife.
- 14 Remains of a Knife.
- 15 Iron Article, unknown.
- 16 Portion of a Glass Armlet.
- 17 Disk of Sandstone, with circles cut upon it.
- 18 Iron Spear Head.
- 19 Metal Tube, use unknown.











ON FIRE CLAYS. BY C. W. BINGLEY, ESQ., PH. D., F.C.S., OF  
WHITLEY HALL, NEAR SHEFFIELD.

Amongst the various clay deposits in the kingdom, there are none of equally deserving importance to this town as those which occur in the coal formation, and are known as fire-clays. Of these there are fortunately several very considerable ones in the neighbourhood of Sheffield, skirting the border of the coal formation and the millstone grit of the high moors. To these my attention has been more particularly directed than to those obtained from other deposits in the same formation. As all seem to possess one property in common, that of making fire-bricks, yet, as is well known to the manufacturers who require fire-bricks in the construction of their furnaces and fire-clays for crucibles, a very considerable difference exists amongst them as regards their qualification to resist heat and withstand any sudden change of temperature when intensely heated, as in the case of the withdrawal of crucibles, containing metal in a high state of fusion, and in the cooling of furnaces. With the object in view of accounting for this difference of quality, I commenced some time ago a course of experiments on several of them, intending as any opportunity might occur to continue them until I had completed my researches, so far as to comprise all the various deposits of the neighbourhood. So far I have examined rather more than a dozen, and from these I shall select a few for reference to on this occasion, premising that I must nevertheless request your indulgence for any incompleteness in the present instance attendant upon my having only had a few days' notice to collect my notes of the experiments, so as to condense them into the form of a report. Commencing with an analysis of each, I do not intend to particularise the source or precise locality of each individual specimen selected, inasmuch as it

might be invidious to parties engaged in the making of fire-bricks, in a commercial point of view, and therefore I shall merely indicate each specimen by letters :—

	A	B	C	D	E	F	G	H	I	K	L
Silica .....	43.0	46.2	63.7	83.29	82.48	68.05	65.10	63.87	62.79	47.54	70.25
Alumina ..	40.9	30.8	20.7	8.10	8.60	18.85	22.15	20.96	17.95	29.51	16.90
Lime .....	1.3	..	..	} 2.99	..	.70	..	.40	1.62	1.74	1.27
Magnesia ..	0.1	..	..		..	..	.80	.84	.82	..	..
Iron Oxides	trace	8.4	4.0	1.88	0.22	5.20	1.95	.75	.19	7.93	4.00
Water .....	14.7	14.2	10.3	3.64	8.30	6.00	10.00	11.68	14.77	12.29	7.10
Potash .....	..	0.4	..	..	..	..	..	..	..	..	..
Loss .....	..	..	1.3	00.10	00.40	1.20	..	1.50	1.86	.99	.48
	100.0	100.0	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

The amount of water was estimated by drying each of the samples at 100° Fahrenheit, until it ceased to lose further weight, each being previously dry to the touch.

In order to ascertain the degree of fusibility of each kind of clay, I first baked or burnt a piece to the state of an ordinary fire-brick, from which portions were chipped off so as to present several sharp angular edges. These were placed in a crucible, lined with powdered charcoal, and afterwards heated in a wind furnace, heated to the fullest extent possible for some time. After allowing the crucible and its contents to cool, the pieces were taken out and examined; the comparative value of each being estimated according to the degree it had resisted fusion, as shown by the thin edges of the broken piece being rounded or rendered translucent. To denote this, I arranged each according to a scale ranging from 0 to 10, the lowest number in the scale indicating the highest degree of resistance to fusion. In this manner I obtained the following results from the specimens given in the table of the analysis of each :—

	A	B	C	D	E	F	G	H	I	K	L
Degree of fusibility..	4	6	1	8	1	2	2	1	7	6	5

In a similar manner I denote the power of each, of resisting sudden changes of temperature without cracking. For this purpose a crucible was made of each kind of clay, and

after carefully drying, these were subjected without previous annealing to the heat of an intensely heated air furnace, and when thoroughly heated to the temperature of the furnace, suddenly withdrawn and exposed to a current of cold air. The following table shews the result obtained in each case :—

	A	B	C	D	E	F	G	H	I	K	L
Degree of power of resistance to change of temperature. }	5	3	6	6	4	3	5	4	6	3	4

On comparing the results of these experiments, it appears obvious that those clays in which, according to the analysis given, the minimum amount of oxides of iron, and the alkaline earths is present in their composition, are the best adapted to resist fusion, or crack on being exposed to any sudden change of temperature; desiderata most essential for the purposes they have to be applied to. It is now universally admitted by chemists that clays are definite chemical compounds of silica, alumina, and water, the composition of such consisting of one equivalent of alumina combined with two of silicic acid, and two of water, and thus the various other bodies with which they are found associated are mere mechanical mixtures, to be regarded only as impurities; the presence of these substances materially impairing the qualities of the clays in which they are present.

ON SOME OF THE DIFFERENCES IN THE DEPOSITION OF COAL.  
BY SAMUEL BAINES, ESQ., OF LIGHTCLIFFE.

Coal is of such paramount importance to this, or even any district, that it would be a work of supererogation to dilate upon the fact. It would not be too much to say that we owe more to coal for the prosperity of our country than to that boasted Anglo-Saxon variety of the proud Caucasian family of man, to which we belong.

My remarks will apply more particularly to the West Yorkshire Coal Field, though I think, with slight variations, they are applicable to all; the prevailing opinion being that all coal has been changed by heat into the many varieties of stone coal, of Yorkshire; cannel coal, of Lancashire; culm, of Wales; or anthracite, of mineralogists. The major part of Yorkshire coal is the slate coal of mineralogists. Having on a former occasion advanced the opinion that the Yorkshire Freestone is an estuary deposit, it being but a continuous member of the coal series, further research confirms that opinion, and goes to convince me that the Yorkshire Coal Field and its intermediate strata is one large estuary deposit; one of the strongest evidences being the general thinning of the respective strata to the east, which would bear out the idea that some large sluggish river or rivers had quietly deposited the contents of their turbid waters from the North-west by West. I know of no supposition but that of an estuary deposit, to account for the basin or spoon shape of coal formations, except the extravagant one of satellites, that have fallen to our earth as their primary. The loose floated materials becoming more solid would have a tendency to settle in the middle (as there would be less support in the centre) as we have often seen the basset edge left behind at a greater angle, the change must be allowed to be great and complete between the finishing deposition of the sandstone grit and the commencement of the coal series. From whatever quarter the debris that forms the carboniferous sandstone of this district came, I think it must have been worn on some beach, by powerful drifts, rapid currents, glacial deposits, or the wild dash of some primeval ocean's successive storms, and perhaps the tidal billows of a comparatively inland sea. To me there seems no need to call in any great astronomical change to bring about a more settled state of things. The currents of this inland sea or estuary, by which the

granitic debris has flowed, and met the river water in uproarious contention, would consequently agitate the very bottom at every ebb and flow of its tide, by which some change in the currents of the oceanic deposited debris of the rivers might begin to form a sandbank at the very junction ; and where these forces were equal, or their powers exhausted, this sandbank or bar would have a tendency to check the force of both. We have seen similar effects in the change of currents in the drifting of snow. The continual accumulation would shut out the ocean, and convert the river waters into a sluggish estuary ; and all future deposits would be supplied from the river or rivers through the varied deposits of more than 600 yards of strata, alternating with sandstone, shale, coal, and ironstone, &c. Just in proportion to the gain of the sandbank on the river's current, would be the dry land or the estuary covered with water. I think this is sufficient to account for the varied strata without the hypothesis of an alternate earthquake, or volcanic upheaval and submergence. There is no need of an upheaval to cause dry land, as the silt deposited from the rivers would raise the delta, and a little addition to the sandbank or slight submergence would put the delta under water again. I have a great objection to multiply causes in nature when we have daily before us adequate phenomena. It has been customary to account for the coal strata by upheavals and depressions, but there is no evidence of violence from the deposit of the sandstone grit until the last member of the coal series was finished. The only evidence of upheaval is at the Permian period, when the backbone of England, as it is sometimes termed, was raised. No doubt it was at this period when our coal series was so disrupted. There is no appearance of any erupted matter in the Yorkshire Coal Field ; but there are trap dykes in the Northumberland and Durham series. I have no wish to go into the salt or freshwater origin of the intermediate shales,

sandstones, &c., of the carboniferous strata. No doubt there are both. The fossil pecten of the Halifax and Sheffield bottom coal shales, denotes a mixture at least of saltwater, and the enormous mass of freshwater mussels, of the middle coal and ironstone beds of Shelf and Low Moor, are a strong evidence of the strata having been deposited in a lake or inland sea. I think the major part of the vegetation from which coal has been derived, has grown upon dry land, or in swampy lagoons, similar to the Cypress Swamps of the Delta of the Mississippi, described by Sir Charles Lyell;\* also in Mr. Hawkshaw's Reminiscences of South America; and the researches of Mr. E. W. Binney, who, with praiseworthy industry, has laboured to explain those curious trees, the *Lepidodendron* and *Sigillaria*, of which the coal is so largely composed in the Lancashire and Yorkshire beds. I suspect, however, the annual fall of the foliage has contributed more to the deposit than the stems themselves, the reed-like calamite has evidently been a water-plant, from its being found in such abundance in the black shale, rather than in the coal itself, though there are beds of coal on the Continent, largely composed of calamites.† Mr. Binney says, "where the plants grew and the strata " in which they are found, were no doubt deposited under water " and shew no evidence of being dry land;" p. 162. "The " presence of the remains of bivalve shells and fish in cannel " coal clearly proves that it was formed under the water;" p. 163. "In the upper new red sandstone, of Western Bank, " near Runcorn, in Cheshire, we have the first evidence hitherto " discovered of dry land in England." Again he remarks, "There is no positive evidence of dry land before the tertiary " period." Sir R. I. Murchison observes, "It may be well to " state that there is no geological difference between stone

\* P. 334. of his Manual.

† Manchester Philosophical Society, see vol. 13, p. 167.



“coal and culm or bituminous and common coal. They are in fact mere mineral varieties of the same substance which occur in formations accumulated at the same period.”\* Sir C. Lyell, in his *Manual*, p. 333, quoting Liebeg and Bischoff, says, “The disengagement of all the gases gradually transforms ordinary or bituminous coal into anthracite; to which the various names of splint, glance, culm, and many others have been given.” Liebeg, in his *Chemistry*, gives the following analysis of Mineral coal: “Hydrogen 13, carbon 24,” and states that it “appears to be produced by long-continued decomposition of wood or wood coal, by which carbonic acid and water, and carburetted hydrogen are separated; when the whole of the hydrogen is removed in the form of carburetted hydrogen the residue must be anthracite, which is nearly pure carbon.” Professor Johnston, in his inaugural address to this Society, said “Cannel coal contained one atom more water than coking coal,” which is very correct. Dr. A. A. Hayes, United States, in a paper read at the Dublin Meeting of the British Association, in 1857, has evidently been struck forcibly with the difficulty to account for the conversion of bituminous coal into anthracite. No coal tar being found in the vicinity of the beds, how is the absence of this material to be accounted for but by supposing that it has been originally a different kind of deposit?

Dr. Hayes details a course of experiments to illustrate his opinions, but the experiments were performed under a light atmosphere of gases, whereas the bituminous coal has an enormous weight of superincumbent strata. This, to me, appears a fatal objection to his experiments in proving the change of the coal after being deposited, as there should be springs of natural bitumen or petroleum near the cannel beds, if this theory be true.

\* *Silurian System*, vol. 1, p. 371.

Sir C. Lyell, in his *Second Visit to America*, vol. 1, p. 286, says, "I found on visiting the various localities of the natural coke, that it was caused by the vicinity or contact of volcanic rocks, greenstone, and basalt, as in the Durham coal field."

Mr. Buddle writes, in the *Transactions of the Natural History Society of Newcastle and Durham*, vol. 1, p. 13, "That in some cases a cinder dyke converts the coal for one hundred yards into coke or smudge coal."

Mr. Foster, in the same work, p. 48, remarks, "That the coke should be specifically heavier than the coal," but accounts for it "from the extreme pressure it was under when the Trappean dyke changed it, and passed other matters into it as the gases were driven off."

Mr. H. D. Rogers, in his work on the *Geology of Pennsylvania*, vol. 2, p. 809, says, "The causes of the different degrees of de-bituminisation of the coal in different parts of their range, I am disposed to attribute to the prodigious quantity of intensely-heated steam and gaseous matter emitted through the crust of the earth, by the almost infinite number of cracks and crevices which must have been produced during the undulation and permanent bending of the strata."

Dr. Bevan, in the *Geologist*, vol. 2, p. 80, says, "I cannot help imagining that the changes have been caused by trap rocks, far below the surface; and that the gradual disappearance of the anthracitic tendency has been simply the diminishing distance from the heat which has caused the change north crop coal anthracitic, while the upper measures are bituminous. I consider the reason to be that the changes were subsequent to the deposition of the lower measures, and prior to the upper ones."

The authors of the *Fossil Flora* remark that three or four species of plants go to the formation of coal. One-half may

be said to be ferns, some firs, a few palms, a few species unknown, and no exogens. One never differs in opinion, but with regret, from the ever-honoured name of Humboldt, but I do think a century is too long for the deposition of eight French lines; and, on the other hand, a century is too short for the nine-inch bed of coal at Bolton, with the large trees grown upon it.

Mr. R. Hunt says, "Without the light of the sun, no tropical plant can be produced." But perhaps there may be some little error in requiring one great phenomenon to do what a great number of little disturbing causes may have effected. We know that the sun's rays are not required to produce that luxuriant, though it may be pale and almost flowerless, flora of our present woods, beneath the rich spreading oaks, elms, and ashes, on the steep slopes of our shaded glens, in the shadow of our dark pointed rocks, where the rays of the sun never shone, where annually rises the brake or common fern, with a variety of other annuals to the height of a man, and with a luxuriant compactness that makes it difficult to wade through them in the beginning of autumn. And if you work down to the roots of the present growing ferns, it will be found that many years are required to produce their partial decomposition. Perhaps rivers from the tropics, having connection with a similar stream to the gulf stream, hot springs, and certainly a more moist and extra quantity of carbon in the highly charged atmosphere, may probably produce these so-called tropical plants. But from whatever phenomena, causes, or length of time coal is in forming, I think the variety of minor disturbing causes is more consistent than calling to our aid the axial changes of our planet; for however slow we consider the formation of coal to have been, we must allow a very rapid deposition in some cases of the intermediate strata of shale and sandstone, as also bands of coal. For instance, the large fossil tree at

Low Moor could not have lived for the enormous time necessary for the deposition of all these surrounding strata, if not quickly deposited. It makes no difference whether the tree grows from the black bed coal, or is floated as a snag, with its heavy roots keeping it upright.\*

I think the most consistent theory to illustrate the formation of coal is in the low marshy islands, or level delta, in the mouths or estuaries of large rivers, similar to the Mississippi and Ganges, whose deltas are forming more than 300 miles out in the ocean, in a basin-shaped depression, as if the centre had receded. That it has been an extremely quiet deposit is evinced from there being no water-worn pebbles as large as an ordinary pea. Again, that the forests and under-wood have frequently grown on or near the place where they were submerged, there is I think sufficient evidence; as also that the vegetation was only partially decayed; and few evidences occur of a force of stream to float vegetable matter anything like the timber rafts of some of the large rivers of the present day. If there had been a sufficient force of stream it would have brought coarser materials than we find in our shales. By a careful examination, I believe it is quite possible to prove what coal is deposited from water, which is removed a short distance from where it grew; and what has been embedded, comparatively dry, on the very place where it flourished. A stream, at the fall of the leaf, may float the decayed vegetation out to any varying distance without being decomposed, and the water may quietly filter through a similar deposit, and leave the accumulation of several seasons' leaves, in a

\* Since this paper was read, it has been ascertained that the top of the tree was originally broken off at the period of the deposition of the shale, with which the interior is filled up, shewing very evidently that the vegetable tissues had been decomposed and washed away, leaving the bark to be converted into coal, and the centre a hollow cavity to be filled up by the material which was last deposited. The main strata which surrounds the tree is sandstone.

series of layers, as they get interrupted in their progress among the weeds, trees, and under-wood. In some places the water would, of necessity, be highly impregnated with decomposed vegetable matter, sufficient to destroy the lives of any small fish. The sedgy edges of different lagoons or marshes may be sufficiently open to allow the teeth or scales, or other remains of fish to pass through, as is found in cannel coal. As regards the formation of bituminous coal, however, a familiar illustration is furnished by observing a large hayrick which has been put together when the grass was too much saturated with moisture, owing to rain, after having been cut. In this state it is more liable to ferment than from the effects of its own sap, and in such instances the centre of the mass, if examined, will have the appearance of bituminous coal, similar to the Bradford better bed. Upon the top of this coal is from four to six inches of stone coal, which is a distinct deposit, and from water, self-evidently from this fact amongst others, that the upper part of the formation has more mineral matter in it than the lower.

There is a gradation in the amount of silty matter which the water mixes with the surrounding vegetation, and consequently a diversity is found in the composition of coal and the accompanying shales. When some kinds of coal are burnt there remains what is provincially termed "white trub," of about one-third the original bulk, containing a greater amount of shale, and less carbon. In the shale above, when burnt, the residue is a fine red laminated material, so useful for macadamizing roads. In other cases, a fine laminated blueish shale remains, containing numerous impressions of leaves. When the coal and shales exhibit an even and laminated appearance, and split with smooth flat cleavage, containing impressions of leaves, I am of opinion that the vegetable masses have been floated in water a greater or less distance without sufficient chemical or mechanical action to decompose

the fibres and tissues. In the fermentation or chemical change that takes place in the process of crystallization, it is pretty evident electricity or magnetism has formed the cleavage in coal, as it runs very exact to 15 degrees west of the present magnetic pole; but the magnetic pole varies, and all the coal series are the same where this particular cleavage is distinct. It is well known, from a variety of experiments, that some plants decompose sooner in water than others; and hard-wood trees sooner than firs, ferns, &c. The partially decomposed fibre of the hard-wood trees would, in some cases, be floated; in others left in the stagnant waters. These stagnant ponds would be very similar to those described by Hawkshaw, in his *Reminiscences of South America*, "where, in the commencement of a fresh, the turbid waters were poured out as black as ink." In the regular mass of cannel coal, the crystalline structure so conspicuous in cokeing coal is wholly wanting, according to Lindley and Hutton, as quoted by Dr. Buckland. But this is not quite correct, as the crystalline structure is present, but changed into crystals of a larger size, which gives the idea that the vegetables have not been deposited in a mass but partially decomposed. I am of opinion that stone or cannel coal has been formed by a quantity of water charged with decaying vegetable matter, submerging a district in which partially decomposed and growing vegetables were present, and containing a sufficient amount of acid to cause active fermentation, similar to the swamps described by Hawkshaw, for the wavy or undulated appearance of the coal indicates such a kind of action to have been in operation. I have seen a somewhat similar process going on in a partially stagnant pond, where a sufficient amount of vegetable decomposition had taken place for the liberation of gases that would support flame on the surface; when this pond had been dried up I have seen, by cutting a section of the black sediment at

the bottom, that it had the appearance of stone coal, and the properties of shale. A further illustration is afforded in a lower pond or lake, where the water has been dried up, and the lighter vegetable matter floated away by the upper stream. Some of the aquatic grasses have become imbedded in the mud or sediment, and there remain to undergo a further change under pressure, or become in process of time fossilized.

Dr. Bevan speaks of the lower measures in the South Wales coal field as being anthracite, and the upper as being bituminous. At Popplewell, near Low Moor, however, just the reverse of this occurs, as below the anthracite there are four beds of bituminous coal, and in the cannel coal-bed there are two partitions of bituminous shale, which evidently indicate that the former has been deposited at three distinct periods. It is very common for one kind to run into the other, and it is this gradual transition that disproves the igneous agency suggested by Professor Rogers; and to me his steam theory is no explanation of the difficulties to be solved in accounting for the origin of the different varieties of coal, for when the materials are hermetically sealed up it is impossible on either theory to produce the change which is observable. At the bottom of one of the cannel coal-beds at Wigan, there is a bed of shale from one to two inches in thickness, and beneath this one or two inches of bituminous coal. In the neighbourhood of Batley there is a considerable amount of ironstone in the shales, which is almost composed of shells,—commonly called the cockle shell roof by the miners, and the mussel band of the geologists; this particular roof being over so many of the cannel beds, some of the miners imagine one is a necessary accompaniment of the other. The Middleton coal has also a similar roof.

The prevalent idea is that bituminous coal was the only kind originally deposited; and that stone coal, anthracite, cannel, culm, splint, and glance coal, are the effects of heat

changing the bituminous to the above-mentioned kinds. If so, we should naturally expect the coal near breaks to be more altered, whereas we know there is no difference. When the water has been off for a few years, the admission of air through the interstices changes the colour of the iron pyrites from white to yellow. Now as we always find the pyrites to be white in fresh cuttings, it is demonstrative evidence that the metalliferous deposit has never been exposed to the action of the atmosphere.

Mr. H. D. Rogers,\* says, "The striking fact that we "nowhere, not even in the most dislocated and disturbed "districts of the anthracite coal field, find any traces of true "igneous rocks, that by their contiguity to the coal could "have caused the loss of its bitumen, is a circumstance in their "geology which goes far to confirm the truth of the hypothesis."

We know from experience that cannel or stone coal is preferred for our domestic gas manufactories, because it contains more pure carbon and hydrogen than bituminous coal does. If then it had been changed by heat, the hydrogen would have been driven off at this early period, which we know is not the fact.

Where trap dykes have been known to come up through or near the coal, it has either converted it into coke, cinder, or smudge coal; and where it has only disturbed and broken up the coal strata into small patches, and then mixed it up with other materials, allowing steam and water to pass through, there is no anthracitic tendency. I do not think, therefore, from my observations and a careful consideration of the subject, that when once bituminous coal is deposited, and a subsequent strata laid upon it, that it can be converted into cannel coal by any process in nature with which we are conversant, but that it is a distinct and original deposit from water.

\* Geology of Pennsylvania, vol. 2, p. 809.



# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-FOURTH MEETING, HELD IN THE

MUSIC SALOON, WAKEFIELD, ON WEDNESDAY, APRIL 18TH, 1860,

AT TWELVE O'CLOCK AT NOON.

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HENRY BRIGGS, Esq., in the Chair.

The CHAIRMAN, in commencing the proceedings, said the Society had been established now for some twenty-five years, he having been one of those who proposed it, and that in the town of Wakefield. The original object of the Society was to enable the coalmasters of the West Riding to meet together, and to compare notes with each other, in order that they might identify the different coal beds in the West Riding, and see in what manner they could be most successfully worked. It had been deemed right, however, to extend its operations so that it would embrace all inquiries of a useful nature; and, therefore, it had now become the Geological and Polytechnic Society.

The Honorary Secretary, Mr. W. S. WARD, read the annexed financial report for the past year:—

## STATEMENT OF RECEIPTS AND EXPENDITURE

OF THE GEOLOGICAL AND POLYTECHNIC SOCIETY OF THE WEST RIDING OF YORKSHIRE.

From March 17th, 1859, to April 18th, 1860.

DR.			CR.		
	£.	s. d.		£.	s. d.
By Subscriptions—			Messrs. Baines, for Printing Reports	20	0 0
From 1 Member for 1856	0	13 0	To Advertising Meetings	2	17 4
" 1     "     1857	0	13 0	Expenses of Meetings	4	16 2
" 21    "     1858	13	13 0	Collecting Subscriptions	2	19 9
" 102   "     1859	66	6 0	Postage Stamps and Postages	2	7 4
" 6     "     1860	3	18 0	Books and Stationery	0	5 6
By Sale of Reports	1	16 9	Philosophical Society for Rent of		
Mr. Sorby, for 100 copies of his Paper	0	10 6	Museum	20	0 0
			Subscription to Palæontographical Society (two years)	2	2 0
			Assistant Secretary on account	31	3 2
			Sundry Expenses	0	19 0
	<u>£87</u>	<u>10 3</u>		<u>£87</u>	<u>10 3</u>
LIABILITIES.			ASSETS.		
	£.	s. d.		£.	s. d.
Messrs. Baines	21	19 0	Arrears of Subscriptions	18	4 0
Assistant Secretary	14	3 10			
	<u>£36</u>	<u>2 10</u>		<u>£18</u>	<u>4 0</u>

P. O'CALLAGHAN, Esq., proposed, and H. C. MORTON, Esq., seconded, that the following noblemen and gentlemen be the Council and Officers for the ensuing year:—

## President.

THE EARL DE GREY AND RIPON.

## Vice-Presidents.

THE DUKE OF NORFOLK.	W. B. BEAUMONT, Esq., M.P.
THE DUKE OF LEEDS.	E. B. DENISON, Esq.
THE EARL OF EFFINGHAM.	WILLIAM BECKETT, Esq.
THE EARL OF DARTMOUTH.	R. M. MILNES, Esq., M.P.
EARL FITZWILLIAM.	J. SPENCER STANHOPE, Esq.
LORD WHARNCLIFFE.	GODFREY WENTWORTH, Esq.
VISCOUNT GALWAY.	J. G. MARSHALL, Esq.
RT. HON. SIR C. WOOD, M.P., BART.	MICHAEL ELLISON, Esq.
EDWARD AKROYD, Esq.	REV. WILLIAM THORP.
JOHN WATERHOUSE, Esq., F.R.S.	THOMAS WILSON, Esq.

## Council.

HENRY BRIGGS, Esq.	R. CARTER, Esq., C.E.
DR. WM. ALEXANDER.	T. W. EMBLETON, Esq.
H. C. SORBY, Esq., F.R.S.	JOHN HOPE SHAW, Esq.
HENRY HOLT, Esq.	DR. SCHOLEFIELD.
BENTLEY SHAW, Esq.	WILLIAM CHADWICK, Esq.
T. P. TEALE, Esq., F.L.S.	SAMUEL BAINES, Esq.

## Honorary Secretary.

WILLIAM SYKES WARD, Esq., F.C.S.

### Honorary Curators.

J. G. MARSHALL, Esq.

T. W. EMBLETON, Esq.

### Local Secretaries.

H. C. SORBY, Esq., F.R.S., Sheffield.  
HENRY BRIGGS, Esq., Wakefield.  
DR. ALEXANDER, Halifax.

DR. SCHOLEFIELD, Doncaster.  
BENTLEY SHAW, Esq., Huddersfield.  
RICHARD CARTER, Esq., Barnsley.

The CHAIRMAN then called upon Mr. W. S. WARD to read a Paper

ON THE GEOLOGY OF THE ESK VALLEY. BY JOHN WATSON, ESQ., OF WHITBY.

This paper is illustrated by a section laid down from actual measurement, of 554 feet in thickness, taken in the Esk valley, near Whitby, Yorkshire, (*see page 100.*) The section, geologically speaking, comprises part of the lower Oolite, the upper and part of the lower Lias. I will remark on such as are of most value.

2.—The freestone is very valuable, generally speaking, on account of its texture, colour, and large sized blocks; and has been extensively worked for upwards of 50 years, and sent from Whitby, by shipping, for the construction of piers, breakwaters, &c., in nearly all parts of the United Kingdom.

9. *Oolitic Ironstone.*—This seam of ironstone is very valuable for smelting purposes, but varies very much both in quantity and quality; in some places showing a thickness of 20 and even 30 feet, containing only from 15 to 20 per cent. of iron, and a large proportion of silica; and in other places, from 5 to 12 feet in thickness, containing from 30 to 40 per cent. of pure iron, with only a moderate percentage of silica. This seam of ironstone has only been known and worked for about eight years. It is, however, now worked very extensively, and sold to the iron smelters, principally in Newcastle, for the purpose of mixture with

the argillaceous ores of the lias. Its principal advantage is on account of its being more easily fluxed in the furnace.

10. *Upper Lias*.—Consisting of aluminous shale, cement stone, ironstone, nodules, &c. From this shale the Whitby alum has been made for centuries. The upper part is used for this purpose on account of its containing a greater percentage of sulphate of alumina and magnesia, and being more free from iron, which is injurious to the process. The Mulgrave Alum Works, which have been so long carried on, are the largest on the coast, and are situated at Sandsend and Kettlethness, three and six miles north of Whitby. They manufacture, when in full operation, at these two works about 150 tons of alum, and 120 tons of rough sulphate of magnesia (Epsom salts), monthly. I will endeavour to give a short description of the process, which runs as follows, viz. :—First, the shale is worked and broken up into pieces, say fourteen pounds weight, run into heaps containing many thousand tons, always having refuse wood, faggots, &c., placed at the bottom of the heap, and in a proper position for burning the same. When the fuel is fired, there is sufficient bituminous and sulphurous matter in the rock to calcine it. The calcined mine is then lixiviated with water in large pits. The liquors are then taken and evaporated down to a certain specific gravity, and an alkali added, generally sulphate of ammonia,—then run into large vats or coolers, and allowed to stand six days to crystallize the alum. The crystals are then taken out, washed, then dissolved again in water, and run into large casks to re-crystallize; after that broken into large lumps, or ground according to the requirements of the markets. It must be remembered that the sulphate of magnesia is held in solution during the crystallization of the alum, and evaporated again to a higher specific gravity, then run into vats and crystallized in the same way as the alum. In working the alum shale, large quantities of cement and

ironstone nodules are found, from which is made the far-famed Mulgrave cement. There are also a quantity of fossils found in working this shale, chiefly ammonites, but some excellent specimens of the higher vertebrated forms of life have been met with. In the Kettleless Alum Works some years ago, almost in the same place, two large specimens were taken out in a very perfect state: an Ichthyosaurus and a Plesiosaurus, measuring from 20 to 30 feet each in length. Many other of those immense saurians in an imperfect state have been extracted; they are found at a depth of about 65 feet below the surface of the alum rock.

11. *Hard Jet Rock*.—This bed of shale is much stronger and of a more bituminous and sulphurous nature than the aluminous shale; it is always indicated by a nodulous band of inferior limestone, locally known as the top jet dogger. The usual mode of getting the jet is by taking the front of the cliff away where the line projects, until a seam is found, then followed by mining until it runs out. The seams vary very much both in length and thickness, in some places only a few inches broad, and not more than a quarter of an inch in thickness, extending only a few feet; in other cases, from eight to fourteen inches broad, and from one to two inches and a half in thickness, extending as far as thirty yards. I have frequently observed when the workmen are taking the jet out, the centre of the seam was the thickest, thinning towards each edge. The jet from this line is superior to any other, in consequence of its being easier to work, much lighter, and susceptible of a higher polish. Its present price in the market is from 5s. to 15s. per lb. The manufacture of jet ornaments appears to have been known in Whitby since about 1589; however, after that time it had gradually declined, for in 1810 there was no consumption of jet in the town. I know individuals who have told me when they were employed on the beach collecting and burning sea-weed

to make into kelp (formerly used as an alkali in the manufacture of alum) that they frequently collected and brought a bag of jet home to burn, there were such quantities at that time on the beach, undoubtedly produced by the washing away of the cliffs for centuries. Those individuals affirm that no coals are equal to it for making a good fire. The origin of jet is held as a matter of doubt, but the prevailing opinion is that it is of vegetable origin—fossil wood in a high state of bituminization, and I have no doubt but this is correct. I have observed in Kettleness Alum Works pieces of lignite, weighing two to three hundred weight, completely encrusted with jet, about half an inch in thickness; but, on becoming exposed to the air a few months, the jet falls off, leaving the lignite perfectly clean, and in a high state of preservation. Although I have never observed the real hard jet of the lias having a ligneous structure in the strata where it is found, nor have I observed any lignite encrusted near so low down as the jet lines; but the fact of having found lignite encrusted with jet (and even jet in a soft state, as if forming) in working the alum shale 90 to 100 feet above the jet lines, has led me to the conclusion that those jet seams lower down are nothing more than the lignite found above, dissolved and reformed by the agency of the more powerful sulphurous and bituminous gases of the jet shale. The chemical composition of the lias shale varies considerably, the top part containing a large per-centage of alumina and magnesia; but as you go deeper in the lias those ingredients decrease, and the shale becomes so highly impregnated with sulphur and bitumen, that by the time you arrive at the jet shale, such is the per-centage of those ingredients, it is not at all uncommon after wet weather that this shale will ignite spontaneously and burn for months. The manufacture of jet ornaments must, in some measure, be regarded as the staple trade of Whitby at

present; although it will not probably long remain so, as the immense formation of iron ores is now being fast developed, and smelting works in the course of erection. The amount of money turned over in jet at Whitby is over £20,000 annually. The population is about 14,000,—800 to 1,000 of whom are employed in the manufacture of jet ornaments.

13 and 17. *Pecten and Avicula Ironstone*.—Those two important measures of argillaceous or clay band ironstone, together nine to ten feet in thickness, are of excellent quality, and have been extensively worked for upwards of 20 years, and sent to the Tyne for smelting. Now that we have got direct Railway communication to the Durham Coke Fields, and an immense limestone formation close at hand, preparations are making on a large scale to convert the ores into iron on the place where risen; and the day is not far distant when this locality will rival, if not excel, the Cleveland district—this district having the advantage of a variety of ores for mixing, so essential to the production of good iron. From calculations made by practical men, (iron masters), good pig iron can be produced for from 45s. to 47s. per ton in the Esk valley. Those measures of ironstone, geologically, are the same as the Cleveland ores, although the latter is in *one seam*, and partaking more of our Oolitic seams. However, they can be traced along the Cliff from one place to the other, shewing distinctly where the seams begin to separate at Kettlewell Beach. The difference in appearance is probably from our stone laying at a greater depth, and subject to a greater pressure. I observe that S. H. Blackwell, Esq., in his little work on the Iron Making Resources of the United Kingdom, represents the Cleveland seam as the Oolitic or Northampton ore, and refers to Eston mines, and the Whitby, under the class of argillaceous ironstone of the lias. But in this Mr. Blackwell is not correct, for they are one and the same seams, geologically speaking, with the

hard jet lines, running with the same regularity above the Cleveland seam as those, and worked to a considerable extent.

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Professor R. HUNT, F.R.S., of London, next rose to read a Paper, entitled "A short notice of the Recent Discovery of a Deposit of Iron Ore in Lincolnshire." He said that before he commenced to read his paper, he would make a few remarks on the view set forth in the preceding paper respecting the origin of jet. He did not think the direct conversion of lignite into jet was made out. He was disposed to believe that the vegetable matter from which jet may have been derived, was first converted into a sort of fluid bitumen, which was eventually consolidated into jet. In fact there was evidence of this in the museum at Whitby, in examples of ammonites having bituminous matter still fluid in their cells. Something analogous to the process he had indicated was now taking place in the bituminous lake in the island of Trinidad.

The CHAIRMAN asked if amber might be regarded in the same light?

Mr. HUNT replied that it was a matter for inquiry, but he believed not.

Mr. O'CALLAGHAN said that he had resided in Trinidad, and with regard to the bituminous lake, he might say that it was a volcano, in a state of constant ebullition, and not a vegetable asphalte lake.

Mr. HUNT replied that the immense quantities of vegetable matter which were brought down to the sea by the great rivers of South America, might possibly re-appear in the shape of bitumen in this lake.

Mr. O'CALLAGHAN said that the Orinoco, which was the river alluded to, brought down great quantities of mud, though not of timber, and even if it did bring timber it would be intercepted before it reached Trinidad.



ON THE IRON ORE DEPOSITS OF LINCOLNSHIRE. BY ROBERT HUNT, ESQ., F.R.S., KEEPER OF MINING RECORDS.

In the spring of 1860, having paid a somewhat hasty visit to the Iron Ore deposits near Kirton-in-Lindsey, and examined the country at various points between that town and the village of Scunthorpe, I was induced to give a brief description of those ferruginous beds to the meeting of the Society, held at Wakefield.

The following notes record my views on this Lincolnshire deposit, its relations to the iron-ore formations of the Cleveland and Whitby district, and to those discovered in Northamptonshire and the adjoining counties.

The first deposit which I examined was about half a mile from the Railway station at Kirton-in-Lindsey. The portion exposed was situated on one side of a hollow, on each side of which the ground rose slightly. The iron ore was found about a foot below the cultivated surface: in some places, a few inches only of soil being removed, the iron-ore deposit was exposed. This was in a loose state of aggregation, the hardest masses being easily crushed, and by far the largest portion having the appearance of a very ferruginous earth. This deposit varied in depth, where I saw it, from two to four or five feet. I was, however, informed that in some places it acquired a somewhat greater thickness. I have frequently seen the ordinary soil of ploughed fields looking more ferruginous than this iron ore. Indeed, it was so unusual a thing to see men digging iron ore from the ground and shovelling it into carts, like so much loose earth, that it was difficult, at first, to believe this substance to be of any value to the manufacturer of pig iron.

From this point I proceeded northward about ten miles towards Scunthorpe, examining the country to the eastward of Messingham. A geological map will show the reader that the Lias formations which commence in the north, near the

southern side of the mouth of the river Tees, and extend across the country to the Severn, terminating on our southern coast at Sidmouth and Lyme Regis, pass just to the west of Kirton-in-Lindsey, which is situated on the geological equivalents of the Lower Oolites of the Cleveland district. The Middle Oolite being found at Brigg, and extending to near Caistor, above which, passing through the upper series, we reach the lower Cretaceous formations, to the east of which is the Chalk. Such is a rapid outline of the geological character of the country, a sketch of which appeared to be necessary to convey a correct idea of all the conditions under which this iron ore occurs.

At several points slight indications appeared to show the probability of the large extension of this superficial deposit of iron ore; but near Scunthorpe alone was there any direct evidence of its presence. Some small openings had been made, each one of them proving the existence of this bed, but at one point several acres of the surface had been removed, disclosing a bed of from 10 to 15 feet in thickness. This was in every way a remarkable deposit. On its upper surface was found a black sand, the analysis of which, to be given presently, proved it to be nearly pure peroxide of iron. It became indurated in depth, but varying considerably in its colour and character. In some parts of the bed large masses of very coherent iron ore were visible, with patches of a yellow stone, and small veins of white stone, apparently carbonate of lime, which were, however, completely separated from the main mass of ore.

I have been favoured by the proprietor of this property, Rowland Winn, Esq., with a set of analyses of these ores, made in one case by Hugh Lee Pattinson, Esq., of Newcastle, and in the other by J. D. Sollitt, Esq., of Hull. As a knowledge of these results will best enable us to determine the correctness, or otherwise, of the views I entertain, the analyses are given at once.

## ANALYSIS OF THE WET ORE, BY H. L. PATTINSON, ESQ.

	Small Yellow Stone.	Small Black Sand.	Orange Stone.
	Used in Puddling.		
Oxide of Iron .....	58.00	62.71	74.28
Manganese .....	3.31	2.20	.46
Alumina .....	4.21	3.79	1.53
Lime .....	.91	1.49	1.11
Magnesia .....	.45	.53	.30
Silica .....	4.10	5.97	5.62
Sulphur .....	..	trace	..
Phosphoric Acid .....	1.32	2.00	1.02
Water .....	27.82	20.82	14.90
	100.12	99.51	99.22
Metallic Iron .....	40.60	43.90	52.70

## ANALYSIS OF THE DRY ORE, BY J. D. SOLLITT, ESQ.

	Small Yellow Stone.	Small Black Sand.	Black Stone.	Orange Stone.	Soft Top Stone.	Hard Stone.		
	Used for Puddling.					1.	2.	3.*
Oxide of Iron ..	81.12	90.11	91.50	93.00	92.34	58.50	47.10	66.25
Alumina .....	12.31	1.18	1.92	2.14	2.44	5.52	8.50	21.30
Carbonic Acid ..	..	..	..	..	..	19.25	15.50	27.12
Lime .....	.03	.02	..	..	..	3.25	6.63	4.32
Magnesia .....	.15	.14	1.10	trace	.05	7.78	14.84	trace
Manganese .....	4.25	3.75	4.40	trace	..	4.25	5.27	.51
Silica .....	2.14	4.80	1.07	4.86	5.16	3.45	2.14	.50
Phosphoric Acid ..	trace	trace	.01	..	..	..	..	..
Sulphur .....	trace	trace	trace	..	.01	..	..	..
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Metallic Iron ....	56½	63	64	65	64½	42	33	48

\* This may be regarded as a pure Spathic Ore.

From a lower bed of ironstone three analyses are also given by Mr. Sollitt.

Oxide of Iron ....	40.21	Containing Spathic Ore, 33 per cent.	37.50	Containing Spathic Ore, 8 per cent.	51.75	Containing Spathic Ore, 2 per cent.
Alumina .....	4.94		5.34		4.25	
Carbonic Acid ....	26.75		23.94		11.52	
Lime .....	22.38		26.06		19.75	
Magnesia .....	trace		5.21		5.23	
Manganese .....	3.12		.75		.75	
Silica .....	2.60		1.20		6.75	
Phosphoric Acid ..	..		..		..	
Sulphur .....	..		..		..	
	100.00		100.00		100.00	
Metallic Iron .....	29	26½	36			

The first impression on seeing this wide-spread bed of iron ore (for the most part in a perfectly soft state) was, that it was the result of deposit from water at once, as peroxide of iron, in the same manner as we see ferruginous springs depositing, as the water is exposed to the air, the iron it holds in solution. Under this hypothesis these beds may have been of comparatively very recent formation, having no relation indeed to the geological conditions by which they are surrounded. Nor would there be much difficulty in discovering sources from which the iron might have been derived. Waters flowing through and from the Green Sand might have been spread out over this district as a shallow lake, or the water might have obtained its iron from either the Oolite or the Lias formations, since we know of vast beds of iron ore in each.

A careful examination, however, of the geological section as we find it in Lincolnshire, and as we have it in the Esk valley, near Whitby, will lead to a contrary conclusion. Again, the analyses clearly show that these beds must at one time have existed as carbonate of iron; and hence the inference is that the oxidation, which, as we have seen is not entirely complete, has been produced by long continued exposure to the action of water, and of atmospheric air, probably in alternating intervals.

The section of strata in the Esk valley, as given by Mr. T. Watson, of Whitby, is as follows:—

	Ft. in.		Ft. in.
1 Sand and Clay .....	13 0	12 Jet Rock .....	30 0
2 Freestone .....	25 0	13 Sulphur Rock.....	42 0
3 Marl and Shale .....	24 0	14 <i>Pecten Ironstone</i> .....	6 0
4 Freestone .....	15 0	15 Sulphur Rock.....	12 0
5 Marl .....	8 0	16 <i>Ironstone</i> .....	1 0
6 Coal .....	0 10	17 Sulphur Rock.....	24 0
7 Marl .....	8 0	18 <i>Avicula Ironstone</i> .....	5 0
8 Freestone .....	10 0	19 Sulphur Rock and Shale	30 0
9 <i>Oolitic Ironstone</i> .....	14 0	20 Fire Clay.....	4 0
10 Aluminous Shale .....	185 0	21 Sulphur Rock and Shale	40 0
11 Cement Dogger Line ..	—		

The Oolitic ironstone (No. 9) band appears near the surface in the coast section, on the southern side of Whitby Harbour ;

the Pecten and the Avicula beds being probably identical with those which are now worked so extensively at Cleveland. In the above section the local names have been retained; it may therefore be necessary to explain that the sulphur rock represents a shale formation impregnated to a greater or less extent with iron pyrites.

A boring has been made by Mr. Rowland Winn, about half-a-mile to the south of Appleby. The section of strata, as shown by the borings, being as follows:—

	Yds.	ft.	in.
1 Lower Oolite Limestone, with clay partings.....	12	0	8
2 Blue Shale.....	11	1	4
3 Sandstone.....	0	1	11
4 Grey Shale.....	8	1	10
5 Grey Stone, <i>Lower Oolite Ironstone</i> , supposed to correspond with Northampton Ironstone.....	2	1	10
6 Lias Shale, with Cement Stone Nodules, Alum Rock..	22	1	6
7 <i>Upper Ironstone Bed</i> , supposed to correspond with the Pecten Bed of Cleveland.....	1	1	2
8 Blue Lias Rock.....	29	2	9
9 <i>Lower Ironstone Bed</i> , corresponding probably with the Avicula Bed of Cleveland.....	8	0	3
10 Blue Lias Shale, Marlstone, &c.....			

The Oolitic ironstone (No. 9) of the Esk valley section, and which appears in the High Cliff, at Whitby, is, there can be little doubt, the grey stone (No. 5) of the above Appleby section, which is a continuation of the beds worked upon the warren at Scunthorpe, which dip slowly towards the sea.

If we continue our examination southward, we discover iron ore workings at Stamford, where the deposits are very extensive; and some smaller workings have been carried on near Peterborough. The iron ore deposits of Northamptonshire are well known; and those are believed to be the equivalents of the deposits which are now being worked in Lincolnshire. The iron ore which has been discovered at Blenheim, in Oxfordshire, has been thought by many to be also a continuation of the same series. Mr. E. Hull, of the Geological

Survey, in his memoir on "The Geology of the Country around Woodstock, Oxfordshire," is, however, disposed to place this lower. He says, "All these facts tend to prove that the ore forms a continuous bed under the area of the Great Oolite." We are not in a position, at present, to determine this point. Three discoveries, however, of ores of iron over large tracts of country which were not a few years since thought to contain any mineral treasures of commercial value, appear to prove the probability of the extension of vast iron ore deposits along the range of the Lias and Oolite formations, over tracts of country which have not yet been explored with this object.

The value of our more recent discoveries of iron ore will be shown by the following table of the production of iron ores in 1859, from those geological formations which have been engaging our attention :—

	Iron Ore. Tons.	Money Value. £
Cleveland .....	1,520,342	228,255
Lincolnshire .....	2,735*	890
Northamptonshire, Buckinghamshire, &c.	130,058	33,114
Warwickshire .....	30,500	10,560
Oxfordshire .....	6,030	2,412

\* In 1860 the produce from the neighbourhood of Scunthorpe was 16,192 tons.

ON THE RECENT DISCOVERIES IN EXCAVATING THE REMAINS OF THE ANCIENT ROMAN TOWN OF URICONIUM, (WROXETER,) NEAR SHREWSBURY. BY THOMAS WRIGHT, ESQ., M.A., F.S.A., &c.

(THE FOLLOWING IS AN ABSTRACT ONLY.)

The village of Wroxeter is rather more than five miles west from Shrewsbury, and occupies a little corner of the southern portion of the site of the ancient city of Uriconium, on the banks of the river Severn. This place was known for centuries to have been the site of an ancient city, from the many relics which the plough had turned

up. Antiquarian research had corroborated these casual excavations; and from those researches it was evident that the ruined town was that mentioned by Roman writers, under the name of Uriconium. It stood at the junction of two roads, now known as the Watling Street Roads. The estate on which these vestiges have been found belongs to the Duke of Cleveland, and the excavations were commenced about a year and a half ago, with the concurrence and approval of the noble owner. Many difficulties, however, were thrown in the way by the tenant, but these have now been removed, and in addition to the two acres originally granted by the Duke, two others have been placed at the disposal of the excavators at a rent. The part already excavated lay a little to the east of the village, and it has resulted in most important discoveries.

The site of the ancient town is marked distinctly by a mound covering the foundations of the Town wall, round the whole circuit of Wroxeter, and a large piece of a Roman wall was also visible near the centre of the town. The first attempts to explore the ground were made, and the excavations commenced, on the north side of this wall. The ancient town has evidently been one of considerable importance, for the site is one mile and three quarters long, and one mile broad. It is also evident, from the excavations and researches which have been made, that the town had been destroyed by those barbarous tribes, whether Saxons, Scots, or Picts, which, after the departure of the Romans, devastated the country. From the indications of fire found in all directions, there is no doubt that the town has been burnt, and from the number, sex, and position of the skeletons, there is as little doubt that the inhabitants had been massacred in the sacking of the town by the barbarians. In one of the rooms were found a number of skeletons, scattered here and there, as if the inhabitants had been trying to

escape by flight, including that of an old man crouched in a corner, at whose side was a box containing 132 small coins, which is a very interesting discovery, as showing what coins were carried about and were in circulation at the time of the Roman occupation.

It is very probable that after the destruction of the town it had been left as a ruin, in which condition it would remain until the twelfth century, when it would share the fate of the Roman works in this country, and be dismantled, in order to provide material for the castles and monastic structures which were then erected. In proof of this I may state there is scarcely a monastic ruin in the neighbourhood of Wroxeter which has not, as a portion of its structure, some Roman remains. We all know from experience the quickness with which earth accumulates round ruins, and thus the ancient town has become buried. With regard to the excavations which have been made, the results have been considerable; and, in consequence of these, we have been enabled to decide what was the economy of a Roman town in England, in a manner which there had never before been an opportunity of doing. In speaking of the town, however, it is evident that the great road of Watling Street ran over the principal street of the town, which gave evidence of its importance. The principal buildings which had been discovered were as follow:—A large edifice, evidently the public baths, in which were warm baths, tepid baths, and all the other kinds of baths used by the Romans. Adjoining these, on the south side, were two large irregularly shaped courts, portions of which were paved with large flat tiles; from this, it is conjectured, they were reservoirs or cold baths. A breach in the eastern wall of one court had been newly repaired with inferior masonry at the time the city of Uriconium was taken and destroyed; and it is a curious circumstance that some large



pieces of stone lie here on the floor of this court, left unfinished by the stonemasons, as though repairs and alterations in the buildings were going on at the very moment of the final catastrophe. The western and southern sides of the square occupied by the buildings belonging to the baths were formed by a wide gallery, or cloister, no doubt the ambulatory, which was considered as an important part of the public baths of the Romans. There was also a large space without any indications of buildings, which suggested the idea it might have been the garden, which was also usually connected with the same establishments by the Romans. Adjoining the Baths, on the north, was an oblong building presumed to have been the Basilica, or Town Hall, where the public business was transacted. This is 220 feet long, the exact length of that of Pompeii. In close proximity is a wide space, believed to have been the Forum of Uriconium, which from its peculiar form may have been used for athletic exercises, as well as for other purposes; and it is rather remarkable that the Basilica held here the same place in regard to the Forum as at Pompeii. The Basilica abutted into the principal or Watling Street, but not so the baths, for the space between the latter and the Forum is occupied by buildings, which have apparently been quite independent of the baths. One of these is supposed to have been the Market place, or an establishment of store-houses and shops. It was entered by a large doorway, approached by an inclined plane, and by a foot entrance with worn steps on each side. Within was a series of small square rooms, and on the eastern side a sort of gallery with recesses; the place was strewn about with bones of animals, many of them cut or sawn, as though they had been used for different manufacturing purposes.

Another building, parallel with the market, which is now undergoing exploration, presents some rather singular

features. It is a room nearly square, and about 30 feet in its longest dimensions. The side towards the Watling Street seems to have been open, or at least the masonry of the wall presents the appearance of having had wide folding doors or a framework of wood of some kind in two compartments. In the centre of the room is a large pier of masonry, perhaps a table for workmen ; more towards the north-western corner a sort of furnace or forge was found, built of red clay, with a hole or cavity in the upper part sufficiently large for a man to thrust his head in. As the internal surface of this cavity was completely vitrified, and as there was much charcoal strewed about, there can be no doubt that the cavity had been occupied by a very fierce fire ; a low wall was traced across the room, from east to west, in a line with the furnace, and a shorter transverse one to the north. Upon the former, a little behind the forge, the excavators came upon what was supposed at the time to be the lower part of a column, with its base ; but as it is formed very roughly, I think it more probable that it was a stone table for the use of the workmen at the furnace. Among other things found in this room were nearly a dozen hair pins, two of which were much more ornamental than any we had found before during the excavations, a much greater quantity of fragments of Samian ware, and of higher artistic merit than had previously been met with in one spot, a portion of a large bronze fibula, a number of coins and other things ; one of the vessels of Samian ware is a fine bowl, with figures in high relief, representing a Stag hunt. Upon the lower wall of the sill about 60 copper coins were found together, and near them the fragment of a small earthen vessel, in which they had probably been carried by some one who dropped them here as he was hurrying out of the place.

I have already said these buildings looked upon the open

space, which I have supposed to be the Forum. A gutter very well made of carefully squared stones, and remarkably well preserved, runs near the houses on the eastern side of the street, which is the only side at present that can be explored, it is about a foot deep, and from place to place square stones are laid in lozenge fashion, apparently intended for stepping stones, when the drain was full of water. With regard to the dwellings of the people they all appear to consist of a single story, the walls of which are solidly built, and present no appearance of windows, it being evident that the lighting had been from the top; which was the more probable seeing that the houses consisted of but one story. The houses were warmed by hypocausts, or what has hitherto been supposed to be a modern method, namely, hot air, the fires probably being of charcoal, though from the specimens I have found it is also evident that mineral coal had been used. There were indications that considerable manufactures had been carried on in Uriconium, amongst the rest perhaps that of glass, many articles of which had been found of elaborate workmanship and elegant shape, which proved the acquaintance of the Romans with the art of glass manufacture. Remains of pottery have been discovered of a different kind to those usually found at other places, the colour being white instead of red, which was altogether a novelty as regarded Roman pottery. Some of the pottery found in the excavations at Uriconium has evidently been made of the clay of the Severn valley, and was the same as that which is now known as the Broseley clay. Several painters' palettes have been found; and an inscribed stamp, which turns out to have been a stamp for patent medicines, has been discovered; a great variety of ladies' hair pins and personal ornaments, such as necklaces, rings, beads, &c., industrial implements, some weapons of war, and a large collection of miscellaneous objects; of the

bones of animals cart loads had been taken up, varying from the deer and the ox, to rats and mice, and among them bones of several extinct species of animals. Several human skulls have also been discovered in that portion of the town which lies on the east bank of the Severn, which presented a singular deformity, one side being apparently more prominent than the other ; but whether this arose from accidental or natural causes, it was difficult to determine. The malformation of a number of skulls has led to the supposition that they had belonged to the assailants of the town ; inasmuch as it was well known that many of the barbarous tribes that assisted in the overthrow of the Roman empire, were in the habit of disfiguring the heads of their infants, in order, it was thought, that they might present a more terrible appearance to their enemies. This is not quite the case, the anatomists, &c., who decided rather in a hurry, are all changing their opinion.

Altogether, the discoveries add much to our knowledge as to what was the economy of a Roman town in England, what was the period at which the town of Uriconium was destroyed, and what was the manner. With regard to the destruction of the town, the skeletons which were found about the streets, and which included those of women and children, showed that they had been murdered ; and the charred remains which had been found—among other things of wheat—showed that the town had been burnt. Then a quantity of coins that had been discovered, were of a date posterior to the Roman occupation of the island ; and had evidently been made in the first half of the fifth century, which would show the date of the destruction of the town. With regard to the economy of the town, not only had they discovered much with reference to public matters, but also with respect to the domestic economy of the people,

and the manufactures which were evidently carried on in the Roman period.

The explorations are very far at present from being completed, the great desideratum is the pecuniary means for doing this, and it is much to be hoped that Government will make a grant towards carrying on the excavations. A grant has recently been made for similar operations at Carthage, which does not possess half the attractions of Uriconium, which promises to rival Pompeii itself. I would strongly recommend any of those who hear me, and who may happen to be in the neighbourhood of Shrewsbury, to pay a visit to the ruins of Uriconium.

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In a discussion which followed the reading of the paper, Mr. O'CALLAGHAN suggested that instead of the building, which had been described as a Basilica, being such, it was probably a military parade-ground under cover, and its construction evidently suggested such an explanation.

Mr. WRIGHT said it was difficult to speculate upon the character of a building when the remains were but little more than a few inches in height. He would, therefore, leave that question open until further discoveries threw light upon the matter.

Mr. HUNT said that he was not surprised to hear that glass had been found at Uriconium, inasmuch as its manufacture was known to the ancients; and he believed that it was the same with regard to many other supposed modern discoveries. The coal which had been found was, so far as he could judge, the outcrop at Colbrookdale; and its discovery was conclusive with regard to the disputed question as to their having been acquainted with it.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-FIFTH MEETING, HELD IN THE  
COURT-HOUSE, BARNSELY, ON THURSDAY, NOVEMBER 1ST, 1860,

AT TWELVE O'CLOCK AT NOON.

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JOHN SPENCER STANHOPE, Esq., Vice-President, in the  
Chair.

The following noblemen and gentlemen were elected  
Members of the Society :—

His Grace the ARCHBISHOP OF YORK.

The Right Hon. LORD LONDESBOROUGH, Grimston Park.

Sir JOHN HENRY LOWTHER, Bart., Swillington House.

HUGO CHARLES MEYNELL INGRAM, Esq., Temple Newsam.

JAMES FARRAR, Esq., M.P., Ingleborough House, near Settle.

EDWIN BOOTH, Esq., Mining Engineer, Barnsley.

JOHN RICHARDSON, Esq., Engineering Surveyor, Barnsley.

The following Papers were then read :—

OBSERVATIONS ON COLLIERY VENTILATION. BY RICHARD CARTER,  
ESQ., C.E., OF BARNSELY.

It is perhaps necessary that some apology should be offered for selecting so direct and practical a question as colliery ventilation to form the theme of a discussion in a society like the present. No one can feel more forcibly than the author of this paper that the question is one which challenges and deserves the soundest applications and treatment of practical

wisdom and experience; at the same time, it is but too manifest in this, as in many kindred propositions, that the vast importance of the subject is by no means a sufficient passport for its ample consideration and intelligent direction. In this age of emulation and progressive enterprise, the common habit waits for no minute investigation of a principle, if, by ready adaptation, its general results can be brought within profitable command. And hence it is, that notwithstanding the mighty achievements which science has won for the present and immediately preceding generation of our race, the actual labourers in her domain are by no means to be counted by the number of those who profit by her results; but they consist of the comparatively small army, which not unfrequently find it necessary, in the interests of humanity and philanthropy, to array themselves in momentary antagonism to established custom or unreflecting prejudice.

The arena which this society presents, is one which admits of the investigation of prejudices, without calling into existence the invidious reflections pertaining to their practical application. And so it is presumed, that colliery ventilation, even where its practice so much prevails, as in the district surrounding the place in which we are now assembled, may not unfairly or unprofitably be made the theme of our inquiry and discussion. The subject is one which stands out in prominent invitation to the exercise of practical and scientific skill; and if, happily, from no recurrence of the fearful disasters which have at one time and another staggered us with their overwhelming melancholy results,—there is still the incontrovertible fact, that the circumstances are in all but universal operation, as identified with the system of coal mining in this country, which in times past have associated themselves with calamities, which even the memory shudders to recall.

It was well remarked some thirteen or fourteen years ago, by one of the most venerated members of this society, and one whose persevering labours in the geology of the mining districts of Yorkshire entitled his opinions to be received with the utmost deference and respect (the Rev. W. Thorp, late of Misson), "that the person who would discover any safer modes of ventilation, or even any additional precautions to those now in use, and should succeed in having them generally adopted, would be for ever conferring a lasting benefit upon the mass of our mining population."

Ten years later than the period of this declaration, and at the last meeting of this society in Barnsley, the writer undertook in a paper, hastily prepared like the present, to bring before the society the views he entertained on the subject of colliery ventilation, as the result of a somewhat limited, though by no means unreflecting professional practice, extending over several years, in the lower and thin seams of the Yorkshire coal field. His views were subsequently maintained in a more elaborate paper read by Mr. Brakenridge at the Huddersfield meeting. And no doubt can now exist of there being a very general acquiescence on the part of scientific and practical men, in the soundness of the theory, that colliery ventilation becomes more perfect and effectual in the ratio in which the currents of ventilation can be maintained in *ascending* columns, after they have once penetrated the workings; and, *a fortiori*, that system is defective, which involves the necessity of conducting such currents along avenues of descent, as now practised with all but universal consent. The exceptions are happily increasing as new collieries are being commenced, and examples are not wanting of a laudable resolution to unfetter the prejudices of custom, and to bring under operation of the more natural and philosophic plan, workings which



had already been established on what may be termed the old-fashioned principle. By the definition "old-fashioned," is implied a system of working out the entire area of the colliery by means of the two shafts—down-cast and up-cast—which had been sunk in close proximity to each other, at the commencement of the undertaking. These, for very obvious reasons, as pertaining to the mechanical process of extracting the coal, were generally placed in such position (having some regard to the convenience of delivery on the surface) as would command the coal to be worked at its lowest level or dip. And so far as the down-cast shaft is concerned,—usually applied to the two-fold object of admitting the fresh air for ventilation, and the drawing up of minerals out of the mine,—it is not presumed that this principle of selection is in any respect defective or objectionable. But whilst recognising the policy with regard to one of the shafts, the gravest objection may be taken to the other, as a permanent portion of the arrangements for working the mine. It may be that the balance of mechanical force in extracting the coal is greatly accommodated, by placing the drawing pit on the lowest dip of the stratum. But the very reverse is true in relation to the vitiated air which it is a grand object of ventilation to expel from the mine. And in these two conflicting elements, the principle arises which this paper aims at supporting. The coal, by its weight, when placed in the miner's corf, will gravitate towards an outlet on the dip. The air to be expelled will, in obedience to an equally natural and energetic law, seek its escape in the opposite direction, and upon the rise. It is unnecessary here to enter minutely into the constituents of that which for brevity's sake we have denominated "vitiating air," and which by ventilation is, or ought to be, expelled. The fact, however, must be noted, that the ingredient by far the most important, and that which constitutes in itself the

basis of explosive mixture, is the carburetted hydrogen so generally given out by coal, and the strata with which it is in immediate contact. This gas has the remarkable property of being one of the lightest substances in nature, and possesses a specific gravity very little more than one-half that of atmospheric air; and hence (to use again the words of Mr. Thorp) its "constant tendency (particularly if the coal bed rises to an acute angle) to creep along the roof to the upper and higher portions of the excavated mine, and thereby accumulating to form a most dangerous magazine." This constant and ever active tendency to creep along, and insinuate itself into every elevated cavity or space, is a fact far more familiar to those accustomed to mining operations, than are the expedients by which its dangerous presence may be counteracted or removed. Moreover, the activity with which it possesses itself of such elevations, pointing, as it does, in so conspicuous a manner, to the provision which should be made for its natural escape, is not unfrequently taken advantage of, and the gas is permitted to accumulate in such situations, from its inherent hostility to the downward course by which the ordinary ventilation is forced through the mine. Surely it is requisite to show that every other principle has been exhausted, before a system is propagated, which so essentially opposes itself to the natural habit of the agent under consideration. It is not intended to overlook the affinity which the gas possesses for the atmospheric air, and the fact that, in union, the two may be passed off together along the steepest descents, by the ordinary expedients of ventilation now in use. But there is nothing in this affinity which at all compensates for the separate attribute of gravity, imparting so active a tendency to the hydrogen gas to isolate itself from all such admixture, and so to elude the chances which otherwise might lead to its expulsion.

Every one at all acquainted with this subject will have learnt from experience that this habit of isolation may be recognised between the ventilating air and the inflammable gas of the mine, when in close proximity to each other. Even the little irregularities which unavoidably exist in the roof of the air-courses themselves, will often be found to contain the gas in a highly inflammable condition; whilst the current of ventilation is sweeping along the floor and lower level of the passage. It is to be feared that a sad misapprehension too frequently attaches to the quantity of air which may be caused to circulate through a mine, and that in proportion to the quantity, will be the purifying effect to be looked for. The incident of isolation already referred to, will at once suggest the fallacy of such a conjecture; and the frightful consequences which ally themselves to such an imaginary source of impunity. It is a peculiar characteristic which nature has stamped upon this gas, that it possesses neither colour nor smell. And its presence is therefore to be ascertained or judged of, by expedients, which only a practical skill can safely deal with. And herein would seem to consist the weight of gravest responsibility with every owner of a colliery where this gas is liable to be generated; a responsibility which stops not with himself, or the pecuniary interests which centre in him, but extends to every individual workman employed, whose safety and existence, from the moment of his entering the mine, are beyond his own control, dependent on the wisdom, intelligence, and care which the management and direction of the working is made to exhibit. No doubt the points of danger are generally known in practice, and a proper caution may be made to surround the existence of localities where unavoidable accumulations of inflammable gas have taken place. But a sad reflection on the past reveals how insecure are all the avenues of safety, where they become associated with con-

ditions such as these. No amount of precaution can equal all the emergencies which may arise, so long as the old system is made to answer the purposes of vastly extended areas. The whole proceeding as regards ventilation is perplexing and difficult, and this from the simple circumstance that the theory adopted is in direct antagonism to that which the gas obeys as a law, and in which obedience it perseveres with an insidious activity which no human observation or skill can at all times detect or command.

It is from the peculiar conditions to which reference has now been made, that a coal mine, after being worked for a time, becomes a vast reservoir in which every cavity becomes charged with gas or air, in greater or less degree of purity; and before this reservoir can be penetrated with safety, the air must be extracted, and a fresh supply admitted, in which human respiration can be carried on. The circumstances are analogous to a reservoir on the surface, filled with impure water, which it is desirable to replace with liquid of a more satisfactory quality. The process of emptying may be performed either by pumping the water over the embankment, or by allowing it to escape by a perforation made through the base of it. In the latter case advantage is taken of the gravitating force impressed by nature on the element itself, and with a freedom and facility commanding our admiration and delight, the operation is performed without labour or expense to ourselves. In the former case the work is equally practicable. Pumps may be resorted to, and by their long, tedious exercise, the complete exhaustion may be consummated. Precisely the same holds good with the subterranean reservoir of gas. Expelled by means of an up-cast, placed upon the dip of the mine where gas is generated, the act of exhaustion becomes strictly analogous to the pumping operation on the surface. In both instances the element is made to obey an impulse to which it has a

most natural and active repugnance. The water must be raised by virtue of mechanical appliances, which bring it under the secondary action of atmospheric pressure—it may be at a considerable pecuniary and other form of expense. And during the whole operation there is not a globule which yields a voluntary impulse, but all the particles, to the very last drop of the fluid, exert an active effort to elude the objects of their expulsion. And when command has been exercised on all within reach of the pump, the exposed bed of the reservoir will exhibit the numerous little pools and irregularities of surface which the last dregs of the fluid has occupied, rather than surrender itself voluntarily to the compulsory effect which it was sought to bring into contact with it. What truer analogy can be conceived, than that which exists between this, and the underground reservoir already described? We have only to turn the description upside down, reading top for bottom, and *vice versa*, and the two cases are perfect and most beautiful types of each other. The subterranean reservoir is “pumped” out, when drained of its gases by means of a dip-outlet. The action of the furnace or similar expedient, is precisely analogous to the vacuum-creating action of the pump. So also is it limited by the involuntary habit of the gas, towards all operations with which it has not a direct natural sympathy. Perforated at the bottom of the reservoir, the water escapes by its own natural impulse; and all the operations for cleansing the pool, so long as they preserve the gravitating influence, become simple, easy, and certain. In like manner when perforated at the top, will gases exude from a mine. And harmonized with this quality of their being, all the processes of ventilation become simplified, certain in their action, and comparatively inexpensive in their provision and maintenance. The time is not distant when such a picture as this would have been regarded as purely imaginary—and, for all

practical purposes, deceptive and fallacious. Thanks to the more spirited enterprise and philanthropy of some of the proprietors of collieries even in our own district, the mists of prejudice have begun to be dissipated by the energy and liberality of a wise intelligence. The principle of direct ascending ventilation is now being pursued—and enough has been already demonstrated to justify the representations of its perfect and economical application.

It may perhaps require a little further experience—and certainly more application—than the writer has been able to bring to bear upon the present paper, to illustrate in detail the various and important advantages which such a principle of ventilation is calculated to secure, as against the one so generally found in practice. These, however, he is happy to think, are within the prospect of an early future. The most interesting opportunities have been placed at his command, especially by Messrs. Craik and Co., whose extensive colliery works in this locality, are now being made to exhibit a conclusive test of the whole case; and to their most ready and polite courtesy the writer is greatly indebted, for the confidence with which he has been able to bring this important subject again under the notice of the West Riding Geological and Polytechnic Society. It is only by efforts of this kind that the public mind can ever be adequately informed on such questions; and until the maxims of a sounder philosophy are forced upon the system, it is to be feared that an active and increasing principle of commercial and competitive enterprise will hesitate but little to reflect upon the improvement and changes which are requisite to be introduced into our systems of colliery working, in order to their being harmonized with the deductions of a correct science, and the safety and preservation of the lives and limbs of our industrious and pity-deserving colliery population.

ON THE RELATION EXISTING BETWEEN THE OCCURRENCE OF  
EXPLOSIONS IN COAL PITS, AND THE STATE OF THE  
BAROMETER AT, AND PRECEDING, THE TIME OF THE  
EXPLOSION. BY WILLIAM R. MILNER, ESQ., M.R.C.S.,  
M.B.M.S., OF WAKEFIELD.

The data on which this paper was founded were a list of 79 fatal coal pit explosions, occurring in the years 1850—9, within the district inspected by Mr. Morton, and an unbroken series of observations of the barometer, taken at Wakefield Prison, and extending over the same period.

The results have been embodied in two tables. The first table shows the differences of the barometer readings on the day of the explosion, as compared with the readings on

- 1st. The day preceding the explosion.
- 2nd. The day but one preceding the explosion.
- 3rd. The mean height of the barometer during the month in which the explosion occurred.
- 4th. The mean height of the barometer during the period of ten years over which the observations extend.

The differences are grouped in tenths of inches. The explosions are arranged in two columns for each class of comparisons; the first column of each pair showing the number which occurred when the barometer on the day of explosion was lower than at the period with which the comparison was made, and the second the number occurring when the barometer was higher on the day of explosion.

The general result was that of 79 explosions, 59 took place when the barometer was lower than it had been 24 hours previously, and 20 when it was higher. Sixty when the

barometer was lower than it had been 48 hours previously, and 19 when it was higher. Forty-four when the barometer stood lower on the day of the explosion than the mean of the month in which the explosion occurred, and 35 when it stood higher. Sixty-six explosions occurred when the barometer was below the mean of the ten years, and 13 when it was above the mean. A further analysis of the table shows that taking the first pair of columns there were six explosions when the barometer, on the day of explosion, was less than a tenth of an inch lower; and ten when less than a tenth of an inch higher than on the preceding day. When the difference was one-tenth, and less than two-tenths, twenty-two explosions took place with a falling, and 8 with a rising barometer. With a difference of from two to three-tenths 17 were with a falling, and two only with a rising barometer. Above three-tenths, 14 with a falling, and not one with a rising barometer. The law also holds good when applied to the other columns.

The numbers in the third pair of columns would seem to indicate that the mean height of the barometer was generally low in those months when the greater number of explosions took place; and those in the fourth pair of columns also support that view.

The second table shows the number of explosions which occurred in each month of the year respectively, and the mean differences found between the barometer readings on the days of explosions, and at other specified times.

This table clearly shows that a generally low and falling state of the barometer exists when explosions take place in coal pits; for there are in the whole series of numbers only two in which the positive sign indicates that the barometer was rising at the time of the explosion, and these are found in the column giving the comparison between the state of the barometer on the day of explosion, with the mean of the



month in which the explosion occurred; and it is also remarkable that these are found in the months of January and May, which are among the months when the fewest explosions took place. It is tolerably clear that there is a greater tendency to explosions in coal pits when the barometer is low, and that the tendency is increased when the barometer is falling.

It is, therefore, very desirable that the state of the barometer should be carefully watched, and additional care exercised when it indicates a diminishing atmospheric pressure, so as to guard against the danger arising from an increased flow of inflammable air into the pit.

TABLE I. of 79 Colliery Explosions in the District inspected by C. MORTON, Esq., showing the relative state of the Barometer on the days of explosion, and at certain other times.

Amount of Difference of Barometer Reading.	A Height on day of Explosion.		B Height on day before.		C Height on day but one before.		D Mean Height of the month.		E Mean Height of the whole period.	
	A less than B	A greater than B	A less than C	A greater than C	A less than D	A greater than D	A less than E	A greater than E		
.000	6	10	2	4	5	3	4	3		
.100	22	8	21	8	12	9	13	6		
.200	17	2	11	3	8	6	12	3		
.300	5	..	10	1	7	11	13	..		
.400	6	..	8	2	3	4	7	1		
.500	1	..	4	..	4	2	5	..		
.600	..	..	..	1	..	..	4	..		
.700	1	..	1	..	1	..	..	..		
.800	..	..	..	..	2	..	2	..		
.900	..	..	1	..	1	..	3	..		
1.000	..	..	1	..	..	..	..	..		
1.100	..	..	..	..	..	..	1	..		
1.200	..	..	..	..	..	..	..	..		
1.300	1	..	..	..	1	..	1	..		
1.400	..	..	..	..	..	..	..	..		
1.500	..	..	1	..	..	..	..	..		
1.600	..	..	..	..	..	..	1	..		
	59	20	60	19	44	35	66	13		

TABLE shewing the number of Explosions occurring in each month of the year, and the mean difference between the Barometer readings on the days of Explosions, and at certain other times.

Months.	No. of Explosions.	Mean Height of the whole period.			
		A : B	A : C	A : D	A : E
January . . . .	4	— .163	— .110	+ .024	— .215
February ..	6	— .109	— .159	— .029	— .188
March . . . . .	5	— .222	— .162	— .162	— .533
April . . . . .	3	— .139	— .092	+ .005	— .355
May . . . . .	4	— .192	— .253	— .125	— .307
June . . . . .	10	— .119	— .131	— .014	— .235
July . . . . .	6	— .061	— .119	— .054	— .156
August . . . .	7	— .079	— .067	— .011	— .083
September ..	7	— .178	— .236	— .076	— .208
October . . . .	14	— .071	— .160	— .087	— .308
November ..	5	— .425	— .400	— .206	— .577
December ..	8	— .147	— .189	— .188	— .294

ON WATER SPRINGS AND THEIR RELATION TO MANUFACTURES.

BY JOHN JEBSON, ESQ., C.E., OF HUDDERSFIELD.

The connection of water springs with manufactures, and the influence of one over the other, is a subject of considerable importance, and worthy of a careful investigation by this society, for, without an adequate supply of water, the staple trade and the towns of the West Riding would thereby be seriously affected in a commercial, domestic, and sanitary point of view. Many difficulties have to be surmounted before we can obtain this essential element in proper quantity and quality, as many have painfully experienced; and many circumstances have to be taken into consideration in relation to a good supply of water for the purposes named, before the object aimed at can be obtained. For instance, locality has a most important bearing on the

case; and it is only by strict attention to this particular that it is possible to obviate many of the difficulties and disappointments that we should otherwise meet with. Another difficulty which often presents itself would be removed by a strict attention to NATURE'S LAWS. In all her arrangements we in general find a wise distribution of minerals, metals, clay, stone, and water; but where there is a preponderance of any one of these, there is almost invariably a corresponding scarcity of another, a wise disposal of all created things by the Creator; we thus find that the general results of each separate locality conduce to the well-being of the human species. Water has ever been and ever must be an important element for the sustentation and well-being of man, whether as an individual, or in society. Supply, for domestic purposes, has ever been a subject of the highest moment, particularly in countries less provided for in this respect than our own. We have proof in sacred and other histories, how man's ingenuity has been taxed, and his toil and exertion required in providing a sufficient supply. And in the distribution of this prime essential, perhaps no people in ancient times displayed more skill, prudence, and energy than the Romans in the various methods which they adopted to supply their towns and cities. The supply of water in adequate quantities and of the requisite quality is becoming, or indeed has become, an all-important question in this part of the country, not only as the element to be generated into steam—the motive power, or the prime impulse of manufacturing—but also for domestic and other purposes, the certain concomitants of manufacturing pursuits. Many towns and rising districts have been seriously impeded in their onward progress from the lack, in sufficient quantity, of this most useful and essential element. The gathering principle on the surface has been largely adopted in almost all available places, either in the immediate or the more remote vicinity

of various towns, in the counties where manufactures are extensively carried on, or where large populations are brought together; but experience proves that some other mode of supply must also be adopted, as the result of gathering only is not equal to the increasing wants of our increasing population. We have painful illustrations of the truth of this assertion where manufactories rise up as if by magic, as in the case of Dewsbury, Batley, Heckmondwike, and the surrounding places; also Bradford, Leeds, Huddersfield, and the immediate outlying districts, not excepting Barnsley. Rivers, streams, brooks, and rivulets, are almost all rendered unavailable beyond a very limited space from their several sources, either for domestic or manufacturing purposes, because of the insane mode pursued of polluting them with the sewerage of towns, and the poisonous refuse of our manufactories, and other industrial operations. Strange as it may appear, it is no more strange than true that very few of the manufactories where our finest qualities of goods are produced, are supplied with water from these natural sources. Again, why are there so many failures in obtaining suitable supplies of water for the different requirements of trade?

In seeking for supply, as before stated, "locality" should be first considered. It is folly to expect a large supply of water for the purpose of manufacturing in a locality where mining operations are extensively carried on, for, generally, mines are worked much deeper than wells or shafts for water are sunk, and the mines thus drain all, or nearly all, the springs over large tracts of country; this water, when pumped to the surface, is so highly impregnated with deleterious substances, that, as a rule, it is unfit for use for the purposes named. Almost all springs of water in the carboniferous strata, or coal measures, are useless for the particular purposes here contemplated. Another difficulty

is that the various strata containing water, with particulars of its qualities, and the depths at which it might be obtained, are omitted to be set forth in our maps, records, and other sources of geological information. Of what avail will be the useful inventions of those great men, Hargreaves, Arkwright, Cartwright, Crompton, and Watt, and of the modern application of the great principles developed by these men, if we fail in adequately providing THAT without which none of them can be successfully worked?

I would therefore suggest that the delineation of water springs, their qualities, quantities, and depths, be indicated upon our maps, in the same manner as beds of coal, clay, iron, stone, and other strata are set forth, as information equally necessary and essential. A careful collection of facts from experience and observation, and thus delineated, would form a very valuable addition to our present stock of useful knowledge, and would often prevent the loss of capital in mere speculative search to provide that which does not exist in sufficient quantity to justify the outlay. Again, is it possible to ascertain the sources from whence springs are supplied, the rate of supply, and the quantities to be realised from springs at depths varying from 10 to 600 feet? Here a question arises. Does water exist beneath the surface beyond a certain depth in any and every locality? There is a theory that it does not. How to reconcile this theory in all cases with the facts, I know not. In many mining districts the theory is borne out; in others the reverse is the case, as at La Grenelle, near Paris, in London, Bristol, and other places. To confine attention for the present to the West Riding of Yorkshire, if we draw a line south from Penistone to Otley or Pateley Bridge, north of the gannister of Halifax beds of coal, we shall find an uniform result, both as to what may be termed surface water and deep springs. These springs are found in various places, finding

an outlet from the sides of the hills ; they are found also at considerable depths below the surface. I am not in a position to give from chemical analysis the component parts of the water, but it is generally of a very superior quality ; and when proper arrangements have been made, and skilfully executed, failure in securing quantity is the exception and not the rule. In the strata overlying the Soft or Halifax low bed of coal (known by that name in the West Riding of Yorkshire, and as Mountain Mine in Lancashire) there is a peculiarity which has proved hitherto a never-failing supply of water, and of a superior quality.

From whence are these subterraneous reservoirs supplied ? surely there is only one source—from the rains which fall from the clouds ; for there is no direct communication between the elevated hills and the sea or the rivers. That there is a constant source of supply must be evident, or we are reduced to the alternative that these springs will fail at a period not very remote. Hence the necessity of ascertaining whether our means of supply are unlimited, or whether it be not necessary to enforce a more wise economy in the use of that which we possess. There are few of Nature's bounties with which we are so lavish as water, and yet none is more essential to our comfort.

The object of this Paper is principally to point out a few of the causes why persons fail in obtaining a sufficient quantity of good water. We particularly notice three—

1st. Places are selected where water does not abound.

2nd. Persons do not ascertain beforehand the quantity of water they are likely to require.

3rd. The projects set on foot are often not compatible with the objects sought to be accomplished.

There is a notion very prevalent, but not the less absurd, “ that water in all cases ought to, and will, rise to the surface of the ground, no matter what the elevation may be.” On

this supposition many projects have been started and failed, simply because impossibilities have been expected.

One fixed and universal law governs all water springs, viz. :—That the outlet, or escape, is governed by the source, or inlet. That all springs are supplied from the surface is, we take it as a fact, confirmed when we bear in mind that the strata of the ground beneath the surface differs very greatly in character. Clays, shales, and solid rocks are so close in texture, that water cannot find its way through them. Others are more loose, and allow water not only readily to flow, or percolate through them, but, owing to their porous nature, become both channels and reservoirs; such strata, cropping out to the surface, and inclining so as to underlie the more impervious ones from the natural reservoirs, to which those in pursuit of water, by underground operations, should have recourse. Such is the principle to be observed in the search for water; but how often do we see attempts made to procure water where no such strata exist, to the great loss of capital, and disappointment of the parties, who in all probability would not have made the efforts had such means of information as I have suggested been within their reach. The reason why springs from under the hard bed coal, or gannister, are abundant in quantity and superior in quality, is simply this :—the strata through its porous nature and freedom of composition being unusually free from impurities, with a rapid incline to the hills, together with its open character, the soil being a mixture of bind and shaly sandstones, forms both passages, filters, and subterraneous reservoirs. The sandy ground absorbs the rain that falls upon it, and thus so long as evaporation from the sea is continued, and the rain falls on the porous hills I allude to, so long may we expect a supply to be continued. To the supply thus afforded there is certainly a limit; and I sincerely trust that before long some definite result may be obtained, and recorded, as to

the decline or otherwise, of those springs that have been flowing for years. I remember a bore hole, five inches in diameter, put down eleven years ago, to the depth of 400 feet, on the premises of the late Mr. Samuel Routledge, dyer, of Huddersfield, which supplied more than 100 gallons per minute, and I am not aware that there has been any decline to the present time. The force was such, that the water rose 20 feet above the surface of the canal, and at that altitude was stationary. The quantity increased in proportion to the depth below the point above-named, at which the outlet was fixed, clearly establishing the principle that the force of a current of water, when flowing vertically from a bore-hole, or pipe, is in proportion to the difference between the inlet and the outlet. Adopting this as a sound principle, is it not more wise in such operations to sink shafts or wells to a considerable depth below the surface of the ground, because of the certainty in the one process over the other? There is no part of the country that I know of where nature has been more lavish or profuse in the supply of water, than within the lines I have named; as in addition to the numerous runs from under the various deep strata I have referred to, there is an abundance of water, of excellent quality, within a reasonable distance from the surface. In fact, water can here be obtained at depths varying from 1 to 600 feet in depth, and seldom failing in either quantity or quality. A judicious application of the artesian principle, so-called, would provide an ample substitute for the failure from our streamlets and rivers, which are now so fouled as to become nuisances instead of boons. Much of this might be remedied, if the fouled and pure water were kept separate, which would not be a very difficult or expensive process, and which some day or other will have to be enforced. Until this is effected we shall have to resort for a supplement and substitute to these internal sources I have spoken of, and



thus procure a good and constant supply. While the South of Yorkshire produces an abundant supply of coal, North Yorkshire an abundant supply of ironstone, West Yorkshire clay stone, and with a good supply of water and skilled labourers, we have within our reach and power those elements and essentials eminently calculated to produce great social, local, and national advantages. These natural advantages enable each district to have a well-defined staple trade of its own, and which admits of no interference by the others. We have, therefore, coal, ironstone, manufactured iron, steel, and machinery of every conceivable kind; we have cloths, linen and woollen, coarse and fine; we have alpacas, carpets, yarns, and fancy goods; the world is our market, our ships sail on every sea and known navigable rivers; and for all, water is one great essential.

It is not our intention in the least to raise a needless alarm, or to insinuate that the water supply is about to be diminished, but rather to point out the wisdom and utility of a considerate economy in its use, or rather abuse, more especially on the part of those who are situate at the head of streams, and who, by the deleterious matters they pour into them, renders them unfit for their neighbours' use. This caution appears necessary, from the fact that in many densely-populated districts the present supply is not equal, in all seasons, to the demand. The health of the inhabitants is thereby jeopardized, and the welfare of the community imperiled by a continuance of such a state of things. The resources of each district should be ascertained, and the best means adopted for rendering those resources available at the least cost, both to manufacturers and to the inhabitants of the various districts.

I hope this subject will receive the attention it deserves from those most interested, viz., the commercial part of the community; these are directly interested, but it is a national

subject. Trade creates our wealth, and contributes most to England's greatness as a nation, and those who best conserve her interests are her most sincere friends. I trust the meeting will bear with me for occupying so much of their valuable time with these crude observations on what many may consider an unimportant subject; but its importance is frequently and deeply felt by those who have erected large manufactories, and those about to do so.

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CONSIDERATIONS CONNECTED WITH THE RELATIVE CHANGE OF  
LAND AND SEA UPON THE SURFACE OF THE EARTH. BY  
CAPTAIN DRAYSON, ROYAL ARTILLERY, WOOLWICH.

There are few subjects connected with geology the accuracy of which have been so well established as that the land and the sea have frequently changed their relative positions. Upon first considering this subject, the mind is naturally influenced by a feeling of wonder and surprise.

If we stand upon some elevated snow-capped peak of the Alps, and survey the vast accumulation of ponderous rocks and towering pinnacles, heaped together in masses, or separated by yawning chasms, and then turn our eyes to the calm and verdant landscape beneath us and in the distance, it is really difficult to realize the truth of the statement that these lofty mountains were not only once level with the plains, but at no distant epoch were actually the bed of a sea. Fortunately the human mind is in the majority of instances guided by facts which, however strange or wonderful to our ideas at first, will still, after a lapse of time, be generally accepted and placed within the museum of science. Thus, when shells which were undoubtedly of marine origin, were found embedded in the solid rocks which formed the most elevated mountains, it was impossible, or at least

unreasonable, to deny the truth of the statement, that the sea must once have covered these rocks. No sooner do we become aware of this fact than we may discover that we have lifted but one of the veils which conceal from us the simplicity of nature.

To know a bare fact is in itself interesting ; but to trace effects to their ultimate cause, or rather to trace a succession of effects, may lead us to perceive some of those wondrous laws by which the machinery of the universe is regulated. In the present inquiry we will start from the acknowledged phenomenon that mountains now several thousand feet above the sea level, were once beneath it ; and we will direct attention to the successive steps by which this result has been attained. First, it is granted that a mountain, now thousands of feet high, was once beneath the sea. It follows then that either the mountain must have *risen*, or the ocean must have *decreased* and passed away since.

It is now so generally known to all those interested in geology, that facts prove that the mountains have been raised, that we need not here enter into the proofs of this part of the subject, but will advance to the next step in the inquiry.

It is found that not only are there mountains which were once beneath the sea, but that there is land which is now considerably beneath the level of the sea, and which was once above it, and that submergences and emergences must have occurred repeatedly. The alternate beds of coal, sandstone, and shale, most clearly prove this change from land to water. The first conclusion to which this fact might lead us would be, that the same land had been forced upwards from the centre of the earth, and had then sunk, and so on, and thus that the change of water and land had been produced by a *process of oscillation*.

To reach truth by means of inquiry, it is absolutely necessary, in the absence of direct evidence, to consider by

what means the most evident phenomenon *might* have been accomplished, then to collect all the evidence connected with the effects, and lastly, after putting aside our preconceived opinions, to consider which of the many explanations is most in accordance with the actual facts before us.

To the scientific minds of the middle ages, few subjects appeared more unnatural and more ridiculous than that the earth should move. Yet actual facts were in favour of this movement. And these individuals forgot that whilst they rejected as *absurd* the theory of the earth's movement, they admitted as *sound* and *probable*, the theory that the whole of the fixed stars, the sun and the planets, rushed round the earth with a velocity a thousand times greater than that assumed by the new theory for the earth. Thus, it not unfrequently happens, that a truth, if novel to our minds, is rejected from its supposed absurdity, whilst a falsity which we have long tacitly acknowledged as a truth, is looked upon as quite in accordance with nature.

Whenever any change of level is spoken of, it is necessary to refer to some fixed point as a datum; in the present inquiry this datum will be the centre of the earth. That the same land should rise, then sink, then rise, and so on, is not by any means necessary to produce a change in the relative position of land and sea. Let us take an example: Suppose that the whole surface of Africa were to gradually sink, so that it approached 10 miles nearer the centre of the earth, (this distance being merely taken for illustration), in consequence of water finding its own level, there would be a transfer of a body of water from the whole ocean, equal in cubical contents to the area of the continent of Africa, and 10 miles deep. This withdrawal of water would leave a vast area of land, in many parts of the world where sea now exists,—such, for instance, as the Newfoundland bank, the English Channel, the plateau across the Atlantic, &c.

Again, suppose that Europe, Asia, and America sunk nearer to the earth's centre by 10 or 12 miles, the whole bed of the ocean which was not covered more than 4 or 5 miles with water would then probably become dry land, whilst the now dry land would be ocean. If the *then* dry land were to sink whilst the then ocean beds were to remain stationary, the change of sea and land would be again produced. Thus, if these continued *sinkings* took place, all the changes of land and sea, which are visible on the earth's surface could be accounted for.

Let us now take another view of the case. Let us suppose that at the present time the beds of the Atlantic and Pacific Oceans were to be forced upwards, and to the amount that the Alps were raised during a recent geological epoch. The water now lying above the Atlantic and Pacific beds would spread over the surface of the earth, and would cover the lowlands in various parts of the world, and would consequently cause these to appear as though they were sinking, whereas they might really be stationary as regards the central datum. All these changes, be it remembered, taking place slowly, but with varying intensity according to the causes producing them, a continued rise of the ocean beds would cause the whole of the dry land to be submerged, and a transferral of water to be produced. The elevation again of portions of the submerged continents would again transfer the water to other parts of the world; and thus, by a continued *elevating* process, all the changes of sea and land might be produced. It is highly improbable, that supposing either this or the former case to have occurred, that the continents would have risen, and in the same shape as at present. If either an elevating force be at work, or if there be a process of depression going on, then both these effects must have a cause, and this cause must work according to the conditions which produce it, the greatest force being

exerted when and where the conditions are the most favourable.

Thus the fact that land and sea have repeatedly altered their relative positions yields us a problem, which may be explained by three causes—

First. By an oscillation from and to the centre of the earth.

Secondly. By a gradual but irregular contraction of the materials of the earth, particularly at the central parts thereof.

Thirdly. By a gradual expansion of the same materials.

Either of the latter two suppositions may strike us as bordering upon the marvellous, but we shall require something very extraordinary to astonish us, if we bear in mind such facts as that the Himalaya Mountains, now 26,000 feet above the level of the ocean, were within quite a modern geological period the bed of a sea.

We will now examine the probabilities connected with the existence of these three supposed causes. Every effect must have a cause. If the surface of the earth has been elevated, the cause must be the action of some force from below, or some attraction from above. If the same surface become depressed, the effect must be caused by the withdrawal of this force, or by the action of a fresh and more powerful agent, and in a contrary direction. It is certainly more probable that some force has acted from below, than that an attraction from above has caused the elevation of mountains. To elevate such a mass as the Alps, the Andes, &c., the force, when measured by human ideas, must have been enormous; and this force must have consisted of some material power, such as the expansion of the dense masses deeply seated in the earth, or of some gaseous or steam-like force which had been generated in the interior of the earth.

It is almost impossible to conceive how any gas could act so as to *sustain* a range of mountains, even if we grant that

it could force them momentarily from their positions beneath the sea level. But if we suppose a mass of rocks acting from beneath by an expansive tendency, there is no difficulty in comprehending how a range of mountains might be forced upwards, and sustained there. When we consider the submergence of the mountains, we have a very difficult problem to explain. Mountains could not sink unless they had a vacant space into which to sink, and how is this vacant space to be obtained? We could only obtain a vacant space by assuming the withdrawal of the cause that produced the elevation; by the shrinking up of the rock that had expanded, if we grant an expansion, or by the perpetual shrinking, if we grant only the sinking probability. The sinking theory obliges us to make very many guesses and assumptions, and is more intricate than the elevation, which requires but *one cause* to be continued to produce all the effects. Assuming for a moment, that as the interior of the earth is of a density equal to nearly treble that of granite, there is an effort going on to relieve this density, then it would follow as a mathematical law, that the exerted force would act with the greatest intensity upon that portion of the earth's surface which was nearest to the centre, and thus, other conditions being the same, that portion of the land which was at the time the bed of the deepest sea, would be acted upon with greater power than the land which was farther removed from the centre, and thus by a self-adjusting system the various portions of the earth would be raised in turn, and would become mountains, plains, valleys, or ocean beds, and thus the transferral of the water would be effected.

Geology, fortunately, is a science which rests upon facts, an examination of which will probably render us independent of mere probabilities, and may yield us some substantial evidence connected with the subject under discussion.

In consequence of various beds which were once contiguous having been elevated or depressed irregularly, it follows that the strata of which these beds are composed must be broken and dislocated. If the same strata have been repeatedly elevated and depressed, we should find that the various fractures produced all descriptions of forms and appearance without any regularity. The planes of cleavage would show signs of repeated rubbing and scratching, or the respective fractures would assume one form for *elevation*, and another for *subsidence*. If the surface soil has always sunk nearer to the earth's centre we should have a larger area attempting to accommodate itself to a smaller surface, consequently there would be a lapping over of the various beds at the lines of fracture, whilst none of the lower deposits could ever come to the surface. First, because there must have been a contraction of the lower strata to admit of the upper sinking. Secondly, because the superficial area of the strata on the surface would, owing to the depression, have to arrange itself to the smaller superficies, and consequently there would be no opening for the lower strata to protrude through. If the surface soil has been continually elevated by the action of forces acting from the central portions of the earth, the various strata would be separated by short intervals, which would contain matter forced upwards from probably the expanded rocks themselves. Also there would be great horizontal distances between beds which were formerly connected with each other.

Now it is a well known fact that the planes of cleavage exhibit only one kind of action. Professor Phillips has observed this, and has mentioned in his *Geological Treatise*, page 40, vol. 1, that "an examination of the smaller and larger 'faults' where their planes can be clearly seen appears to show that only *one* kind of action has been impressed



upon the masses, as they appear to have slid in one direction, have been rubbed on their faces in one direction, and seldom if ever exhibit any signs of repeated action, along the same or neighbouring planes, we are forced to adopt as a highly probable view of their origin one continuous effort of a great force tending to extend and consequently inducing tension in, and fracture of, the crust of the globe." Thus the oscillation theory appears to be disproved by the appearance of the planes of cleavage; and if one force only has been at work, and if this force was an expanding force, then there must be an uniformity in the position of the beds where separated by "*a fault.*"

The researches of inquirers connected with the peculiarity of faults, have shown that there is one almost invariable rule in connection with this subject, viz., that the fault invariably "*hades,*" or underlies, in the direction of the downthrow, that is, if A and B are beds once continuous, they will always be found, at a fault, to lie as shown in Plate, fig. 1, and never as shown in fig. 2. It is therefore impossible for any bed to be brought vertically under another part of it, and thus no fault can bring a superior bed under one originally below it.

As a corollary to the above, it follows that the alternate change in land and sea must be caused by one continued elevating process, acting from the interior of the earth. In addition to the evidence afforded by the faults, we have the proof of a force acting from below in the intrusion of trap rock, &c., which has been actually forced to the surface through the openings consequent upon an elevation of the upper beds. If, then, we were to attempt to fit together the now disjointed strata, we should have to place them upon the surface of a sphere of smaller dimensions than is our globe, or there would be vast chasms separating the various portions.

### A GEOMETRICAL PROBLEM CONNECTED WITH THE ABOVE.

—A very simple, but at the same time a very interesting geometrical problem is submitted in connection with the faults, viz., If there be a horizontal separation between two beds, what amount of elevation has caused this separation? See Plate, fig. 3.

This question is solved as follows:—Suppose  $BAC$  a portion of the earth,  $C$  the centre of the earth,  $AB$  a portion of the surface, which has been raised from the position  $XY$  by the action of expanding deposits at  $F$ ? The question is, to find the distance  $XA$ , that the strata has been raised.

Suppose the distance  $AB$  to be 10 miles, and that in this distance the various beds have been separated in horizontal distance a total amount of 50 yards. Then taking  $CA$ , the present radius of the earth to be 4,000 miles,  $AB$  to be 10 miles,  $XY$  to be 10 miles, less 50 yards, we should have the following proportion:

$CA$  is to  $AB$ , as  $CX$  is to  $XY$ , and thus  $CA$ ,  $AB$  and  $XY$  being known, we can find  $CX$ , which in the present example would enable us to find that  $AB$  must have been raised 11 miles at least to produce a horizontal separation of 50 yards in 10 miles. This amount, although apparently large to us, is still not one six-hundredth part of the thickness of this globe, and would be comparatively as insignificant as one-tenth part of the thickness of the peel of an orange, to the orange itself.

From the above problem we could, if given the horizontal distance between two sides of a fault, immediately find the amount of elevation which had caused it.

It is to be hoped that those geologists who devote their time to collecting details and facts, will give some more information than at present exists, connected with the *horizontal* distance separating the various beds. Whilst a

considerable amount of attention has been directed to the dip of the beds, and the distances vertically of the upcast from the downcast, there appears a deficiency of published information connected with the horizontal distances, or with the horizontal extent of the fissures into which trap rock, &c. has been forced. Yet this information must lead to the most important results, if we consider the causes of a phenomenon to be as well worthy of philosophical inquiry as is the evident phenomenon itself.

Sir R. Murchison mentions in his work, "Siluria," that there is a fault near Wolverhampton, which is 140 yards wide; and in the same work he mentions several which are of great width.

To test this matter thoroughly, it requires that the dip of the beds on each side should be measured, as well as the horizontal distance between the fractured ends. The horizontal distance of the beds would then require to be divided by the cosine of the angle of dip, to obtain the true horizontal distance of the beds, and hence the horizontal extent of the fault, after which the amount of elevation might be easily calculated by the following formulæ:—

$$C X = \frac{C A \times X Y}{A B} \text{ and } A X = C A - A X.$$

Where C A = present radius of Earth.

A B = present length of strata + the horizontal width of fault.

X Y = length of strata — fault.

C X = former radius of earth.

A X = elevation of strata since deposition.

**PROBABLE CAUSES.**—We will now consider the probable causes which have produced the elevations shown by the evidence of the faults, intrusions, &c., to have actually occurred.

To cause vast portions of the earth's surface to be raised from the direction of the centre, it is necessary that the masses of matter lying deep down in the centre of the

earth should by some means be caused to occupy a larger space than they formerly did. In what manner could this tendency to expand be induced?

If we examine a common pebble, or stone, we must be aware that this is composed of various particles, which are held together by some mysterious power. If we direct our attention to a piece of granite, we must come to the same conclusion; yet the granite, bulk for bulk, will probably weigh much more than the pebble. That power, or force, which attracted and held together the particles composing these two substances, must have acted with a diminished intensity, or for a shorter period, upon the particles composing the pebble than upon those composing the granite, or these pebbles would not be composed and arranged differently. What then is the power which has acted with a varying intensity on these substances? By what means was it produced, how may it even now be working, or what are the laws regulating it? Alas, we are reminded that science is but yet in its infancy, and that we live in the age of names. We speak about attraction, repulsion, electricity, magnetism, gravity, and other things, just as a Caffre might talk about the moon, the sun, the stars, &c.; and we know as much of the actual components of these forces, or of their real nature, as does the savage of the celestial bodies. It is true that we know some of the effects of gravity, electricity, &c., just as the Caffre knows that the sun shines, and that the stars twinkle, otherwise we have our unknown, just as he has his. There is, then, some unknown, although named, power, which has caused various substances to differ in the approximation of their component parts.

We find that the whole earth possesses a density equal to five and a half times that of water, consequently the particles of matter near the centre of the earth must be held to each other very closely. Is there any tendency on

the part of this attracting force to decrease in intensity, becomes a fair question? If there be, then its action upon these dense and central portions would cause an expansion in the mass, which expansion would cause the elevation of the surface, and the forcing up of any matter which might be in a fluid state above the expanding mass. We know as a fact that heat will cause an expansion in almost all substances, that is, that heat will cause the particles to separate in a measure from each other, the amount of separation depending on a law, the details of which are unknown. Thus, if there be any such tendency on the part of the lower strata, we have an adequate cause for the expansions mentioned above.

Let us now consider another question. Heat produces expansion in almost all substances: might not the exposure of the earth to great heat cause a considerable elevation of land by means of the expanded strata? Certainly this result might follow; and if we could see a means by which an additional amount of heat might be obtained by the earth, we should not be supposing a cause which was itself inexplicable. We must at this point entirely separate our ideas from that vague indefinite cause spoken of as the *central heat theory*, which assumes that the earth at a short distance beneath the surface is in a state of fusion from intense heat. There is not a well established fact of any kind to prove this assumption, and there are *very few facts* in geology which are explained even if we grant the truth of the theory. This theory about the centre of the earth being in a state of fusion from heat is based upon the fact that if we descend into the earth we find a greater heat than upon the surface. Surely this is a very slight foundation upon which to build so singular a supposition. Yet this theory is assumed by many individuals to be so firmly established by facts as to be unquestionable.

It has often been remarked that that which has been unquestioned, need not be unquestionable. But let us take an example :—Suppose that we placed a cold 68lb. shot in front of a fire, and caused this shot to rotate for about half-an-hour, we should then have the surface the hottest part, whilst the centre would be quite cold. Then suppose that we removed this shot from the fire, and swung it about in a cold air, the surface would then get cold before the lower portion, in consequence of the radiation of the heat. Thus if we were to examine the metal at a short distance from the surface, this metal would increase in heat *up to a certain distance, but it would again decrease*, until it became quite cold near the centre.

What then should we consider the value of the conclusion, which at once affirmed that because the heat increased from the surface of this shot to one-tenth of an inch from the surface, that *therefore* the centre of the shot *must be* red hot. Most surely this would be too hasty a theory. Yet this is the only evidence which leads to the conviction that the centre of the earth is in a state of fusion from heat. Heat will explain much in geology, but it must not be a heat in the centre of the globe, nor can a cooling globe explain any of the geological facts, for contraction follows cooling, and direct evidence speaks to expansions only.

A powerful telescope being directed to the planet Venus enables us to perceive that some very singular conditions prevail upon her. She is spherical like the earth, she rotates on her axis, she revolves around the sun, she has an atmosphere, and, in fact, appears very like our globe, except that a singular annual variation of climate prevails upon her surface. If Great Britain were transferred to the same latitude on Venus that it occupies on our earth, we should have an arctic climate in winter, during which the sun would be absent nearly 40 days, and thus Scotland, Wales, and

England would have their glaciers and icebergs formed in winter. In the summer, however, there would prevail a heat of which we have no conception. The sun would then return, and would remain 40 or 50 days entirely above the horizon day and night, not low down as is now the case in the arctic regions, but nearly vertical both day and night. Those only who have felt the fierce heat of a tropical sun, which remains scarcely more than 12 hours above the horizon, can imagine what would be the intense furnace-like heat, were the sun to remain nearly vertical during 40 days and nights. The rocks on the surface, and even deep down in the earth, would become heated beyond anything which we have ever seen, whilst the sulphurous strata would be forced into a volcanic condition. These and many other changes are probably occurring in Venus, *for it is a fact* that on that planet the sun does so remain above her horizon.

This singular climate is the result of the axis of Venus being inclined at an angle of only  $15^{\circ}$  to the plane of her orbit. From the consideration of the conditions on Venus, we naturally turn to the evidence afforded by geology on our own globe. We read about the singular climate of the glacial epoch, when glaciers extended down to  $35^{\circ}$  of latitude, and when huge boulders were carried from and to various parts of the world. The actual conditions now enacting on the planet Venus, dovetail very singularly with the evidence afforded by geology on our own earth. The intense heat of the sun during about 40 or 50 days, would certainly produce great heat in the earth, and even to the depth of some miles, especially if this condition prevailed during several thousand years. Surely we should have an expansion going on in Venus; mountains would be raised, fusion produced, and a heat induced in the lower strata just as there would be in the 68-pounder exposed to the fire.

In conclusion, therefore, we venture to point out that there are three methods by which the alternation of land and sea might be produced. That the greater number of facts point to a continued elevation of land by means of forces acting from the interior of the earth as the cause. That an examination of the fractured strata will show to what extent the elevation within modern geological periods has amounted. That there is no difficulty in finding a cause for the production of an elevating force, when we consider the density of the central portions of this globe, and believe it possible that this density may be decreasing. Or if we examine the other members of our system, and consider the conditions now transpiring upon *their surfaces*, and then find that there is a movement of our earth which appears to tend to the manifestation of the same conditions.

In a short paper like the present, it is difficult to do little more than glance at the probabilities which we have had the honour to submit to the meeting. Nor is there time to discuss the value of the objections which may be urged against the views here put forward.

Thanking the meeting for their attention, we beg to request the favour of their consideration upon the matter contained in this paper.



Fig 1

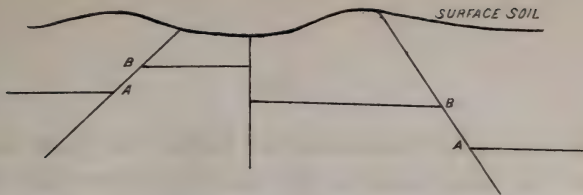


Fig 1

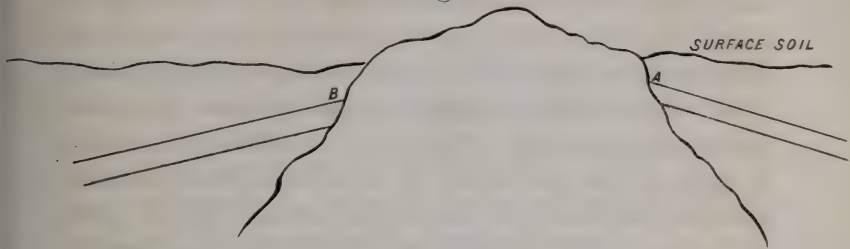


Fig 1.

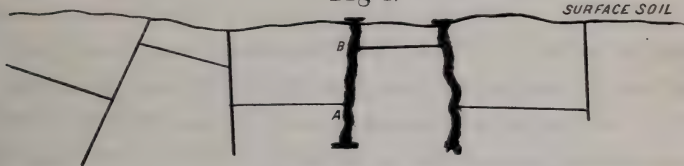


Fig 2.

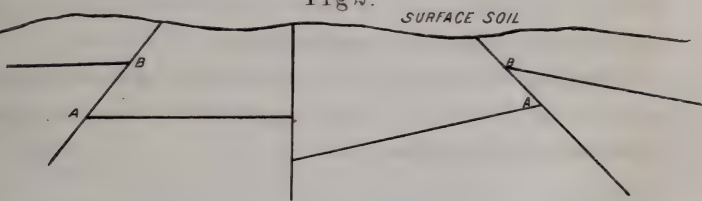


Fig 2.

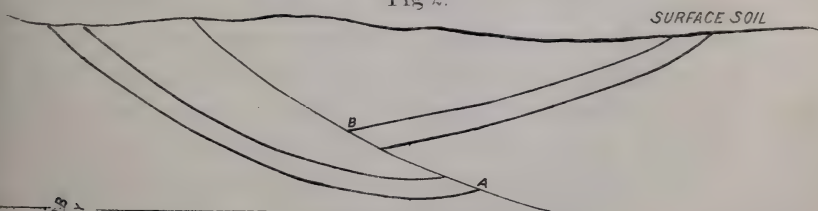
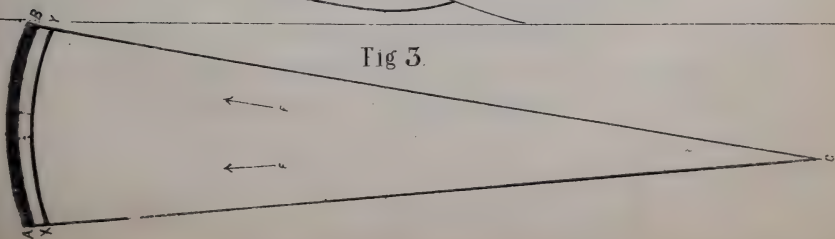


Fig 3.







On the motion of Mr. O'CALLAGHAN, the following noblemen and gentlemen were appointed as the Officers and Council of the Society for the ensuing year:—

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THE EARL DE GREY AND RIPON.

**Vice-Presidents.**

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THE EARL OF EFFINGHAM.	W. B. BEAUMONT, Esq., M.P.
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HENRY BRIGGS, Esq., Wakefield.	BENTLEY SHAW, Esq., Huddersfield.
DR. W. ALEXANDER, Halifax.	RICHARD CARTER, Esq., Barnsley.

The first Paper read to the Meeting was—

ON THE FORMER EXISTENCE OF THE ROEBUCK IN THE WEST RIDING OF YORKSHIRE. BY MR. H. DENNY, A.L.S.

As no amount of knowledge of the physical geography of Britain will supply evidence which could warrant a belief so apparently absurd as that the peaceful and rural districts of Yorkshire, or even the sites of our busiest towns, were once the abodes of large carnivorous and herbivorous quadrupeds, whose present analogues are now only to be found in tropical or boreal regions, we

are, therefore, required in a matter-of-fact age like the present, to produce positive proof of the truth of our assertion that such a different order of things to what we now see around us, and so contrary to what our unassisted reason would lead us to infer, has really once existed. Now this evidence is supplied by our local museums, in which Geological specimens accidentally discovered find a resting place and a record ; and which, but for such valuable depositories, would in numerous instances be neglected and lost. In the majority of cases the individuals who first disinter these enduring records of remote ages are unable to appreciate their real value, and it is therefore to accident alone that the circumstance of their existence becomes public, for it is a fact that nearly all our most important discoveries regarding the primæval animals of this country have been the result of accident. To such I would refer the discovery of fragments of the lower jaw of a monkey, at Kyson, in Suffolk, in 1839 ; at Northeliff, in Yorkshire, in 1829, of portions of a skeleton of an enormous species of lion or tiger ; at Newbourn, in Suffolk, in 1839, of the teeth of a species of leopard. To the same accidental discovery in the Stonesfield slate of Oxford, and the Eocene sand at Kyson, of two or three small jaws, we owe the evidence that marsupial animals, now only found in America and Australia, were not only once indigenous to Britain, but the first indications of mammal life on our planet. To the accidental breaking in of a limestone cavern on the roadside near Pickering, in 1825, we owe the discovery of the former existence of the elephant, rhinoceros, hippopotamus, and hyæna, in the East Riding of Yorkshire. By mere accident the labourers in a brick-field at Wortley demonstrated the former existence of the hippopotamus, elephant, and gigantic ox, in the valley of the Aire. In the cutting of a drain at Cowthorpe, near Wetherby, the fact was discovered that the gigantic deer or Irish elk, was

not only once a British, but a Yorkshire ruminant. By the casual visit of an intelligent person to the limestone Caves near Settle, we owe the discovery that the tiger, bear, hyæna, and wild boar, once roamed over the romantic hills and dales of the West Riding of Yorkshire; and lastly, to a similar cause in examining a gravel pit at Maidenhead, in Kent, in 1855, it was ascertained that the musk ox, now only a denizen of the most dreary regions in the Arctic Circle, was once a British animal, coeval with the elephant.\*

As the identification of a single bone of anomalous character may be the means of throwing much light upon the former animals of a district, and also of adding very considerably to our knowledge of the succession of life on the surface of the earth in past ages, it is of the utmost importance that no circumstance, however trifling in itself, which affords evidence of such a changing scene, should be allowed to pass unrecorded. I have, therefore, much pleasure in being able to state, that to the list of mammalia formerly natives of the Yorkshire hills must now be added the Roebuck, the most northern species of the family at present existing in Britain. In a collection of bones, pottery, and other articles recently exhumed from one of the chambers of the Dowkabottom Cave in Craven, and transmitted to me by

\* In allusion to this last ruminant, Professor Owen observes:—"In the Musk Buffalo encountered by our enterprising and much enduring Arctic Explorers of Melville Island and Baring's Island, we have the living exemplification of the slight and superficial modifications which enable one species to find its appropriate theatre of existence in a far different latitude from the rest of its congeners. Ought we to have been much more surprised if some individuals, some lingering remnants of the species of the two-horned woolly rhinoceros, or even of the equally warmly clad mammoth had been met with in the same rarely visited region of North America, deriving their subsistence from the thick forests near the Mackenzie, or resorting to the scattered clumps of spruce fir that skirt the barren ground between the 60th and 66th parallels of north latitude? The conclusion from present evidence appears to be that the circumstances which have brought about the extinction (probably gradual) of the Northern rhinoceros and elephant have not yet effected that of the contemporary species of Arctic buffalo."—*Geological Journal*, vol. 1856, p. 130.

James Farrer, Esq., M.P., of Inglebro' House, the most valuable and interesting specimen is the upper portion of the skull of a mature Roebuck with antlers, indicating its age to have been probably six years. During my exploration of this cave in 1859, I found portions of jaws and skulls of a small species of ruminant, which at that period I could not satisfactorily identify, as from the size of the teeth I knew they could not have belonged merely to young animals. I have now, however, no hesitation in assigning them to this animal, and that they belonged to mature females. The occurrence of the Roebuck in the Dowkabottom Cave is, therefore, an important discovery, as it substantiates the probable antiquity I ventured on a former occasion to assign to this cave and its contents, as we know this animal was a contemporary of the rhinoceros, the mammoth, and the megaceros. Dr. Buckland mentions an antler found in the Paviland Cave resembling the roe. Professor Owen, in his invaluable History of British Fossil Mammalia, says he received remains of this animal from the Ossiferous Caves in Pembrokeshire, from a fissure of a limestone rock in Caldy Island, off Tenby, Glamorganshire, where the capreoline antlers were associated with the remains of the rhinoceros tichorhinus, and also from limestone caves in the neighbourhood of Stoke-upon-Trent. Almost the entire skeleton of a small ruminant agreeing in size and general character with the female Roebuck, was discovered in the lacustrine formation at Bacton, in Norfolk, with the remains of the trogontherium, mammoth, and other extinct animals, &c. In a lacustrine deposit of marl, with freshwater shells below the peat, at Newbury, in Berkshire, the skull and antlers of a Roebuck were exhumed, in which county the remains of this animal are not uncommon. In the fenland of Cambridge, at 10 feet below the surface, antlers of this animal have been discovered. In October, 1859, while cutting a water-course in the parish of

Coldingham, in Northumberland, the workmen disinterred two antlers embedded at the depth of five or six feet in a deposit of gravel, earth, large boulders, and water-worn stones. One of these was a nearly perfect antler of the Roebuck in its sixth year, and the second was the palmated expansion of the antler of the gigantic Irish deer (*Megaceros Hibernicus*) from whence we obtain evidence that they were contemporaneous inhabitants of Berwickshire, and where it is probable the latter ruminant existed during the *historic* period, as in Maxwell's "Hill-side and Border Sketches," it is stated that near North Berwick "A medal of Trajan, a fibula, a patera, and a horn of a moose deer" were discovered. From the foregoing instances it would appear that the Roebuck was extensively distributed over this Island, probably before its insulation; and perhaps Yorkshire can boast of having possessed more species of the Cervine family than any other portion of Britain; as the megaceros, strongiloceros, red deer, fallow deer, and roebuck, have now been satisfactorily identified as former natives of this county.

THE REV. MR. M'ENERY'S RESEARCHES IN THE BONE CAVE OF KENT'S HOLE, TORQUAY, AND THEIR RELATION TO THE ARCHÆOLOGY AND PALÆONTOLOGY OF BRITAIN, BY THE REV. JOHN KENRICK, M.A., F.S.A., OF YORK.

Although the scene of Mr. M'Enery's researches is very remote from Yorkshire, the value of his discoveries is not confined to the locality in which they were made.

No higher testimony to their importance can be needed than that of Professor Owen, who says, "The richest cave depository of bears hitherto found in England, is that called Kent's Hole, near Torquay. It is to the Rev. Mr. M'Enery that the discovery of the various and interesting fossils of this cave is principally due." Mr. M'Enery was the chaplain of the old Roman Catholic family of Carey, of Tor Abbey,



and he has left an interesting account of the circumstances which led him to engage in those investigations, which have connected his name with the Archæology and Palæontology of Britain. It will be better understood if I briefly advert to the nature of the district in which they were carried on.

The geological relations of Devonshire generally, and especially of that part of its southern coast in which Kent's Cavern exists, were long a problem to geologists, till the sequence of organic remains cleared up the obscurity which mineralogy could not alone remove, and decided its place to be in the old red sandstone, intermediate between the Silurian and Carboniferous systems. The whole of the coast from Berryhead to Watcombe appears to have undergone great disturbances in former times, from the agency of both fire and water. Raised beaches occur,—in one instance on a rock, which now stands out some hundred yards in the sea, 70 ft. above the present level of the shore,—containing shells entirely different from those now found in the adjacent seas; and the remains of a submarine forest, with trunks of trees in a vertical position, are found opposite to Tor Abbey. The conglomerate, from boulders of which the beautiful marbles of Babbicombe are worked, must have been formed by the action of water. The crystalline limestone, which forms the hills over which the town of Torquay has spread itself, has been disturbed by igneous rocks, which have altered their composition and thrown them into every variety of inclination. In one place, the contact with the trap has so changed the limestone that it will scarcely effervesce with acids. So anomalous is the structure of the coast that, at Watcombe, the red conglomerate, tilted into a vertical position, is in contact with the horizontal strata of the new red sandstone.

This limestone, which is found in various parts of South Devon, as far west as Plymouth, everywhere abounds with

caves, some of which, as at Oreston, Brixham, and Torquay, have furnished both archæology and palæontology with facts of profound interest. Kent's Cavern—the discoveries in which are connected with the name of Mr. M'Enery—is at the distance of about a mile and a half eastward from Torquay, and does not differ materially in its structure from the caves which characterize limestone districts. Like these, it has a floor covered with stalagmite, while stalactites depend from the roof. These appearances had attracted visitors long before flint implements or the fossil bones of extinct animals had become objects of research. To cut their names in any remarkable spot, which they may happen to visit, is an ancient custom of our countrymen, and Kent's Cavern bears testimony to its existence for at least 250 years. Names and dates have been cut in the stalagmite, and the earliest of these which is legible is of the year 1615. But scientific research into its contents did not begin till 1824, when it was explored systematically by Mr. Northmore, an ingenious but eccentric man, who hoped to find there some evidence in support of a theory of pagan mythology which he had adopted. Mr. Bryant, whose views had been reproduced by the Rev. G. Stanley Faber, had led many persons to embrace what was called the *Helioarkite* origin of mythology, according to which heathen polytheism, including Druidism, was the worship of the Sun, combined with the deification of Noah, as the symbol of the Deluge. Mr. Northmore had adopted this theory, and had joined with it the belief that the Mithraic worship had been widely diffused over the ancient world, and especially had its share in producing Druidism. Now, the Mithraic rites were known to have been celebrated in caverns, and the report of the wonders of Kent's Hole convinced him that he should find there the various objects which indicated the performance of Helioarkite and Mithraic worship. It is not the first time that a man, who has gone

out in chase of a chimera, has brought home a valuable truth. In the course of his exploration of the cave, Mr. Northmore found a tusk of a hyæna, a metatarsal bone of the cavern bear, and about twenty or thirty other teeth and bones. Mr. Trevelyan speedily followed Mr. Northmore, and obtained results of a more scientific character. He carried with him to London specimens of the teeth of rhinoceros, hyæna, and tiger, with jaws of the bear and fox; and engravings of them were executed by the lady who subsequently became the wife of Dr. Buckland, and gave him such important aid by the exercise of her skill in drawing. It was at this point that M'Enery took up the investigation, which he carried on for several years, and, as the result of which, made a large and valuable collection of fossil remains and works of art. It was his intention to have published a memoir, illustrated by numerous plates; but geology was not then so popular as it has since become, and perhaps his own name was not sufficiently known in the scientific world. At all events, he was compelled to renounce his plan, after making two appeals for subscriptions. At his death, his collections were sold by auction, and dispersed. The MS. of his intended work was included in a lot, at the sale, with sermons and other papers; and for many years it remained unnoticed by the purchaser, and was supposed to be lost. It has, however, come to light, and has been recently published by Mr. Vivian;\* and from it the account of his researches is derived. It appears, from Professor Owen's work on Fossil Mammalia, that some of the most rare and valuable of Mr. M'Enery's specimens have found their way to the British Museum.

The cavern has long been completely cleared of every curiosity, whether of art or nature, that could be removed,

\* Cavern Researches, by the late Rev. J. M'Enery, F.G.S., Edited from the original MS. Notes, by E. Vivian, Esq., 1859.

but it is the opinion of a very competent judge, Mr. Pengelly, that much remains to be explored, if only a sufficient sum could be raised for the purpose. The cavern goes on expanding as it descends, and attains a greater extent towards the bottom of the hill. It branches out into many recesses, which, from the remains found in them, have been called by Mr. M'Enery, the *Bear's Den*, the *Wolf's Passage*, the *Cave of Rodentia*, the *Cave of Inscriptions*; but as no plan accompanies his work, it would be useless to attempt to give an idea of their relative position. A more important point, as throwing light upon the history of its contents, is the vertical order in which they succeed each other. According to Mr. M'Enery, the ancient rocky floor of the cavern was inhabited by bears and hyænas, as well as by rodentia, such as water-rats and shrew mice, but chiefly by hyænas, who left in it not only their own bones and other traces of their existence, but those of animals which they made their prey; in this respect closely resembling Kirkdale. He supposes that, while it was in this state, a body of mud and gravel rushed into it, covering the bottom, and enveloping in it the organic remains which lay scattered about. This appears to have come from the land, not from the sea; for it contains no marine exuviæ, but fragments of the formations of the adjacent country, and rolled pebbles of the granite of Dartmoor. But, though it entered with a violent rush, the agitation did not continue long; the bones bear no marks of any long friction. The masses of rock and heavier bones sunk to the bottom; the lighter remained in the upper part. No similar second irruption of mud and gravel could be traced; and as Buckland's "*Reliquiæ Diluvianæ*," recently published, had given currency to the opinion that all such phænomena were attributable to one great historical event—the Deluge, the mud was called by him diluvial, and everything of subsequent age, postdiluvial.

After the quiet settlement of the mud, the cavern appears to have been inhabited, for it is on the surface of this sediment, slightly adhering to it, but not incorporated with it, that the flint implements were found, which attest the presence of man. They are of three different kinds, corresponding with the varieties observed in other places; some, M'Enery calls arrow and spear heads; some, knives or chisels; some, wedges for splitting wood. The regularity of their form, he observes, precludes the supposition of its being accidental. I am reminded of a similar testimony, of Professor Ramsay's, in regard to the implements from the Valley of the Somme, with regard to which a doubt has been expressed (but only by those who had not seen them) whether their form was not owing to natural causes. "For twenty years," he says, "like others of my craft, I have handled daily, stones, whether fashioned by nature or art, and the flint hatchets of Amiens and Abbeville are to me as clearly works of art as a Sheffield whittle."\* In the Cavern of Kent's Hole they are never found, according to Mr. M'Enery, more than three inches deep in the diluvial mud, they bear no mark of abrasion by friction in water, and, consequently, they were not brought in along with the mud. Mr. M'Enery argues that they could not have been introduced through the stalagmite, which lies above the diluvial mud, by any excavations for ovens or pits, as had been conjectured by Dr. Buckland, who was unwilling to admit that the position in which they were found was their original one. Mr. Vivian adds, that the Torquay Natural History Society had found the flints, below stalagmite, so hard and thick that without quarrymen's tools it could not have been broken up, and therefore it was in the highest degree improbable that those who possessed only implements of flint should have made

\* See also the papers of Mr. Prestwich and Mr. Evans, in the Philosophical Transactions.

excavations in it. Some of those, in Kent's Cavern, according to Mr. M'Enery, had one end in the diluvium, and the other sticking in the crust of the stalagmite, which lies over it. But, according to his repeated assurances, the flints are never found at the bottom of the cave, or mixed with the bones of the hyænas and bears in the lower part of the mud, though, as he argues, if they had been washed down from the mouth of the cave they would, from their superior gravity, have sunk even lower than the bones. He considered the cave to have been inhabited by a tribe using the flint implements, after the deposition of the diluvium and *before* the deposition of the stalagmites; and regarding the diluvium as the production of Noah's flood, he was naturally surprised that there should be traces of human population in this distant part of the world so soon after that event. No human bone has ever been found in the mud, the upper part of which contains the flints. We have therefore the same phænomenon as in the gravel beds of the Somme, the presence of the works of man, without any bodily traces of him. Such traces, however, are found in the stalagmite which immediately overlies the diluvial deposit—burnt bones and charcoal; and Mr. M'Enery distinctly says that these are not lodged in any artificial hollow, such as might have been made at a subsequent time, but simply repose on a stratum of stalagmite, which has itself been covered by a second stratum, to use his own expression, "Like substances deposited on a grave stone, and subsequently overlaid by a similar slab." At this depth, however, no decidedly human remains, no pottery or beads, have been found.

Higher up again in the stalagmite deposit, human bones are met with in connection with flint implements and coarse pottery, and even metallic remains. In one place an iron spear head was found, and the jaw of a boar, which may have received its death wound from the weapon; and it is probable

that, like the cave at Brixham, it was visited, and occasionally tenanted, during the time of the Romans, who had a station hard by on the down above Babbicombe. Mr. M'Enery was at first inclined to think that the human bones and the flint implements, through all depths, were contemporaneous; but he subsequently abandoned that opinion, and the final result of his researches is the classification of the deposits in the following order, proceeding downward:—near the surface, black pottery, with traces of the lathe, beads, and bone pins, and other articles belonging to the British or Romano-British periods; lower down, arrows, spear heads, and stone axes, among fossil teeth and bones of herbivorous and carnivorous animals, but no pottery nor other work of art; lowest of all, the diluvial bed, containing merely animal remains, with the exception of the flints at its upper surface.

Such are Mr. M'Enery's statements respecting the succession of deposits in the cave and his inferences from it. It must not be concealed, however, that a geologist of eminence, Mr. Austen, in a Memoir in the 6th volume of the "Transactions of the Geological Society," gives an entirely different result of his researches. He says, "Human remains and works of art, such as arrow heads and knives of flint, occur in all parts of the cave, and throughout the entire thickness of the clay, and no distinction founded on the condition, distribution, or relative position, can be observed whereby the human can be separated from the other relics." Mr. Austen also thinks that the bones of the elephant and rhinoceros were washed into the cave, along with the flint implements, from no great distance; remains of these animals being found in many of the valleys of South Devon. These discrepancies render it particularly desirable that a fresh examination should be made by men free from preconceived opinions on either side. Another cave in the same district,

at Brixham, containing similar remains, has been explored by Mr. Pengelly and Dr. Falconer, but no detailed account of their conclusions has been published. Mr. Vivian, who took part in the examination of Brixham Cave, declares his opinion that the flint implements found there, one of which was six inches long, were introduced under precisely the same conditions as the fossil bones and teeth. Some were found at the depth of two feet in the diluvium.

Mr. M'Enery's MS. is very fragmentary, rather materials for a memoir than an orderly treatise, so that it is difficult to reduce his scattered facts and remarks to a distinct arrangement; and the dispersion of his collection prevents our deriving from them an elucidation of his MS. He may even seem to contradict himself, when different portions of his journal are compared together. The fact appears to be that he wavered in his own conclusions. An eminent geologist, who knew him well, says, "M'Enery had no doubt whatever as to the occurrence of flint implements in the lower accumulation with the extinct animals; this, I know, from repeated conversation with him. But Buckland would never hear of it: hence the confusion in his views, when he came to write his account of the cave and its contents."‡

He speaks of the flint implements found in the lower deposit as *rude* compared with those of the upper; but there is no specific account of the difference. From the drawings of two of them, which are of larger size than the others, they appear to have approached in form to the *hatchets* of Abbeville and Amiens; but no account is given of the part of the cave in which they were found, so that we cannot derive from them confirmation of the conclusion suggested by other collections of flint implements, that two distinct æras can be traced in the history of their use. Those which have been found in the diluvial gravel have marked differences from those which occur in British or Celtic tumuli. The



eminent Danish antiquary, Mr. Worsaae, has been led by his own observations to a similar conclusion. He has found in mounds on the fiords in Denmark, or at the bottom of bogs, covered with large hills of gravel, clay, and sand, implements of flint, neither ground nor polished, different in form from those which occur in Denmark in sepulchral tumuli, but resembling those discovered in bone caves and in the gravel beds of Abbeville and Amiens.\* And he comes to the conclusion that these latter belong to an earlier age than those of the tumuli and cromlechs, and to a ruder race. I presume that Mr. Worsaae, who can hardly have seen the flint implements of Kent's Cavern, when he speaks of bone caves has had some other discoveries in view. Mr. M'Enery's account leads us to believe in the existence of a difference, but does not enable us to decide on its amount. The prehistoric age of Europe has been divided into the Stone Period and the Bronze Period; but that a subdivision of the stone period itself is required is a conclusion which has latterly forced itself upon historical inquirers; and, in the absence of written records, it is only to material antiquities that we must look for the means of deciding the question. The rate of the deposition of the stalagmite appears, in Kent's Cave, to have been subject to irregularities which preclude the possibility of founding upon it any calculation of chronology. At present the deposit has ceased.

There is something truly formidable in the list which Mr. M'Enery gives of the ferocious animals, whose teeth remain to attest their powers of destruction. The elephant and the rhinoceros appear as peaceful creatures among the gigantic

\* See also Mr. Lubbock's paper on the Kjökken Möddings of Denmark, "Natural History Review," Oct., 1861. The bones found in these heaps, however, are not those of the extinct animals which occur in the drift gravel and bone caves. They belong to a geological epoch not very different from our own.

specimens of carnivora, to which Kent's Cavern served as a den or a sepulchre. Professor Owen considers that to the great extinct tiger, bear, and hyæna, of the caves, was assigned the office of controlling the members of the richly developed order of the herbivorous mammalia, and that with them was associated in the work a feline animal, as large as the tiger, and, to judge by its implements of destruction, of greater ferocity. From the form of the teeth of this animal, each movement of the jaw combined the power of a knife and a saw, while the apex, in making the first incision, acted like the two-edged point of a sabre. The backward curvature of the full-grown teeth enabled them to retain, like barbs, the prey whose quivering flesh they penetrated. Of this terrific animal, which Professor Owen has named *Machairodus latidens*, Mr. M'Enery discovered several canine teeth in Kent's Cavern. The teeth of the fossil hyæna, from the same place, proved it to have been larger than the largest known species of tiger. The great cave bear, judged by the length of his canine teeth, found there by Mr. M'Enery, must have equalled the size of a large horse. If man were the contemporary of these tremendous animals, he must have needed all the advantage which reason gives him to hold his own against them, armed only with flint hatchets, spears, and arrows.

But was man really contemporary with them, or with the gigantic elks, the *Cervus Megaceros* and *Cervus Strongyloceros*, whose shed antlers have been found in Kent's Cave, and against whom his flint weapons would have had a better chance? From the conflicting statements of Mr. M'Enery and Mr. Austen, no decisive conclusion can be arrived at, and it would hardly yet be safe to build upon the recent discovery of a human jaw in the same gravel with the bones of rhinoceros tichorhinus, and ursus spelæus, in France.\*

\* Address of L. Horner, Esq., to the Geological Society, 1861, p. 33.

Yet scientific men are evidently inclining to the admission that man has been the contemporary of *some* extinct species. At Ilford, bones of the *Elephas primigenius* and the rhinoceros have been found along with those of the extinct ox and the Irish elk. And as no broad line of distinction between those last mentioned and the large pachydermata can be derived from their state of preservation or the places which they occupy, it seems reasonable to extend to them also the admission of contemporaneousness with man. On this point a great change has taken place within the last few years. When Mr. Teale gave the British Association, at its meeting at Hull, an account of the discoveries in the valley of the Aire, his conclusions were evidently received with scepticism both by geologists and archæologists. Professor Phillips, however, in his last published work, "Life and its succession," says, "In the alluvial sediments of the valley of the Aire lie nearly complete skeletons of the extinct Hippopotamus Major, in another place, jaws and horns of the deer. Perhaps man was contemporary with this extinct hippopotamus, which has also been found in the peat deposits of Lancashire." The same author, speaking of the flint implements from the valley of the Somme, says, "In this gravel have been found remains of the *Elephas primigenius*, now extinct, with whom man may have been contemporary in Europe—not a startling inference, if we remember the discovery of the entire specimen, covered with flesh and hair, at the mouth of the Lena." This sound and cautious reasoner is not startled at the length of time required for producing those changes in the earth's surface which these phænomena imply. "To heap 20 feet or more of sediment over a buried canoe, he says, by the ordinary operations of a river like the Yorkshire Aire, would require thousands of years; if it were accumulated under different geographical conditions, this would perhaps require the hypothesis of still

longer time. The gravel beds of Amiens and Abbeville appear to furnish evidence of higher antiquity for the flint implements found there, for they lie at the bottom of the deposit, twenty feet or more in depth." The evidence of the contemporaneousness of man with some of the extinct mammalia, is strikingly confirmed by the researches of M. Lartet, who has found on various parts of their skeletons in the drift, marks of wounds inflicted by flint weapons. Not only do these wounds correspond with the traces which experiment on recent bones shows that flint implements would leave, but even with the marks which *such* flint implements as accompany the mammalian bones would produce. And M. Lartet finds that the edges of metallic implements would not produce such incisions.\* The argument may be carried yet further. In Suffolk, the teeth of a *Macacus* have been found along with those of the extinct elephant and rhinoceros. The *Macacus* might have been brought over as a *pet*; but the others must have come hither while Britain was still joined to the Continent. The same gigantic animals have been found in Sicily and in Malta, whose distance from the Mainland of Africa is such that but for this evidence, the idea of their former union would have been thought an extravagance. Geological phænomena, referred to by the President of the Geological Society, in his anniversary address of the present year, make it probable that the separation of England from the Continent did not take place till after the deposit of the rolled diluvial pebbles, from among which the hatchets of Abbeville and Amiens have been obtained. In contemplating such stupendous changes on the earth's surface as these facts imply, and

\* See the Duke of Argyll's Address to the Royal Society of Edinburgh. His Grace accedes to the conclusion "That the discoveries in the Valley of the Somme furnish important collateral evidence of the necessity of assuming for the development of our race, a number of years far exceeding what the common chronology allows."

contrasting them with that equable and gradual transformation which it has been undergoing by the agencies to which it has been subject from time immemorial, who does not feel that the history of man also is carried far back into those dim regions of primæval time in which geology expatiates so freely?\*

The question thus opened of the time of man's first appearance on the earth, historically not geologically considered, was lately discussed before an eminent scientific body with considerable eagerness, but not, as it seems, on either side, in a spirit favourable to the discovery of truth. On the one side an attempt has been made, on very questionable evidence, to establish some definite period—20,000, 40,000, 55,000 years, in place of the common chronology; on the other side arguments have been used which, not belonging to Science, only confuse and obscure a scientific discussion. I will again quote Professor Phillips, who says, "Geologists have not escaped censure for countenancing speculations which assign to the human race a period longer than that hitherto adopted on historical grounds. They deserve no rebuke, however, for endeavouring to force their way into the citadel of natural truth, provided they undertake the siege, after a sufficient survey of the difficulties of the enterprise, which in this case are not slight." We may presume that there is also nothing culpable in the endeavour, by legitimate means, to gain possession of the citadel of *historical* truth. The difficulties indeed are obvious. Beyond the highest point, to which the written or sculptured monuments of history ascend, whatever that may

\* Professor Owen, at the Meeting of the British Association, at Manchester, speaking of the natives of the Andaman Isles, who differ in stature, osteological character, language and manners, from all existing eastern races, supposes that they may have been an indigenous tribe, who have existed for thousands of years in their present state, having been cut off, by geological changes, from the Continent of their primitive origin.

be (and we may safely challenge for those of Egypt, an antiquity of 5,000 years), there must evidently be a period in which the human race was attaining to that degree of civilisation which written monuments pre-suppose; for no diary is kept in the cradle or the nursery. The formation and ramification of languages, the diffusion of population, the variations in colour and type, the coalescence of families into tribes, and tribes into kingdoms and empires—all these things must have proceeded according to some law, and a law of which time has been an element. What that law has been it may be even more difficult for the historical inquirer to ascertain, than for the geologist to calculate the time which it required to form the series of the coal strata. A negative opinion alone can at the present moment safely be enunciated—namely, that a certain definite time, popularly assumed, is insufficient for the production of the phænomena. Still this need not prevent us from observing and reasoning upon every circumstance which can help us even to an approximate conclusion.

Geology has done more than merely to show us the existence of vast cycles of change in the past history of the globe; it has given to the whole series the character of a continued preparation of the earth for the residence of man. It has established a long gradation of animal life, suited to the successive conditions of the earth, and varied by Creative Power, as those conditions varied. Of this ascending scale as man stands at the summit, so the latest of the geological æras shows the earth's surface in the most perfect adaptation to his wants and capacities. Where the ox and the deer lived, he could not want the means of subsistence. It seems a reasonable conclusion that the scene thus prepared did not wait long for his introduction upon it. He is the heir of all the ages that preceded him; the earlier he entered upon his inheritance, the stronger is the testimony which

his history bears to the benevolence of his Creator. And thus a conclusion, which has been denounced as hostile to religion, will be found to be in harmony with its highest truth.

SUGGESTIONS FOR THE INTRODUCTION OF THE SILKWORM INTO THE WEST RIDING OF YORKSHIRE, AND MORE ESPECIALLY A NEW SPECIES WHICH MAY BE FED ON THE TEAZLE PLANT. BY MR. H. DENNY, A.L.S.

It has been several times suggested that the cultivation of the Silkworm should be introduced amongst the cottagers of this country, with a view to improve the condition and diversify the occupation of our agricultural population. This would afford an industrious employment for their children, and thus add very considerably to the general income of the family, with little or no outlay, and also be the means of increasing our commercial products.

The first period when this branch of national industry was attempted in England was, I believe, in the sixth year of the reign of James I., who was extremely anxious to promote the breeding and rearing of Silkworms in England, and in 1608 he issued a royal edict, despatched official circular letters, also to persons of influence throughout the country, recommending the subject to their consideration; and arrangements also were made for the distribution of mulberry trees in different counties. The experiment was unsuccessful in consequence, it was said, of the climate being unsuited to the Silkworm. About a century later, 1718, a Company was incorporated, which obtained a lease for 122 years of Chelsea Park, where mulberry trees were extensively planted, and large buildings erected for managing the business of breeding Silkworms. This scheme also failed. The last attempt to introduce this trade in the United Kingdom on a large scale was made in 1835, by a Company which commenced its operations by planting 80

acres in the county of Cork with 4,000 mulberry trees, but the design was abandoned, and the Company transferred its operations to Malta.

At this period there was but one species of Silkworm (the *Bombyx Mori*), reared for its silk in Europe. Now, however, a second species, the Ricinus or Assam Silkworm (*Bombyx Cynthia*), is become a competitor as a silk-producing insect. It was introduced into Prussia in 1856, and has since spread through Germany, and even into Sweden and Russia, with the most extraordinary results. As the produce of the two insects, however, is very different, I think that both species might be introduced with success.

In 1825, Mr. John Murray published a pamphlet on the common species, in which he says, "I have often thought that the cultivation of the Silkworm would form a most valuable and profitable addendum to the poor-houses in England. The aged, and even the infirm, might find here an occupation of healthful interest to themselves, and relief to the burdened benevolence which supports them. There can be no question about the success of this method of culture in England, as, with all the disadvantages the individuals had to encounter, I have seen, I think, 6lbs. weight of silk raised in one season by a poor family in Whittlesea, near Peterborough."

The last individual who brought this subject before the public was Mrs. Whitby, of Newlands, near Lymington. This lady, besides calling the attention of the Agricultural Society of England to the importance of the measure, at the meeting of the British Association at Southampton, in 1846, communicated the results of an experiment she had begun on her own estate ten years before, and exhibited specimens of raw and manufactured silk, produced from the worms of her own rearing and feeding. This lady's experiments have all been with the ordinary Silkworm (*Bombyx Mori*). She



began by planting various sorts of mulberry trees for the food of the worms, a most important step, as the deficiency of the mulberry tree in this country has been long considered fatal to the success of cultivating silk in England. From Mrs. Whitby's experience, she found the Dwarf or Phillipine species by far the best, as producing more leaves, and from being more easily propagated than any other, and which, although closely plucked to feed the worms, continued strong and vigorous. Of the various races of Silkworms she found that by procuring the eggs of the large Italian sort she obtained as great a proportion and as good a quality of silk, as is produced in Italy and France. This was attested by several eminent manufacturers in London, Manchester, and Coventry, and Mrs. Whitby had the honour of presenting 20 yards of rich and brilliant damask, manufactured from silk grown at Newlands, to Her Majesty, who was graciously pleased to accept of this indication of a new source of riches in Her dominions.

In other countries a very large amount of revenue is derived from this source. According to Count Dandolo, the amount of raw silk and silk articles exported from Italy alone in 1808-9-10, amounted in all to 334,580,628 lire Milanese, being an average of 83,646,157 lire Milanese, annually, or £2,790,671 18s. sterling. And in this country, although we do not rear the Silkworm, we have a large trade in silk. In 1820 our exports were valued at £371,000; in 1856 they had reached £3,000,000. The average imports of silk in 1856-7-8, were worth £7,000,000. We have now above 300 Silk manufacturers, with 200 millions of spindles going, and steam machinery of 4,000 horse-power, independently of the hand-weaving of Spitalfields, Dublin, and Coventry. We have 15,000 men, and 35,000 women employed in the manufacture; and it is supposed that all those engaged

in the production, manufacture, and sale of English Silks, do not number much less than a million of persons. It surely then is a subject worthy of consideration ; for though it is not expected that, even if the rearing of the Silkworm were to be successfully introduced amongst the rural population of this kingdom, it would supersede the importation of foreign silk, it would at all events be the means of bringing into the home market a large amount of raw material for the first time, and consequently secure a proportionate share of capital to be expended on native products, instead of being sent to the foreign merchant.

The great difficulties urged against the probability of successfully carrying out this project are the changeable climate of Britain, and the inadequate supply of the necessary food required for the worms, with other minor obstacles. The variableness of climate cannot be entirely obviated without considerable expense, which would consequently increase the price of the article, and thus defeat the object in view. The insufficiency of mulberry plants in cultivation, however, is more easy to remove. If a market is produced for the mulberry leaves, the supply will soon meet the demand. When the latter becomes an object, let additional plantations of the trees be cultivated in proportion to the amount required, and then, lest the trees cannot bear the great loss of leaves which the frequent gathering of them would entail, and continue to produce a good crop in time for the next demand, the trees might be only partially stripped, or alternate trees defoliated, which would ensure a succession of leaves, and only require a larger number of trees to commence with. Mrs. Whitby says one of her earliest pupils had a productive nursery at Godalming, for the white mulberry (*morus alba*), and many others were planting in different parts of England, and she is so sanguine in her expectations, that she thinks if gentlemen in England and

Ireland, who have a few acres to spare, would plant mulberries for posterity as they do oaks, we should in a few years be independent of other countries for our supply of raw silk.

The lettuce has been suggested as a substitute for the mulberry, because of its easy cultivation and cheapness; but I understand, from J. D. Holdforth, Esq., of this town, that this plant will not answer as a general source of food, from its being deficient in the resinous or gummy material which gives strength and lustre to the silk derived from the mulberry plant; and secondly, from the lettuce inducing a disease in the worms which proves fatal to great numbers, hence its use should be only occasionally resorted to, and then in small quantities.\* With all these obstacles, however, according to Mrs. Whitby's report, very favourable results were arrived at. After making every allowance for occasional unfavourable seasons, and labour, machinery, outlay of money, &c., she found that land laid out for furnishing food for the caterpillar would yield at least £20 per annum, per acre, profit.

With regard to the rearing of the Silkworm there is little doubt that if we became practically familiar with their habits, and paid due attention to their peculiarities and wants, they might be reared in England as well as in any other country, and with as little loss by death. *Equable warmth*, throughout the period of their existence, *cleanliness*, *classification*, and *ventilation*, with *adaptation* of the food as to its maturity to the different ages of the insect, will ensure success. For instance, the caterpillars in their infancy ought to be provided with early leaves, from their more delicate structure, agreeing with the feeble masticating

\* Sig. Grisari succeeded, however, in feeding worms of the *Bombyx Cynthia*, the new species, upon willow leaves and lettuce leaves, and obtained cocoons similar to those produced from the leaves of the Castor Oil plant, the natural food of this insect.

organs of the worms, while on the contrary, if these were supplied with mature leaves of a firm texture, the worms would not be able to consume a sufficient quantity without exhaustion, and thus induce disease and death from want of support.

Another point to consider is the proper temperature the worms require, which is between  $58^{\circ}$  and  $68^{\circ}$ , and it has been found that they thrive better in a half-subdued light, or even comparatively dark room, the light being in the same manner injurious to the eggs, as it is known to be to seeds of plants. In its native country the insect lives and passes through its changes under the shade of plants, and even in the miserable huts of the peasants of India, where light scarcely ever penetrates. In the year 1850, Mrs. Whitby was most successful in her rearing; the worms had no disease, and made their cocoons in 30 days, and the silk obtained was as strong, bright, and beautiful, as that which in 1844-5 was pronounced superior to the best Italian raw silk.

During the last few years great attention has been paid to other species of *Bombyx*, whose silk is not only more abundant, but which is in general use by Eastern nations, with a view to its introduction into the manufactures of this country. Silk is easy to obtain in large quantities from China and other countries, but the introduction of a new raw material is not the object contemplated. It is the production at home of a material which shall obviate the importation of it from a foreign market, and thus increase the prosperity of our labouring population. To accomplish this two or three other species of moth have been introduced into Europe, as also into some of our foreign dependencies, for the cultivation of their silk. The French and Prussian Governments have considered the subject of national importance, and hence have promoted the cultivation of this new branch of commerce. The Scientific and other Associations have investigated the

nature and food of the different species of silk-producing lepidoptera, and given the results to the public. In this country the Society of Arts have agitated the question, and published several articles upon the *Bombyx Cynthia*, in their journal. It is, however, to Herr Ernest Kaufmann, the chief merit is due, as from numerous experiments and transmission of the eggs of the *Bombyx Ricinus* or *Cynthia* to various individuals, he has done more than any other person to ensure the accomplishment of this new branch of industry. Professor Kaufmann delivered a report on the comparison between the growth of Ricinus and Mulberry Silk, before a general meeting of the Acclimatisation Society of Prussia, on the 22nd Oct., 1858, from which I have derived the most important information on this subject I am about to bring before you.

The first fact alluded to by Kaufmann is highly important as regards the cultivation of the Assam Silkworm, which is, that seldom more than one brood of the common Silkworm (*Bombyx Mori*) can be successfully reared in one season in Germany or Prussia. Further south, the mulberry, if prudently divested of its leaves, will reproduce a quantity of foliage sufficient to supply a second brood with advantage. But in more northern latitudes, where the vegetation is less vigorous, a second crop can scarcely be expected. The cultivator, therefore, must be satisfied with one brood of eggs only, of which every healthy female will lay from 400 to 500. The number of eggs laid by the Assam Silkworm, however, is not so great, seldom above 300. But this is compensated for by the circumstance that the insect goes through its series of transformations in about six weeks, and it is, therefore, possible to obtain eight or nine broods from a single pair in the course of one year. The author gives an approximate estimate of the enormous quantity of cocoons to be derived from a single pair of this moth, in so short a space of time,

supposing the young caterpillars to be supplied with the requisite amount of food, and all necessary attention paid to them. It must not, however, be supposed that every egg will produce a caterpillar and cocoon; many casualties will necessarily occur. The common Silkworm, for instance, loses on an average in each brood from one-fourth to one-third of the original number. Taking the highest of these as the proportion for the Assam Silkworm, although this species is more healthy, and by making the deduction at the outset, it leaves one hundred couples as the first produce of the original pair. Proceeding in this manner with the calculation, it will be found that at the end of the year the descendants of this pair will have reached no less a number than ten thousand million million couples, and that the eggs of these latter will amount to the enormous sum of *two million million million*.

The author calculates that 3,300 empty cocoons are amply sufficient to yield one pound of silk, but he assumes that 4,000 would be required, and this would give 500 billion pounds of silk as the entire product of one couple, and, assuming the population of Germany at 45 millions, this calculation at the year's end would allow more than 10,000,000lbs. to each individual, and many a poor wretch, he says, who now shivers in the winter's cold, would have reason to be grateful to the first pair of moths for a warm and comfortable protection against the inclemency of the season. In making this statement, however, Herr Kaufmann merely does so to show the moderate estimate he has arrived at of the prolific powers of the Assam Silkworm. He does not suppose for a moment that it would be possible, or even expedient, to rear such an enormous number, as neither land nor labour could be spared to furnish the immense supply of vegetable matter which would be required for that purpose. The numbers reared must be regulated by the demand for the material, and

the silk cultivator would be at liberty to discontinue his operations at the end of the 2nd or 3rd generation, or to limit the number as he might find it profitable or convenient.

Another point worth consideration is the value of the cocoon, in the two species of Silkworm. It is well known that if the moth is allowed to emerge from the cocoon of the common Silkworm, the continuity of the silk is destroyed, and, therefore, it is desirable to destroy the life of the moth for the sake of the value of the silk, keeping only such a number as is requisite for the continuance of the breed. In the cocoon of the Assam Silkworm, however, the insect provides a place for its exit, which does not injure the fibre of the silk, and the empty cocoons can scarcely be distinguished from those containing a chrysalis, except by their comparative lightness. There is, consequently, no loss of silk incurred in providing for future generations of Caterpillars. As regards the climate of Britain, which is very variable, and therefore considered so unfavourable to the common species, this will not be an obstacle to the introduction of the new species, as from the Turin Gazette, we find that Sig. Vincenzo Grisari (who was the first person that undertook the rearing of the Assam Silkworm, upon the Castor Oil plant in Piedmont and France) discovered that the worms of this species do not suffer from a *low temperature*, nor from *strong winds nor continued rain*, but, on the contrary, he obtained finer and better formed cocoons than those produced by the ordinary method of keeping the worms confined in houses. His worms were reared upon the Castor Oil plants while in the ground, and in the open air of the gardens of the Chemical Laboratory of Turin. Sir Wm. Reid, Governor of Malta, (who took great interest in introducing the Assam Silkworm into Malta, and also in transmitting its eggs to the West Indian Islands, France, Italy, and Algeria), states in a despatch to his Grace the Duke of Newcastle, accom-

panied by specimens of silk spun from worms bred at Malta, that the worms are breeding faster in Malta than they can rear Castor Oil plants to feed them with, and also that they were thriving in the open air, and as they consumed the leaves of the Castor Oil plant, they travel from plant to plant, feeding upon several other plants growing near, but apparently doing best on the former.

If then the insect can be transported from Assam in Bengal, and successfully reared in latitudes differing so widely as Assam, Turin, Piedmont, France, Italy, the West Indies, Algeria, Malta, Germany, Sweden, and Russia, surely there is a presumption in favour of the insect thriving also in Britain.

In order to arrive at the value in a commercial point of view, the expenses of an ordinary silk crop must be taken as a basis for an estimate. Supposing that the time of one man is required on an average to attend to the produce of each ounce of eggs, the cocoons from one ounce will, on this computation, cost as follows:—

One Man, 45 days.....	12	Thalers,	or	1	17	6	} Value per oz. ..	8	12	6	
8 cwt. of Mulberry leaves.....	8	"	or	1	5	0		} Cost....	3	5	7½
Fuel, Rent of Buildings, Wear and Tear of Utensils, &c. ..	1	"	or	0	3	1½	} Profit ..		5	6	10½
				21	Thalers,	or			3	5	7½

“This estimate,” Herr Kaufmann says, “is rather above the mark than below it. By returns from the silk its rearer expects not only to cover all his expenses, but, as in all commercial and agricultural occupations, to receive a surplus, which it is expected will be as much. The chief outlay of capital being for buildings, plantations, &c., which are made with the expectation of their being required only for a few weeks in each season; whereas, if more than one crop could be obtained each season, the outlay under this head would not be increased, while the returns would be *doubled!*” With the



*Bombyx Mori*, however, this is impossible, the climate and the food being the obstacles.

Although this estimate for adult labour is made according to the foreign rate of wages, I think it might be very considerably lessened, as is the case in factories, by employing children. If, then, some of the elder children of the agricultural labourers were properly instructed in the business, they could perform all the necessary duties required. The great point to enforce would be punctuality in attendance, supply of fresh food, and cleanliness. This might be accomplished by giving, in addition to the daily wages, a slight per centage for every 100 cocoons fully completed, which would make it the interest of the young labourers to increase by all the means in their power the number of cocoons. "With the cultivation of the *Ricinus Silk*," says Kaufmann, "it is far different. While the former must be content with one brood in a year, the latter can have from 8 to 12; and, granting that the expenses in each case are alike, the cultivator in the latter case is in a position to turn his capital some 8 or 12 times as often, and is, of course, able to afford his article at a much more reasonable rate. There will also be a comparative diminution of all outgoings, owing to there being no loss from intermission; to the management being less expensive; and to the very low value of the food. From all these circumstances it will be apparent that the *Ricinus Silk* must claim to be ranked among the cheapest of the textile substances. That it never can be dear is also evident from the fact that carding is found to be the most eligible mode of treating the cocoons; from which, in all cases, the moths may be allowed to escape, whilst the breeder looks for his profit to the quantity rather than the quality.

"As regards the silk produced from the different species of moth, none of these equal that of the *Bombyx Mori*, for

brilliancy of lustre. The silk of the former is dull in comparison with that of the latter. As an article of luxury in dress, the silk of the *Mori* will always be certain to command the admiration and preference of the public ; but goods will, eventually, be produced from the Ricinus Silk, in which the great difference in price will ensure its use among the various classes of persons, from motives of economy. It is confidently expected, however, that with more experience in its preparation, and improvements in machinery, the silk will even bear the test of a comparison with the old material. There is not a shadow of doubt with regard to its practical value as a strong and durable material, equally well adapted for fine and for serviceable articles of clothing ; for stuffs for the use of the upholsterer ; for coarse sail-cloth and tent-cloth ;— and that it will speedily come into universal demand.” Herr Kaufmann, moreover, hopes “ it may one day be his lot to see the labourer following his plough in a Silken smock-frock, the product of his own industry, which he thinks may be realised, as, by a little attention during the summer months, to a light and easy occupation, a sufficient material might be produced to clothe a whole family for a length of time.” In India there is scarcely a native who has not a small patch of the Ricinus plant near his hut, or in the hedges of his fields, amounting to perhaps the 20th part of an acre, which generally yields enough silk for the clothing of a family. Mr. Hugon, in the Journal of the Asiatic Society of Bengal, says “ The silk of this insect is the daily wear of the poor, besides being used by every class in winter.” Dr. Helfer, in a paper read before the same Society, says, “ It gives a cloth of seemingly coarse texture, but of incredible durability ; the life of one person being seldom sufficient to wear out a garment made of it, so that the same piece descends from mother to daughter, and from this property might be well adapted to mix in certain textures with cotton.”

Sig. Grisari states his intention of trying to rear for the same purposes the larvæ of *Pavonia major* and *minor*, which feed upon various plants, and produce a good but coarse silk. In the neighbourhood of Halifax the latter species used to be plentiful, and I have no doubt all the osier cars in the West Riding will also produce this insect in abundance. Whatever may be the ultimate result of the introduction of the true Silkworm (*Bombyx Mori*) into Britain, there appears little doubt that the rearing of the caterpillars of the *Bombyx Cynthia* may be accomplished; for as this has been successfully done in Germany, why not in England? The Castor Oil plant, however, upon which it feeds freely, will not bear a Northern winter without protection, and, therefore, fresh plantations must be reared annually, which would be an objection. But Kaufmann has found, very fortunately, that the caterpillars will thrive equally well upon the common teazle, which is a most important discovery, inasmuch as, while one plant would have to be cultivated exclusively for the insect, the other is already an article of extensive cultivation, solely for the sake of its heads in the dressing or fulling of cloth; and the remainder of the plant being worthless, is left for manure. Now, the leaves and barren branches would supply an abundance of food for a large number of worms, and hence the produce of a crop of the teazle would realize, with a very small extra outlay, a double revenue. It appears to me, therefore, that, in a clothing district like the West Riding of Yorkshire, where the cultivation of the teazle is so extensive, either the growers of the teazle themselves might employ some of the labourers' children to gather the leaves and attend to the worms in buildings erected expressly on the spot, or that it might be a source of remuneration to many cottagers to cultivate the teazle as a crop, instead of potatoes or other vegetables; as in a small building, like a summer

house, many hundreds of caterpillars might be reared upon the refuse of the teazle crop, and only require a little time devoting daily to supply them with fresh food, removing cocoons and refuse substances, which could be readily done by the children before going to work or school every morning.

Kaufmann says an acre of the *Ricinus* plant at its full growth is found amply sufficient to feed a quarter of a million caterpillars. The quantity of leaves which, without detriment to the plants, might be obtained from an equal space of ground planted with teazles will depend upon the state of growth at which the plants have arrived shortly before the buds reach maturity. When the foliage is in full vigour at least one-half may be removed. The cultivation of the teazle yields a clear profit, varying from 25 to 100 thalers per acre, and since the plants have many large leaves and stems of great length, there is thus, in addition to the crop of heads, a large amount of vegetable matter, which may be fixed at 14 or 15 per cent. per acre, dry weight, available for the food of caterpillars, but which, at present, only serves to augment the manure heap. Supposing, then, that over and above the returns from the teazle crop, an additional profit might be derived from a portion that would otherwise go to waste, it is surely a sufficient stimulus to encourage this new branch of industry, independent of the profit derived from the silk.

In the Canary Islands the natives have already more than doubled the value of their rural products by the easy cultivation of Cochineal. Why should we not follow their example, and attempt the introduction of the Silkworm into the rural districts of England, and more especially into the West Riding of Yorkshire? I am happy to find a similar experiment is in agitation in the neighbourhood of Leamington, where the teazle is extensively cultivated, and

Robert Baker, Esq., formerly Factory Inspector of this district, is exerting himself, with the co-operation of Lord Leigh, to introduce the silk culture into the Reformatory, as an occupation for the inmates. Having expressed my wish to M. Ruland, Esq., Librarian to H.R.H. the Prince Consort, to introduce the same insect into Yorkshire, that gentleman politely wrote to Herr Kaufmann on my behalf, for a supply of cocoons, when the latter kindly transmitted me 16, from Berlin, on the 10th Nov., 1859. Unfortunately, this small number did not prove sufficient for a successful experiment, as 10 of the chrysalides were dead, and of those which produced moths, the sexes did not appear simultaneously, and the majority were males. With a larger number, however, more favourable results might be anticipated.

It may probably be urged that even if we could train the children of the cottagers and others to attend to the rearing and feeding of the worms, they would not be able to unwind the cocoons in a way suitable and careful enough for the market, or that could be depended upon. Now it happens, fortunately, that this difficulty, if it did exist, as also the idea that silk cannot be properly reeled in England, is anticipated, as a most valuable reeling frame has been invented and patented by Messrs. Chadwick and Dickens, of Manchester, by which not only the reeling from the cocoons is rapidly and efficiently performed, but the silk is carried directly upon bobbins cleaned and spun, thus not only dispensing with much of the throwster's labour, which is indispensable to prepare China Silk as it is usually imported for the manufacturers, but producing a bobbin of Silk of double the fineness of any China Silk imported, and equal to the finest French grown silk, and calculated to be worth more by 8s. or 10s. per lb. than the same kind of silk would be if reeled from cocoons in China. This machine will be of equal importance in reeling silk spun in this country, as the

producers of silk will only have to send the cocoons to the Silk merchant without any previous operation, which will greatly facilitate the production of the raw material, by reducing the labour to merely rearing and feeding the Silk-worm, until it has perfected its cocoon.

The effect the cultivation of silk in England, supposing it to succeed to a considerable extent, will have upon the Cotton Market is another point of importance, since the enormous sums now paid to America for cotton would be diminished, if the Ricinus Silk is brought into competition. Professor Dieterici, in a statistical work on the Manufactures of Germany says, "Cotton fabrics are daily assuming more importance, and superseding, or at least entering into serious rivalry with those of linen, the chief reason for which is the continually augmenting production of the raw material, and he conceives the same reason will bring the Ricinus Silk into general use. It is estimated that America, Asia, and Africa produce annually nearly four million bales (each of 300 or 400lbs. weight) of cotton, and this is continually increasing. Of this quantity by far the largest proportion is worked up in Europe, and chiefly in England, which requires a weekly supply amounting in value to one and a half or two million dollars. Dieterici estimates the value of the cotton yarn manufactured in England and Scotland in the year 1858, at nearly 165 million dollars. In the Zollverein this manufacture is yet far from being on so extensive a scale, but it is gradually and steadily progressing, as is plain from the fact that on the average of the years 1849 and 1853 the importation of raw cotton had risen 136 per cent. above that of 1837, while that of foreign yarns had only increased about 35 per cent. above that of the same year. Proceeding in his calculations he shows that a sum of 33 million thalers is annually expended within the Zollverein upon cotton manufactures; and, admitting that a

large portion of this must be placed to the account of labour, still half, or more, remains to that of the raw article, and he speculates on the benefit that would arise should Germany produce the quantity of the raw article which he is sanguine enough to anticipate. Prussia would no longer be compelled to send so considerable an amount of its coin across the water,—it would remain at home. A domestic production would compete with and supersede cotton in part, with no detriment to the manufacturing interest; on the contrary, the existing cotton factories—the manufacturing machinery in which might readily be adapted to suit the exigencies of the new manufacture—would receive a fresh impulse, the processes being so comparatively easy, and the consumption of the fabrics being continually on the increase, and in these benefits he seems confident that the whole of Western Europe would also partake.

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\*\*\* The following statistical calculation is curious, if not important :—

It is computed that 16 yards of Gros-de-Naples, of ordinary quality, or 34 yards of a superior description, are manufactured out of 1lb. of reeled Silk, to produce which 12lbs. of cocoons are required. The average weight of a cocoon is from 3 grains to 3½ grains; its average length when reeled off about 300 yards. Taking the Silk consumed in the United Kingdom annually at 5,000,000lbs., the following are the statistics of production :—

Raw Silk.....	5,000,000lbs.
12lbs. of Cocoons to 1lb. of Raw Silk ....	60,000,000lbs.
30,000 Worms to 1lb. of Cocoons.....	1,800,000,000,000 Worms.
1oz. of Eggs to 100lb. of Cocoons .....	600,000 oz. of Eggs.
16lb. of Leaves to 1lb. of Cocoons .....	96,000,000lbs. of Leaves.
100lb. of Leaves from each Tree.....	9,600,000 Trees.

# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-SEVENTH MEETING, HELD IN THE LECTURE ROOM  
OF THE LITERARY AND PHILOSOPHICAL SOCIETY, HALIFAX, ON FRIDAY,  
JULY 12TH, 1861, AT THREE O'CLOCK IN THE AFTERNOON.

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JOHN WATERHOUSE, Esq., F.R.S., Vice-President, in  
the Chair.

On the motion of Dr. Wm. Alexander, Dr. Lister, of  
Shibden Hall, near Halifax, was elected a member of the  
Society. The Chairman then called upon FRANCIS A.  
LEYLAND, Esq., to read the first paper, entitled—

SOME ACCOUNT OF THE ROMAN ROADS IN THE PARISH OF  
HALIFAX; WITH THE RESPECTIVE CLAIMS OF ALMONDBURY,  
SLACK, AND GREETLAND TO THE SITE OF CAMBODUNUM  
CONSIDERED.

The subject I have been requested to bring before you  
to-day, relating to the roads of Roman construction or  
adoption, which are believed to have passed through the  
parish of Halifax, is one of general as well as of local interest;  
for, whatever tends to throw light upon the distant and  
obscure periods of local history, renders more clear the  
general view of times and events which relate to the country  
at large. And it is the primary object of Archæological  
investigation to multiply the evidences of legitimate history  
by furnishing indisputable data on which to form correct



ideas of the ages remote from our own. But I am constrained to admit that I approach the subject of my Paper with considerable diffidence; for, in my search after information relating to it, in the pages of our local histories, I have found little to assist, and much to discourage. On these authorities the ancient roads of our parish would seem, even a century ago, to have been few in number and traced with difficulty. Watson enumerates two—one from York to Manchester; the other from Manchester to Aldborough. Of the former he says, “that having gained the height of Lindley Moor, it exhibited ‘a curious remain of antiquity;’ that it was considerably raised above the level of the adjoining ground; that it entered ‘a field called Tarbarrells,’ and afterwards, being lost in the enclosures, could be traced no further.”\* The late Rev. Joseph Hunter says of this iter, “that all idea of actually tracing it by indicia yet remaining is vain.”† This learned author is also silent about the branch of the same road which must inevitably have passed by the station at Lindwell, in the township of Greetland, the spot where the altar “*Divis Civitatis Brigantum*,”‡ and other heavy remains of the Roman town, which he believes to have been the *Cambodunum* of the Itinerary, were found in the sixteenth century. Of the road from Manchester to Aldborough, Watson says nothing. Indeed, he does not follow any road which attracted his attention, to any great distance from the point at which he commences it; and he generally ends with an expression of his inability to say anything definite or conclusive about it. Dr. Dunham Whitaker, in his account of our parish, affords no support to the present inquiry; from his silence, one might infer that

\* Watson, p. 39.

† Communication to the Society of Antiquarians on the Site of *Cambodunum*, p. 4.

‡ *Divis Civitatis Brigantum, et numini Augustorum, Titus Aurelius Aurelianus dedicat pro se et suis susceptum merito animo grato solvit.*

no Roman roads at all existed in this parish at the time he was employed on his Loides and Elmete.

It is unnecessary to multiply instances of the unsatisfactory allusions to this subject which are found in the local topographies of our neighbourhood, and which so much discourage any further inquiry into the ancient roads of our district. But I may add other obstacles and difficulties which, in more recent times, have been thrown in the way of the subject on which we are engaged. They are of the kind which have arisen from the operation of the general and local Turnpike Acts, passed in the reign of Geo. IV., by which the repair and improvement of highways was vested in trustees. That the trustees, appointed for the purpose, energetically employed the powers entrusted to them, the highways of this district abundantly show. Such have been the renovations, reconstructions, diversions, and enclosures, directed by the Acts referred to, that the highways which formerly retained their ancient pavements, as a general rule, no longer exhibit any of the usual characteristics of either British or Roman roads. Several instances occur in this parish, of the Commissioners of Turnpike Trusts, in carrying on the repairs of highways of known antiquity, under their supervision, having unavoidably, no doubt, obliterated all traces of ancient construction, which old and still living witnesses remember to have existed before the passing of the local Turnpike Acts.

Warburton, the author of an account of the Roman wall and a herald, I believe living in the 17th century, says, in a MS. work of his, preserved in the British Museum, that when he traced the military way from Aldborough to Manchester, through this parish, it was paved all the way. The pavement of the iter from Ilkley to Manchester may still be seen in Finkle-street, in the township of Sowerby, and elsewhere along its course.

On Lindley Moor, the commissioners in trust of the road from Outlane to Rastrick, have formed their turnpike by the side of the great military way from Eboracum to Mancunium, in order, as it would seem, to avoid the trouble and expense of levelling what remained of the ridge, or of restoring what has been lost, at this point, of the second iter of Antonine. But at another place, as on the north west Watling-street,\* a road which does not appear to have been raised above the ground anywhere on its passage through this parish, but rather sunk into it, the trustees have changed its direction; and, in the fields adjoining, the line, which had been worn hollow by the traffic of ages, or deepened and narrowed by natural agencies, may still be seen of a lighter tint than the surrounding vegetation, and still retaining to some extent the depression of the original course. In addition to all this, the obstacles thrown in the way of our inquiry by the General Enclosure Act,† which provides that every kind of road, “*not set out*” by the commissioners, is declared to be extinguished; and the spirit of improvement, which in these days animates society at large, but more especially that of the manufacturing districts, would seem to render hopeless the satisfactory elucidation of a subject invested with so much interest. It is true, that in the out-townships of our parish, on their unreclaimed moors, their lofty elevations, and in their secluded valleys, much still remains to encourage the inquiry. But the society will allow me to express my regret, on account of the difficulty which attends it now, that so much which might have been well and effectually done by abler hands than mine a century ago, has to be taken up and investigated at the present date, under the accumulated drawbacks I have enumerated. Then, as so little aid is to be derived from those local channels of information, to which I would gladly have referred, it

\* The Ilkley iter.

† Geo. 3, c. 102.

will be necessary to seek elsewhere for such data as may be of use in the present inquiry. To do this effectually we must take up entirely independent ground; and, avoiding all inconclusive speculation, deduce from the well known facts of Romano-British history the materials which the obscurity of our subject requires. By adopting this plan, I trust we shall ultimately arrive at a more satisfactory conclusion than we should were we to adopt the principles on which the inquiry appears to have been hitherto conducted.

In their search after the ancient roads through this parish, our local historians seem to have been under the impression that most of the channels of communication between the cities and towns of Brigantia, if ever laid down either by the Aborigines or their Roman conquerors, had been diverted and lost in very early times. One would infer from the imperfect success which attended their search, that the excellent roads which the Saxons found everywhere, in firm condition, throughout the island, were unsuited to their wants, and that either they or succeeding generations incurred the labour and expense not only of enclosing the ancient roads within their pastures, but of forming new ones, more circuitous in their direction, and less durable in their construction! History is at variance with this theory. But it seems never to have entered into the speculations of our antiquaries that the cities of Brigantia stood, if possible, in greater need of roads between them than the cities of any other province of Britain, or that such roads might actually have been constructed. And they appear never to have entertained the possibility of the ancient pack-horse roads, on which they pursued their archæological investigations, being entitled to an antiquity beyond that of a few generations, but whose age they were unable to determine. It seems never to have occurred to them that Roman legions might

have marched over their enduring pavements and along their direct lines, at the behest of an emperor keeping his court at Eboracum ; or that couriers from the second city of Britain might have sped along them with despatches to the other towns and fortresses of Brigantia !

Hence, as they did not follow the *beaten track*—the date of whose construction they were unable to show—they sought for iters where perhaps they had never been made. Let us take a more comprehensive and a deeper view of the question, and go at once to the foundation of the inquiry. Permit me then to recal to your recollection, in as brief a manner as possible, the general state of Britain at the period of Roman dominion. You will remember that it had been reduced to the state of a province ; that its inhabitants lived in cities, towns, and villages ; that their cities consisted of municipal buildings, temples, baths, and dwelling-houses, all provided with most of the conveniences of modern luxury and refinement. That the open country was spotted here and there with the villas and mansions of the wealthy Romans, adorned with all the costly embellishments of which Italian architecture was capable. These cities, towns, and villages, were connected by a vast and well designed series of roads, military and vicinal. It is unnecessary to enter into proofs of the durable construction of the roads, either laid down or adopted and improved by the Roman conquerors of Britain. It is a fact, in every way confirmed, that such was the case, and that their preservation and supervision were entrusted to men holding high positions under the government.\* On the subjugation of a province, the first attention of the conquerors was directed to the roads between the strongholds they had wrested from the defeated tribes ; and it is indisputable, that the more important the province the more complete were these channels of communication between the cities and garrisons within its borders.

\* Curator Viarum, or keeper of roads.

Of this description was the province of Brigantia; and we owe to a Roman general the first knowledge of its inhabitants. When Julius Cæsar interrogated the Belgæ, whom he found on the coast opposite Gaul, near the modern town of Deal, as to the tribes of the interior, he learned that the Brigantes were the most powerful and numerous; and that from the remoteness of their occupation, their ancestors were believed to have been the spontaneous production of the soil. Prior to the Roman invasion, they had penetrated to the western shore, and had formed a kingdom consisting of two provinces—Brigantia and Brigantia Proper. This latter division extended from the bounds of the Parisii northward to the Tyne, and from the Humber and Don to the mountains of Lancashire, Westmoreland, and Cumberland. Beyond the mountains which separate the counties of York and Lancaster, were located the Volantii and Sistuntii, two tribes united in compact alliance. The former had spread themselves over the western parts of Lancashire, and the latter the west of Westmoreland and Cumberland, as far as the wall of Severus. The Volantii owned for their capital Volanty, the present town of Elenborough, in the latter county, and the Sistuntii Reregonium, the Ribchester of North Lancashire.\* It is in the kingdom of Brigantia, including the territories of these subjugated tribes, that we are more immediately interested. And this arises from the fact of the parish of Halifax occupying a large extent of the hilly country on the western confines of Brigantia Proper; and being so situated that several ancient roads, which are supposed to have been laid down between the towns and fortresses which surrounded it, necessarily passed through it. Before entering upon the question of these ancient roads of our parish, it is requisite that we should know something of the places from whence they came and to which they led.

\* Whitaker's Manchester, vol. i, p. 9.

We find that on the sites of the British towns and fortresses, which, under the ferocious and woad-stained Brigantes, consisted of wretched hovels and palisaded encampments, there arose cities and towns resembling in their architectural beauty, their public buildings and villas, those of the vine-clad slopes and valleys of Italy. Recent excavations have brought to light elegancies which equal those of modern dilettanteism, consisting of the remains of extensive buildings and baths, of tessellated pavements and mural decorations; of altars which record that some favoured individual had performed his vow dutifully and willingly, and others which had been dedicated to Jupiter, the Greatest and the Best! The most extensive and important city of Brigantia was, of course, Eboracum, the metropolis. It is scarcely necessary to remind you that it had been raised to the privileges of a municipal city; that it was the garrison of the Victorious legion, and that it was honoured by the residence, within its walls, of many emperors. Ample corroboration of all this, and much more, may be found in the pages of Drake and Wellbeloved. Next in importance was the city of Isurium, the Aldborough of the Saxons, situated at an easy stage on the north road from Eboracum. Its former greatness is attested by the extent of its remains and the interesting discoveries which have been recently made there. Drake estimates its walls at a mile and a half in circuit, and the form of the city quadrangular. Before the subjugation of the Brigantes it was the capital of the province, and the royal city of the infamous Cartismandua. To the west of Eboracum, at about the distance of nine miles, according to the Itineraries, was situated the town of Calcaria, which, by the concurrent agreement of antiquaries, has been placed at Tadcaster. To the south of Calcaria, on the Western Ermine-street, were placed the towns of Legiolium and Danum, the Campodono of Bede. At the distance of thirty-two miles

from Calcaria, according to the corrected numbers of the Itinerary, was the town of Cambodunum; and at Lindwell, in Greetland, at about the same distance, and in the line of the former, from Calcaria, was a station, which, in the absence of all knowledge of the remains at Slack, which had not then been brought to light, and with the information of Camden before him, the learned Horsley was induced to fix upon as that of Cambodunum. I shall have occasion to refer to this part of my subject more fully hereafter. To the west of Cambodunum, at about the distance of twenty-three miles from it, the learned author of the history of Manchester, on satisfactory data, fixed the site of Mancunium on the banks of the Irwell, where the present opulent city of Manchester is situated. To the north of Mancunium was situate the city of Reregonium, afterwards called Coccium, a place at which numerous discoveries of Roman remains have attested its ancient significance. To the east, and about midway between the latter town and Aldborough, was placed the station of Olicana, the present Ilkley, where fixed and heavy Roman remains have been found, and from whence Roman roads diverge. I may also mention the probability of the Coluna of the Ravennas having occupied the site of the town of Colne, in Lancashire. There are visible evidences in its neighbourhood which give strength to the supposition. There was also a station at Adel, near Leeds, where the usual indicia of a Roman population have been found, and which, I perceive, has been suggested as the site of Burgodunum.

In this list of the cities and towns of Brigantia, I have confined myself to those which are more immediately connected with the subject of my paper, and I venture to express a belief that if all other evidence were wanting, the *importance alone* of the cities I have enumerated would be sufficient to place the question as to roads having existed



between them beyond dispute. We are not, however, entirely left to this kind of evidence. That some of these roads did exist, and that they passed through the parish of Halifax, I shall endeavour to show. By reference to a map of that part of the Roman province in which the cities that surround this parish are situate, it will be evident that the more direct the lines which may be drawn over the country are from one station to another, the more certainly will they pass through the parish of Halifax.\* Nay, so central is its situation between the towns I have enumerated, that any lines drawn from one to another with the intention of avoiding this parish would have to depart widely from the direct route. In the map straight lines may be drawn to represent the supposed roads. One from York to Manchester by Slack, and a branch from it to the same place by Greetland and Littleborough; one from Aldborough to Manchester; another from Ilkley to Manchester, and one from Ilkley to Slack; and a line also may be drawn from Doncaster to Ribchester, and another from Slack to Colne. It is, then, in the vicinities of these lines that we must look for roads as parallel to them as the irregularities of the hilly districts through which they passed would admit, and possessing at the same time claims to antiquity. As I have endeavoured to show the true destination and direction of the roads which are supposed to have connected the distant towns of Brigantia, I need not trouble the society with any detailed account of them beyond the boundaries of this parish, I shall therefore confine my remarks to those portions that are within it, or, at least, as nearly so as possible. The first road on which I shall ask you to accompany me is the one we find in Antonine's second

\* This part of the subject was illustrated by a large map of Brigantia, on which the cities enumerated were distinguished; and direct lines were drawn from one city to another across the districts lying between them. The boundaries of the parish of Halifax were marked in their true geographical position, and this portion of Brigantia was found to be intersected by every line drawn upon the map.

account of the iters of Britain. It extends the whole length of the island from east to west. From Eboracum it leads to Calcaria and forward to Leeds, where Thoresby describes a camp at a place called Wall Flat.\* From thence the road was continued over the country towards Adwalton. At this point, the late Mr. Leman, a Fellow of the Society of Antiquaries, and said to be a most indefatigable inquirer into the antiquities of this country, suggested the probability of an intermediate station between Tadcaster and Slack, which he believed to have been lost in the copies of the Itinerary which had come down to us. The name is, no doubt, significant of some such station, as the meaning of Adwalton is obviously "at or against the walled town." At about the distance of a mile to the south of this supposed station the road passes to Cleckheaton, where Dr. Richardson actually found the vestigia of a Roman town, and of which Dr. Dunham Whitaker says he gave a distinct and satisfactory account to Mr. Hearn. The letter containing the information is published in the first volume of Hearn's edition of Leyland's Itinerary, and relates to the discovery of Roman coins in Heaton fields, together with the foundations of buildings. Dr. Whitaker is of opinion that it was a resting place between Calcaria and Cambodunum. To this point we have been conducted in a direct line from Tadcaster, by the authorities I have cited. The road may not be entire the whole distance, but I believe it will be found, for the greatest part, to correspond with the line of the old road from York to Manchester through this country. We have now no alternative but to follow the road in a straight line to Outlane. This leads us to Brighouse, where the iter crossed the river by a bridge, which, with the house that stood by, or upon, it in remote times, gave name to the locality. From the river, the road passed through Rastrick, and thence, by Castle Hill, Ridge

\* Ducatus, p. 104 (1816).

*Handwritten note:* ... - ...

End, Warren House, and Lindley Moor, to Slack. Passing by the station at this place, the road leads by Outlane and Red Lane Dyke—once, perhaps, paved with Roman bricks, and hence its name,—to Castleshaw, and thence to Manchester, the Mancunium of Antonine. These facts seem to point out the true direction of this iter from York to Outlane pretty satisfactorily. For at Rastrick, Roman remains have been found, which it is not necessary I should particularise on the present occasion, and a wayside cross of Saxon workmanship, which gives considerable antiquity to the road on which it was originally placed.

At Rastrick, this ancient road branches off, and passes by Elland, Lower Edge, to Brow Bridge and Lindwell, in Greetland—the spot on which Horsley fixed the site of *Cambodunum*. The road thence continues along the ridge of Greetland Moor, from whence it commands a fine view of the country towards Stainland and Outlane. Passing onward, it reaches Wall Nook, in this township. There are many Roman encampments and earthworks known by the appellation of “wall;” and whenever the term occurs, in situations reasonably supposed to have been occupied by the Romans, the word may safely be considered a contraction of the Latin “vallum” or “wallum,” and indicative of the former existence of entrenchments on the spot distinguished by the name. From Wall Nook, the road leads by Abbot Royd to Bank Cross, where, in the interval between them, several detached portions of an ancient pavement may still be observed on the renovated trust; and those, no longer in situ, may be seen in the fences adjoining, hollowed by the tread of many generations. From Bank Cross, the road is continued to Ripponden Bank, and between these places the causeway still forms an interesting relic of the ancient road. In the Old Bank the pavement is entire. It has a central causeway, set with squared stones, for a carriage track on

each side. The preservation of this pavement is accounted for by the construction of a new and circuitous branch of the turnpike trust, by which a more easy descent from Bank Top to Ripponden is secured, and, at the same time, the Old Bank left unmolested. On reaching the opposite side of the river, by a bridge of one arch, the pavement disappears under the garden wall of the parsonage. Here it has been completely interred under the parsonage grounds, and obliterated by the new Turnpike adjoining. But crossing the latter, the same kind of pavement is found remaining in fragments along Ripponden Old Lane. This ancient way ascends the hill by Swift Cross Spa, and joins the Ilkley and Manchester road at Whitegate Head, where the original curve of the "Old Lane" was, some years since, diverted from its original course, for the purpose, it would seem, of enlarging the adjoining paddock. From the highest point of the road a fine view of the surrounding district is obtained.

To the west, the height of Monshead bounds the horizon, and to the south, the dark moors of Blackstonedged, shut out the fertile and busy plains of Lancashire. To the east, the eye rests upon the height of Wholestone Moor, which rises above the station of Cambodunum, and northward from this interesting point, the road we have traversed is seen descending the hill on the opposite side of Ripponden Vale, in a straight line to the Ryburne, which flows through the village.

It is to be remarked, in respect of this road, that although no existing indicia afford *sufficient* evidence of Roman construction, it is not the less entitled to great antiquity. We have brought it from a spot on which "fixed and heavy" remains of the Roman times have been found indicative of a Roman population formerly existing there—over the high ground of the country, in a very direct course, to its point of junction with a Roman road of undisputed authenticity, namely, that portion of the North West Watling-street from

Ilkley to Manchester, which passes through the township of Soyland. Entering this iter, which, like the Greetland road, is still for the most part in use, it reaches Baitings Gate, where Warburton, in his map of Roman Yorkshire, marks a camp. From this point, the road continues along the modern highway till it enters Black Castle Clough, where, ascending the Devil's Causeway, it crosses the heights of Blackstonedge; and, entering the county of Lancaster, descends to Littleborough, where Roman remains have been found, and where Mr. Whitaker, of Manchester, fixes a station. I have spoken of the great military way from York to Manchester by Slack and Castleshaw, and its branch to Greetland and Littleborough, as, for the most part, at present existing. I have done so, for in addition to the weight of evidence before me I have not been able to bring myself to believe that those direct and durable iters, which were either laid down or improved by the greatest road-makers of antiquity, have been wholly abandoned; more especially as the places to which they led have retained, for the most part, their populations to the present day. I have sought for proofs of the antiquity of the roads which lay nearest the straight lines, drawn on an accurate map, from station to station, and I have hitherto been successful in my search. There are roads through this parish which have claims to a remote antiquity. The names which still cling to them; their ancient pavements, and the discovery along their course of earthworks, tumuli, and coins; as well as of other vestiges of the British and Roman æras, attest their age. It is on such evidences as these that many ancient roads, which pass through our parish, are believed to be of Roman adoption or construction. It ought not, however, to be concealed that our venerable historian, Watson, held a different opinion, and adopted a different course, with regard to the iter from York to Manchester by

Outlane. He corrects Whitaker, of Manchester, for asserting that the camp at Kirklees lies about a mile to the south of the Roman way (Whitaker would have been nearer the mark had he said two). Watson confidently assures us that "it is a great mistake to say that this station lies about a mile to the south of the Roman way, for this may possibly lead some antiquarian to seek for it where he will never find it, &c." He traced the road from Manchester to Lindley Moor, and, after losing it in the enclosures there, he states that he can with certainty say that to the north of Kirklees, even as far as Leeds, he could neither meet with the trace of it nor any tradition relating to it, though "he repeatedly searched for it with the utmost care; taking the greatest pains in the affair on account of what Dr. Richardson had said in his letter to Hearn, &c." He doubts the Roman character of the camp at Wall Flat; and evidently sees nothing important in the Roman vestigia at Cleckheaton. "In a word," he says, "the Roman way from Manchester to York *seems* to have kept the Calder on its left till it crossed it about a mile below Dewsbury, and falling in with the present turnpike road, follows the course of it to Wakefield, having all or most part of the way the name of street; it is known again by the same name about half way between Wakefield and Pontefract; after which it joins the great military way between Doncaster and York."\* If our worthy historian's iter had fallen into a turnpike road, having some claim to the character of a *long beaten track*, and pointing direct to *York* instead of Doncaster, these facts would not have been without their importance. But I fear his object was rather to write down the only two places between Slack and Tadcaster, which might dispute with him his site of Cambodunum, than to trace, in its obvious direction, this military way of Antonine. Hence he would not allow his

\* Watson, p. 39, 40.

road to cross the Calder at Brighouse, but he took it down the right bank of the river until it was fairly out of the way either of Kirklees or Cleckheaton, and turning it several miles out of its direct course, he connected it with an ancient road from *Doncaster to Ribchester*! I have taken up, I fear, too much of your valuable time, and trenched too long on your kind attention, by my remarks on these two roads. But you will, I think, agree with me that they are of greater importance than any others passing through this parish can be, from the circumstance of their having upon them two places contending for the site of Cambodunum. And this is more especially the case as the claim of Slack to be considered the site of this station, an opinion so long held by the common consent of antiquaries, has been called in question by no less a personage than the learned, urbane, and accomplished historian, the late Rev. Joseph Hunter, of the Record Office. To his opinion may be added that of the learned Horsley, and it will be admitted that their united testimony is entitled to great weight. But other opinions have been maintained on this subject. Camden, Burton, Gale, and Warburton, believed Almondbury to be the site; while the author of the history of Manchester, our own Watson, Dr. Dunham Whitaker, and others, contend for the site of Slack, in the parish of Huddersfield. That Camden committed an error in placing Cambodunum at Almondbury is evident, from the fact of Castle Hill being out of the direct route, and of nothing Roman ever having been found there. If Camden *had drawn a straight line on his map* between York and Manchester, and had been guided by it in his search through the West Riding of Yorkshire, he might have anticipated the subsequent discoveries at Slack. He surely would have heard on the spot, in the reign of Elizabeth, the tradition of a great town once having been there, which Whitaker and Watson heard in the reign of the second George! But,

in the absence of all knowledge of the remains either at this place or at Greetland, he gave the weight of his name to the opinion that Almondbury was the site of Cambodunum. This was published in the editions of his great work, issued previous to the year 1600. But in the August of 1599, when on a visit to Sir John Savile, he saw, at Bradley Hall, the celebrated altar which has caused so much controversy, and which had been disinterred about two years before at Thick Hollins, near Linwell, in the township of Greetland. Yet, with this very important discovery before him, Camden did not see sufficient reason to express a different opinion respecting the site of Cambodunum in the next edition of his *Britannia*, which contained an account of the Greetland remains. On the contrary, he maintained the position he had taken, and his judgment led others, equally competent, to the same conclusion. But the profound and accurate Horsley observing that Greetland lay in the direct line from Tadcaster to Manchester, applied to this spot the principles on which he pursued his search after the materials for his *Britannia Romana*. "That the discovery of fixed and heavy remains of the Roman times, such as all altars are, affords a presumption that there has been a Roman population at or near the place where they are found." In addition, aided by his admirable judgment, he observed that the lingula of land near Linwell, and at the junction of the Calder, with its tributary Blackbrook, corresponded with the situations usually selected by the Roman engineers for the erection of their camps. And his superior judgment is shown by the fact that, at the time he made his observation, he did not know that the Greetland remains had been found on the spot which had attracted his attention.

The exact point where the remains were disinterred has been brought to light in a curious note discovered by Mr. Hunter, in a MS. vol., relating to the affairs of the manor



of Wakefield, which he found in the Bodleian. The note states:—"That in the latter end of the month of April, An. Dom. 1597, Anno Elizabethæ Reginae 39, one Thomas Miles, a labouring man, and John Hallywell, digging upon a lawe of stones at the back of the house of Jeffery Ramsden, at the Thick Hollins, did light upon a stone squared, in length about a yard, having Roman characters, on two sides, engraven, and being plain on the other two sides, having partizans or crests at the top and at the bottom, with some flourishes; which stone had four holes at the top, whereunto it should seem some other thing had been fastened, and the foot thereof had stood upon a square stone wrought with partizans, &c. The characters contained five lines on one side, and but two on the other, and were very difficult to read. There was also found in the said lawes, and in other places thereabouts, divers foundations of houses, and some Roman coins, and squared stones and thick stones, with iron nails, in the earth, in divers places of the ground, called Thichhollins, lying upon the height near the Clay House, near unto Linwell."

A drawing of the Altar, which accompanies this account, identifies it with the one described by Camden. An account and engraving of this altar will also be found in Watson. The inscription is to the effect that it was "Dedicated by Titus Aurelius Aurelianus to the God of the states of the Brigantes, and to the Deities of the Emperor, on behalf of himself and his, in grateful remembrance of the success of their undertaking." The altar was erected at the beginning of the third century, about the time of the expedition of Severus and his sons, Antoninus Caracalla, and Septimius Geta, against the Caledonians.

Horsley, with the statement of Camden before him, and in the then state of information on the subject, was justified in fixing the site of Cambodunum at Thick Hollins. And

although he admits that the usual indicia of a station, in fortifications, tumuli, and foundations are wanting, the discovery of the additional information by Mr. Hunter, furnishes ample proof of the existence of a Roman population at Thick Hollins. However, with the candour which everywhere distinguishes his admirable writings, I feel persuaded, that had he been aware of the important remains at Slack, which had not then been brought to light, his name would not have been identified with the Cambodunum of Greetland. He had evidently sought elsewhere, but on the same iter, for a better site than Thick Hollins, in Greetland, afforded, and he appears to have employed one of his correspondents, Mr. Angier, of Heton, to continue the search, who says, "I have made another attempt to discover a station about Greetland or Ribanden, but without success." "Mr. Camden, indeed, gives us an account of a votive altar found there, but says nothing of the whereabouts, and it is too long since to expect any information from the inhabitants." The *Britannia Romana* was published in 1732, and at that date the learned author was dead. He had been aware that the site of one of the ten cities of Britain, which had been placed under the Latian law, would have left more important traces of its existence than Thick Hollins afforded. All that had been found there, as we have seen, were an altar and some foundations of buildings.

This event happened near three centuries ago, and the lingula in Greetland has since then been barren of interest. Let us inquire into the claims of Slack. In the year 1750, Watson chanced to meet with an unknown altar in a farmer's yard in the township of Stainland. He was conducted to the spot where it was found. It was at Slack, in the township of Longwood, in the parish of Huddersfield; and the inscription upon it indicated that Caius Antonius Modestus, centurion of the sixth victorious, pious, and

faithful legion, consecrated it to Fortune, and thus discharged his vow faithfully and willingly—"votum solvit lubens merito."\* The altar had been discovered on the western side of a building, which proved to be a hypocaust. The remains were found within what proved to be the precincts of a Roman station. Whitaker, in his history of Manchester, estimates the four closes which constitute the Eald, or Old Fields, at twelve or fourteen acres. He also relates that there "had been pieces of thick glass, urns, bones, and slips of copper, and crowded foundations of buildings, discovered, some a yard in thickness, and all composed of strong stone and cement." He also states that "two fields had been cleared, but the other two remained entirely filled up with them." And he says that "the farmers had frequently broken their ploughs in all." He also gives his testimony to the fact that this quarry of Roman remains is placed upon the course of the military way from Manchester to York. He says again that "a great quantity of Roman bricks had been discovered in the foundations, some long and some square, and all of a beautiful red. The latter were frequently twenty-two inches in the square, and found in the floorings of the houses; as in some was dug up a thick crust of brick, rudely scored in squares, in imitation of tesselated work, and in others a pavement composed of pounded brick and very white mortar. Near the eastern side of the area, where three stone ledges and three lordships now meet, and whence a long line of houses appears, from the discovered foundations, to have extended towards the north, were lately found three coins of brass,—"two were lost," the third he describes. There were also discovered two inscriptions—one "REBURRHUI," and the other "OPUS."†

\* This centurion was, no doubt, in command of a detachment of the sixth legion at Cambodunum.

† Whitaker, pp. 128, 129.

Watson, at p. 42 of his history, gives further particulars of these remains. He says that a room in the building, previously referred to, was four yards long, and about two and a half broad, but between three and four yards below the surface of the ground, paved near a yard thick, with lime and bricks, brayed together extremely hard. In one corner of this room was a drain about five inches square. This would seem to have been a bath. He further adds that at "about sixty or seventy yards from this old building, called the Croft, by the irregularity of the ground, there seemed to have been a large erection, perhaps a fort; and that the people there had a tradition that formerly there was a great town in what are called the Eald Fields." I once possessed an iron lattice, which had been found amongst a quantity of Roman bricks and rubbish, discovered in digging in the Eald Fields. This relic, I regret to say, is irretrievably lost. On one occasion, I observed, walled into the end of a barn, a stone, much decayed, bearing the fragment of an inscription; it had formed a portion of some word in which the letters CIVCAN had occurred, but on whose meaning it would be useless to speculate.

Large quantities of Roman tiles have also been found at Slack, many bearing the well known inscription "Cohors quarta Bretonum."\* The Halifax museum possesses one fine specimen and several broken fragments. Watson suggests that the fourth Cohort was stationed at Slack, and that as bricks, bearing the same inscription, had been found in the time of Camden, at Grimscar, which is about three miles from the station, the garrison went there to make bricks. It is far more likely that in Grimscar wood there was a country place of entertainment, patronised by the

\* A Cohort was a body of about 500 soldiers among the Romans. The one commemorated in these bricks was the 4th regiment of Britain, or of Britons.

Roman inhabitants and soldiers of Cambodunum. When Camden visited Grimscar, he found there not the remains of a brick kiln, but those of a hypocaust, which denote the existence of baths, and these involve the necessity of other buildings adjoining.

With regard to the hypocaust discovered at Slack, and minutely described by Whitaker,\* I am not quite sure whether it was the identical one removed from Cambodunum, some years since, to the grounds of the late Mr. Allen, of Greenhill, near Huddersfield. This hypocaust was said to have been a new discovery about thirty years since; but the one alluded to by Whitaker and Watson was exposed to light 80 or 90 years before. The Remain in the grounds at Greenhill is surrounded by trees and protected by an arch of stone.

It had long been a custom at Slack to dig for fence stones among the foundations of the buildings which existed below the surface, and it was on one of these occasions that the ruins of an erection, composed chiefly of Roman bricks, were discovered. These remains consisted of a hypocaust, with the floor and portions of the walls of a Caldarium or sweating-room. The roof of the hypocaust is composed of sandstone flags, measuring 1 foot, 9 inches square, and resting on dwarf piers of Roman brick and mortar, varying from 6 to 8 inches square. These piers are 1 foot 9 inches high, and vary from 12 to 14 inches apart. The room measured twelve feet long by eleven broad, and had been surrounded by vertical hot air tubes, about  $4\frac{1}{2}$  by  $3\frac{1}{2}$  inches in diameter, composed of baked clay, which communicated with the hypocaust below. Many of these tubes remain in their original position. The floor of the Caldarium is one foot in thickness, and is formed of thick tiles about the size of the flags on which they are cemented. Upon this floor a layer of mortar and pounded bricks

\* Hist. of Manchester, p. 130.

has been run, when in a liquid state, to about the thickness of four inches. The floor thus formed, where it is perfect, which is the case at both ends of the apartment, is coarse and uneven, possessing no marks of ever having been covered with a tessellated or mosaic pavement. Nor do the wall flues appear ever to have been finished with stucco. This hypocaust has either belonged to one of the commonest kind of thermal edifice, or was in an unfinished state at the time of its destruction. At the south west and north east angles of the remain, and on a level with the floor, are two large fragments of sandstone grit, which appear, from their peculiar form, to have been portions of the baths adjoining the hypocaust. However this may be, one of these fragments is furnished with a channel to carry off an overflow of water from the bath or cistern, of which it formed part.

On the discovery of this remain, the subsequent excavations were conducted under the personal superintendence of Mr. Allen, who was accompanied by a practical engineer; but the injury done to the fences and land, by the immense concourse of people, who collected from every quarter, soon put an end to all further operations. Much, however, remains to be done; and I feel persuaded that if a systematic exploration of the Eald Fields were made, important results would follow.

My account of the earthworks and tumuli, which surround the station at Slack, would extend my paper beyond all reasonable bounds were I to introduce it on the present occasion. I have been induced to devote more attention to this part of my subject than I should otherwise have done, had not the obsolete claim of Greetland, to the site of Cambodunum, been revived by the late Mr. Hunter, in the communication to the Society of Antiquaries, to which I have previously alluded. Greetland, in the presence of Slack, I beg to submit, can have no such pretension; and we can only suppose that the amiable heart of Hunter, filled

with admiration for the exalted qualities of Horsley, induced the learned historian of the Deanery of Doncaster, on the discovery of the note in the Bodleian, to espouse the forgotten cause of Greetland, which was also the cause of the object of his veneration !

Society will thank Mr. Hunter for his valuable contribution ; his discovery shows, in this particular point, the veracity of Camden ; it illustrates the judgment of Horsley ; and proves the existence of a Roman town *within* the parish of Halifax. Slack will continue to be the site of Cambodunum ; and, this being the case, we have, at Greetland, a station without a name. But it is a singular coincidence that, in Brigantia, we have a town without an ascertained site. Richard, of Cirencester, mentions it under the name of Galacum or Galgacum, and Kendal has, on no decisive authority, been suggested as the site. With the superior claims of Greetland, and the somewhat similar sound of its name, I see no present reason why the station there should not henceforth be recognised as the Galacum of Ricardus Coriensis.\*

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Mr. W. S. WARD read the following communication :—

ON THE ROTATION OF THE PLANETS. BY CAPTAIN A. DRAYSON,  
ROYAL ARTILLERY, PROFESSOR OF ASTRONOMY, IN THE  
OBSERVATORY, WOOLWICH.

There are in the solar system at least seven primary planets which “Rotate” or turn round an axis. These planets vary considerably in size and in their distance from the sun, and there appears to be no law in connection with

\* As I find it impossible, within the compass of one paper, to do that justice to the subject which I think it deserves ; or to compress, without losing its force, the mass of materials on the Roman affairs of our neighbourhood, which I have been for years collecting, and am collecting still ; I shall be under the necessity of deferring, to a future opportunity, the continuation of this interesting inquiry.

their size, distance, and rotation. Jupiter, the largest planet in the system, rotates in less than ten hours, whilst Mars, a comparatively small body, occupies upwards of twenty-four hours in his rotation.

The following table shows the relative rates of rotation of the seven principal planets:—

	Hrs.	mins.	sec.
Mercury .....	24	5	28
Venus .....	23	21	21
Earth .....	23	56	4
Mars .....	24	37	22
Jupiter .....	9	55	26
Saturn .....	10	29	17
Uranus .....	9	30	? Supposed.

The sun, the central luminary of the system, also rotates on his axis, and in a period of 607 hours 48 minutes.

The object of the present paper is to offer some ideas connected with the rotation of all these bodies, and to consider the conclusions which have been apparently rather hastily made, in reference to the cause and continuation of the same movement.

At the present time it is acknowledged that all the before-mentioned planets do really rotate. We know the fact, but beyond this we have made no step, and to us the rotation of a planet is like an eclipse to a savage,—an event which he knows does occur, but of the cause of which he is ignorant.

It is not unusual, even in the present age, to find minds so constituted that when they are incapable of explaining a succession of effects, they at once leap from the observed fact to the Great Primal Cause, and thus as the savage thinks that he explains an eclipse by intimating that it is the effect of the Great Spirit's anger, so, even to the present day, the rotation of the planets is supposed to be accounted for, by asserting that they were all spun upon their axis like peg tops, and by "Divine Energy," at the creation. It is certainly very difficult to find any evidence upon which this



hypothesis has been based. We are not informed why some planets were spun so much more rapidly than others. There appears no explanation why all the planets rotate in the same direction, and why the sun also rotates. We cannot, unless we retreat to the first explanation, show why none of the satellites rotate in the same manner as do the planets, for the former merely rotate once during each revolution, and thus show only one side to their primary. In fact if we calmly reflect upon the cause assigned for the rotation of the planets, we shall perceive that the spinning theory is merely accepted for the want of a better, and we must, therefore, remember that it is not a fair hypothesis based upon observed facts, or upon the analogy of nature's laws, but merely a guess, which to us is valuable or otherwise according as we venerate the guesser. Bodies may be made to rotate on earth by means of imparting to them a rotating power, either by means of a string wound around them, or by the application of certain other mechanical forces. Then it is granted that, if there be no opposing force exerted against the motion imparted, the motion will continue uniform and for ever.

Starting from these data, it has been assumed that the various planets were first made to rotate in this manner, (*viz.*, by a spin); and in several important astronomical investigations, this assumption has been treated almost as if it had been an observed fact, hence several other assumptions have been made, all of which are really untenable in consequence of their being based upon a mere guess.

If the only known causes of rotation were the mechanical forces spoken of, we might be pardoned if we assumed as *possible*, that it was by such means that worlds were made to rotate. When, however, rotation may be caused in another way, we may then consider which of the two causes appears to be that most in accordance with nature's laws, and that system which we perceive to have been adopted in the universe.

After detailing many experiments connected with electrical and magnetic phenomena, Professor Faraday, in vol. I., *Experimental Researches in Electricity*, states, "Upon considering the effects which have been described, it is almost impossible to resist the impression that similar effects, but infinitely greater in force, may be produced by the action of the globe as a magnet upon its own mass in consequence of its diurnal motion." Thus we may look upon the earth, and in fact all the planets, as well as the sun, as a series of magnets, each of which influences the others according to its size, distance, and magnetic force. Professor Faraday also states a very interesting fact connected with magnets; he says, "that a ray of light is caused *to rotate* by the action of magnetism, and an effect still more singular is, that according to the line of magnetic force so the *direction* of rotation varies.

"When the pole nearest the observer was a marked pole, *i. e.*, the same as the north end of a magnetic needle, and the further was unmarked, the rotation of the ray was right handed, for the eyepiece had to be turned to the right hand, or clock fashion to overtake the ray, and restore the image to its first condition. When the poles were *reversed*, which was instantly done by changing the direction of the electric current, the rotation was changed also, and became left handed, the alteration being to an equal degree in extent as before, the direction was always the same for the same line of magnetic force." At page 24 of *Experimental Researches*, we find M. Arago's experiment described as follows:—"If a plate of copper be revolved close to a magnetic needle or magnet, suspended in such a way that the latter may rotate in a plane parallel to that of the former, the magnet tends to follow the motion of the plate; or, if the magnet be made to rotate, the plate follows its motion, and the effect is so powerful that magnets or plates of many pounds weight may be thus carried round. If the magnet and plate be at rest

relative to each other, not the slightest effect, attractive or repulsive, or of any kind, can be observed. This is the phenomenon discovered by M. Arago, and he states that the effect takes place not only with all metals, but with solids, liquids, and even gases, *i. e.*, *with all substances.*"

We first find that by the aid of magnetism a ray of light can be made to rotate. We then find that a copper plate when revolved causes a magnet to rotate, and *vice versâ*, and this takes place on earth in spite of all the surrounding subtle disturbing causes, and with such power that magnets and plates of great weight are carried round by the influence thus exerted; solids, liquids, and even gases are thus affected.

Can we now draw the limit to this effect, can we say plates of a weight  $x$  may be caused to revolve, but those of a weight  $x$  and 1 lb. cannot be moved? Is not this effect dependent upon the insulation in space of various bodies, and upon the amount of magnetic force in the relative bodies? May not the distance of the two bodies be increased and the same effects result, if their insulation could be made perfect, and the magnetic force increased tenfold? Suppose this force could be increased ten thousand times, at what distance would the rotation of the one body induce the tendency in the other to follow its motion, and can we decide upon the variety of effects which would result, if the motion were continued during several years or centuries?

We have a certain fact with which to deal, *viz.*, that the rotation in one body will produce motion in another, and that this is not satisfactorily accounted for may be seen from the following:—\*

"The cause which has now been assigned for the rotation in Arago's experiment, *viz.*, the production of electrical currents, seems abundantly sufficient in all cases where the metals, or even other conductors are concerned; but with

\* Experimental Researches, Vol. I. p. 38.

regard to such bodies as glass, resins, and above all, gases, it seems impossible that currents of electricity capable of producing these effects should be generated in them, yet Arago found that the effects in question were produced by these and by all bodies tried. Messrs. Babbage and Herschel, it is true, did not observe them with any substance not metallic, except carbon in a highly conducting state. Mr. Harris has ascertained their occurrence with wood, marble, freestone, and annealed glass, but obtained no effect with sulphuric acid and saturated solution of sulphate of iron, although these are better conductors of electricity than the former substances. "Future investigations will no doubt explain these difficulties, and decide the point whether the retarding or dragging action spoken of, is always simultaneous with electric currents."

We thus know that when a body revolves it induces a motion in another body. We know not what to term the power or force thus induced or produced, we know not at what distance this force would be felt if the force itself became more powerful, or if the bodies could be insulated in space, but it is not unreasonable to conclude that the distance might be considerably increased. It has been shown that it is not necessary that the bodies should be metallic, or even conductors of electricity, to be influenced by this motion. But we know that when both bodies are at rest, then no effect is produced by the one upon the other. When, then, we find that the sun rotates upon its axis, and that the earth also rotates and in the same direction; that all the planets rotate just as does the earth, and that the direction of the motion is uniform, it is difficult to avoid comparing this movement to that of the various bodies suspended around the magnet, the rotation of which causes an exactly similar movement in them.

From experiments of my own I am induced to believe that the velocity of rotation induced by a magnet in any

body, is directly as the amount of magnetic force in that body. Thus if two bodies be suspended near a revolving magnet, rotation will take place most rapidly in that which is the more magnetic.

When, then, we find a vast planet like Jupiter rotating in about 10 hours, whilst one like Mars merely performs the same movement in  $24\frac{1}{2}$  hours, we may, upon the above hypothesis, explain the fact, by the higher magnetic condition upon the former sphere allowing the sun's rotation to produce the greater effect.

It thus appears not only possible but highly probable, that the rotation of a world is a secondary effect, which depends upon the rotation of the guiding orb, and the conditions which exist in the world itself. It may be asked what causes the sun to rotate? And this question will but serve to remind us that, however far we may advance in science, we shall still have a vast ocean of the unknown beyond us, for each step will but enable us to perceive that a greater distance separates us from the Creator than could ever be realised, or even dreamed of, by those whose minds are contracted, and who fear to investigate nature's laws, lest they might rival the wisdom of the Author of nature. At present it is merely intended to suggest that the rotation of a world may be connected with the rotation of the sun, and is probably produced by it. We may consider the various results which follow this probability, without rejecting it simply because we cannot explain the next step. We know that the earth's shadow causes a Lunar eclipse, and this we esteem a fact worth knowing, although we cannot explain how the sun gives its light to us, and hence produces a shadow by contrast. Thus we may, step by step, advance from the unknown to the obscure, from the obscure to the probable, from the probable to the certain. With this intention the rotation of the planets has been thought upon. This rotation

has hitherto been assumed as a direct action of the Creator without any secondary cause. After observing the effects produced by a rotating magnet upon surrounding objects, and after seeing that the sun and the planets are merely magnets of a larger size, it is impossible to avoid a comparison between the two—the terrestrial magnets being models of the sun and his surrounding attendants. Not only is it then possible that the rotation of each planet is produced by the sun's rotation, but the rotation of a planet may, by the same law, be one cause producing the revolution of a satellite. The present paper is already of considerable length, and this latter probability cannot therefore be here fully discussed. It may, however, be mentioned that, if the two effects be connected, we ought to find that those planets which rotate the more quickly, ought to have satellites revolving around them with the greatest rapidity. Such is really the case; our own planet rotates in about 24 hours, and our satellite revolves around us in about 27 days.

Jupiter, whose rapidity of rotation is enormous, has a satellite situated at nearly the same distance from him that our moon is from us; this satellite moves around him in a period of only 1 day 18 hours. Thus the quickest rotating planet in the system has the most rapidly revolving satellites.

Saturn again rotates *nearly* as quickly as Jupiter, and his fourth satellite (Dione) is distant about 260,000 miles from him, that is, about the same distance that Jupiter's first satellite is from him. Saturn rotates more slowly than Jupiter, and this satellite revolves more slowly than that of Jupiter. Thus it really appears that rotations and revolutions are connected by a law, as in each case the quick rotating planet is attended by quick revolving satellites.

It has been assumed as a settled question that rotations and revolutions in the Solar System are independent of each other. This assumption is empirical and unfounded, yet

theories of great importance connected with astronomy have been based thereon. It is hoped that some attention may now be directed to this subject, and the mere sketch which is here given may lead to some discussion and inquiries, which will eventually tend to the greater evolvment of truth and science, and discourage gratuitous assumptions or unbased hypotheses.

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MR. DENNY read the concluding Paper—

ON A VERY REMARKABLE MUMMY IN THE MUSEUM OF THE LEEDS PHILOSOPHICAL AND LITERARY SOCIETY. COMMUNICATED BY PROFESSOR G. SEYFFARTH, PH. D., D. D., PROFESSOR IN THE CONCORDIA COLLEGE, ST. LOUIS, U.S.\*

The mummy-coffin, preserved for more than 37 years, in the Museum of the Leeds Philosophical and Literary Society, ranks, as I have lately demonstrated, with the most important monuments of Egyptian antiquity. For this coffin, with its paintings and hieroglyphic inscriptions, in a high state of preservation, now 3,520 years old, incloses the lifeless remains of an Egyptian minister, born in the autumn of the year 1722 B.C., only 144 years subsequent to the exodus of the Israelites; it refers to the age of the greatest kings of

\* The mummy which forms the subject of this Paper was procured from Gournou, the burial place of Thebes, by Passalacqua, a native of Trieste, and transmitted to London for sale, where it was purchased by the late John Blayds, Esq., and by him munificently presented to the Museum of the Leeds Philosophical and Literary Society, in 1824. An account of this mummy was published in 1828, by Mr. Osburn, M.R.S.L., then Honorary Secretary of the Society, a copy of which, presented to the Library of the American Philosophical Society, at Philadelphia, having been seen for the first time about two years since, by Professor Seyffarth, he read a lengthened Memoir on the same mummy, before the Academy of Science of St. Louis, which was printed in the Transactions of that body in 1860. I therefore wrote to the learned Professor, requesting an abridged Paper on the same subject, to read before this Society, which he most willingly complied with, and transmitted to me the above communication.—H. D.

Egypt; it originated when Osimanphtha built the most famous monument of Egyptian architecture, the Osimandyeum, the colossal ruins of which are still to be seen at Karnak, and when Sesostris, 900 years prior to Romulus, erected the large Obelisk, now placed near the Porta del Popolo, in Rome, the inscription upon which Hermapion translated into Greek during the reign of Augustus; it solves the millennial riddle concerning the Egyptian and all ancient mythologies; it confirms the key to the astronomical monuments of the ancient Egyptians, Greeks, and Romans; it brings the very chaos of Egyptian history into a reasonable system, and into perfect harmony with the true chronology of the Sacred Scriptures, as we shall see hereafter. It is true, Mr. Osburn, Jun., F.R.S., has already published, thirty-two years ago, a learned Memoir concerning this same mummy; but, in 1828, the key to the Egyptian literature, and to the astronomical monuments of the Ancients had not been discovered. It was not then known that no hieroglyph "symbolises" an idea, that, on the contrary, those 620 figures, used by the Egyptian hierogrammatists, express generally each a syllable, that is to say, the consonants contained in its name, (as has been proved in Seyffarth's "Grammatica Ægyptiaca," Leipsic, 1855. See also "Transactions of the Academy of Science," St. Louis, Vol. I., No. 4, 1860.) It was still then believed that the Egyptian deities signified either eminent persons of former times, or fire, water, light, heat, thunder, cold, and the like; or historical periods; or metaphysical conceptions, as strength, wisdom, fidelity, justice, honesty, bravery; or deified powers of Nature, as volcanoes, ocean, mainland, lakes, rivers, valleys; nobody had as yet discovered that the seven Cabiri, the twelve great gods, and the thirty-six demi-gods of the ancient nations, were the seven planets, the twelve signs of the zodiac, and the thirty-six zodiacal subdivisions. As Mr. Osburn, who published an account of this



mummy in 1828, was only acquainted with Champollion's system, it is, therefore, not surprising that he failed in deciphering the inscriptions on the sarcophagus under consideration, and in determining the true age of the defunct, and that of the coeval kings. Mr. Osburn deserves, nevertheless, the thanks of all friends of Egyptian archeology for his learned pamphlet, and for the publication of the most important parts of the inscription on the coffin.

The name of the deceased consists, as usual, of two different roots, of which the first is expressed by the letters N K S F. This word *enkasi*, in the plural *enkasiv*, signifies in Coptic, that is—since Copt, or Gypst is equal to Egypt—in the later Egyptian language : ratio, modus, or condition, nature. The other part of the name contains the name of the god Amun, the sun god. The defunct was, consequently, called Enkasi-Amun, the nature, or likeness of Amun, in one word “Ammonius,” as the Greeks translated it. The Egyptian papyri offer proper names similarly compounded, *e.g.*, Enkasi-Chons (the likeness of Hercules), Enkasi-Amone (the likeness of Gaea, the goddess of the earth).

The employment of Enkasiv-Amun is mentioned, as Mr. Osburn states, on more than fifty places, which, apart from some trifling variations, reads thus :—“The reverend priest, minister of the tributes, the lord of the clerk-office in the temple of Mnut, the sun, who is the lord and governor of Egypt; the superintendent of the fruits tributed to Amun, who is the royal warden of the earth, etc. ; namely, Enkasiv-Amun, the servant, the late.” From this passage we learn what has been the business of the defunct. For, as Egyptian people, including even the priests, were bound to sacrifice one-tenth of all the fruits grown in the land, to the royal treasury, and as the king was worshipped like a god, and therefore called Amun (Augustus, the illustrious one); as, finally, Enkasiv-Amun had been decorated with a peculiar

ornament, composed of three straps of red leather (See Plate I), containing the names of two kings then reigning; it is obvious that the deceased was once what we call the royal minister of finances, or chancellor of the exchequer. At what time may this so distinguished person of Egyptian biography have lived? Of what age may that costly mummy coffin in Leeds and those dies be, which have preserved for us during so many revolutions of the Sun, such an extraordinary monument of the arts and the science of the ancient world?

The question, to which king the defunct was a minister, is answered by two different cartouches, or royal rings, found upon the above stamped leather ornament of the mummy itself, one of which is a sacred, or titular, the other a vulgar name. Both names are to be found on innumerable Egyptian monuments, particularly on the so-called Table of Abydos, now in the British Museum, which contains a list of all Pharaohs reigning successively from Menes, the first king, down to the last king of Manetho's XVIIIth dynasty. The first cartouche, which is the second from the end on the Table of Abydos, is followed commonly by the vulgar name "Osimandya" (Osimantwa, or Osimanphtha). The other name in question corresponds with the last cartouche on the Table of Abydos, and with the last king of Manetho's XVIIIth dynasty, the son of Osimanphtha, called Ramses Meiamun. He was the famous Sesostris,—the author of a great number of temples, chapels, statues, and hypogeums, in Egypt and Nubia,—who conquered, in the lapse of nine years, a large part of Asia. Osimanphtha and Ramses ruled one after the other. Although Osimanphtha ruled previous to his son Ramses, yet according to Manetho, both these kings also reigned simultaneously during sixty-eight years, after the father Osimanphtha had governed five years alone. Hence it will be perceived how it came to pass that the decoration of

the deceased was signed by *two* different kings. For the same reason the names of Osimanphtha and Ramses are to be found standing in juxta-position on many other monuments, *e.g.*, on the obelisk near the Porta del Popolo. In short, Enkasiv-Amun lived during the combined reigning of Osimanphtha and Ramses!

At what time did these kings live? This query no one was able to answer satisfactorily prior to 1833. For the cyphers concerning Manetho's dynasties and single kings, as copied by Julius Africanus, Eusebius, the Armenian Eusebius, and in the chronologic reports of Eratosthenes, the *Vetus Chronicon*, and the Hieratic Manetho at Turin, differ so much from each other, that chronologists were entitled to put the same kings many hundred or even thousands of years earlier or later. Mr. Osburn, following the confused system of Champollion, gives to both kings only the nineteen years from 1493 to 1474 B.C., and in so doing he was in error, as we shall see, by more than 200 years. In 1833, however, when the key to the astronomical monuments of the Ancients was discovered, it came to light that Osimanphtha and Ramses Meiamun were born, the former in 1730, the latter in 1693 B.C. In the valley of Biban el Moluk (the graves of the kings), near Thebes, in Egypt, two royal catacombs are still existing, of which one belonged to the abovesaid Osimanphtha, the other to his son Ramses Meiamun. These catacombs, measured by the French savans accompanying Buonaparte in 1799, have been depicted in the "Description de l'Egypte;" and in the Turin Museum there are two papyri preserved, one of which is the map of Ramses' catacomb, and the other contains the ground-plans of both catacombs, that of Ramses, and of Osimanphtha. In the latter, the magnificent alabaster sarcophagus of Osimanphtha, now in Sir John Soane's Museum, in London; in the former, the colossal granite sarcophagus of Ramses-Sesostris, now in the Louvre

at Paris, and the lid of which is at Cambridge, were discovered. On these sarcophagi the planetary configurations, observed in the birth-years of Osimanphtha and Sesostris are represented. These monuments testify that the kings in question were born in 1693 and 1730 B.C. Besides, on the ruins of the Osimandyeum at Karnak there has been preserved another planetary configuration, referring to the same Osimanphtha, and this concerns again the year 1730 B.C. (See the fac-simile in "Seyffarth's Berichtigungen der alten Geschichte," Pl. 1.) Thus, then, the contemporary age of Osimanphtha and Ramses, is reliably determined; the only question being, whether the planetary configuration, represented on our coffin, agrees with the years 1730 and 1693 B.C. And so we come now to the most interesting part of the coffin, to the planetary configuration observed in the birth-year of Enkasiv-Amun, which, we hope, everybody will understand, without being a professor of astronomy.

The starry sky contains a belt, in which the planets of the Ancients—Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon,—perform their revolutions. This circular girdle, or zone, the so-called zodiac, was, according to the twelve months, divided into twelve segments of thirty degrees each, the so-called signs of the zodiac. Their names are:—Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces; and their direction is from west to east. The same twelve signs were called by the Ancients the Houses of the Planets, because each of the five real planets presided over two signs, one of which lay east, the other west of the winter solstice, *i.e.*, the point of the zodiac, occupied by the sun on the shortest day, the Bruma of the Romans. The sun and the moon had only one house each, which were opposite to the winter solstice, and to the houses of Saturn. The following is the scheme of

the original zodiac with its signs, or houses, together with their planetary presidents, or lords of the houses :—

SIGNS :	Leo.	Cancer.	Gemini.	Taurus.	Aries.	Pisces.	Aqua- rius.	Capri- cornus.	Sagitt.	Scorpio.	Libra.	Virgo.
LORDS :	Moon.	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Saturn.	Jupiter.	Mars.	Venus.	Mercury.	Sun.
	♌	♋	♊	♉	♈	♇	♄	♃	♂	♆	♍	♎

In the first place, we discern, while examining the mythological figures on the coffin (see Plate II.), the twelve houses of the planets, the signs of the zodiac. For each side of the mummy-case contains ten houses, or little temples, which on many other monuments express the signs of the zodiac. To these must be numbered, as usual, the square on the head, and that on the feet of the mummy, which complete the twelve houses of the zodiac on both sides. Further, as the seven Cabiri, the supreme gods of the Egyptians, were the seven planets, and as their twelve great divinities were the lords of the twelve signs, and as the houses on the coffin contain each the image of a deity, it is obvious that each of these houses must have belonged to that god or goddess which stands in the respective house. Again, as some houses contain two, and even three astronomical figures, besides a god facing in the opposite direction, doubtless a planet moving in the opposite direction, from east to west ; it is evident also that some of these divinities must signify the planets, which stood at the time of the birth of the deceased, in certain houses or signs of the zodiac.

The question now arises, which of these astronomical images expressed the seven planets, and which the twelve signs, the houses of the twelve great gods. All the mythological, or astronomical figures, together with their names and insignia, occurring on the coffin, I had previously determined in my “*Astronomia Ægyptiaca.*”

The key to the Astronomical Egyptian Monuments was found in the following way : First, Diodorus Siculus, and many other reliable authors, testify that the Egyptians

had observed innumerable planetary configurations, and represented them on their monuments from the earliest times.\* Consequently, a great many of those monuments seen by Diodorus and others being still in existence, the astronomical inscriptions of Egypt cannot have disappeared entirely. Further, Chæremon, an Egyptian priest, says expressly that all the deities of his country signify the planets and the signs of the zodiac and its subdivisions.† The same we find in Aristotle, and many other Greek and Latin authors, referring their own gods to be planets and the zodiacal signs, which verifies the statement of Chæremon.‡ For, since all the pagan nations, according to Jeremiah li. 7, brought their mythology with them out of Babel; since Plutarchus testifies that there was no difference between the deities of the North and the South, the East and the West;§ and since all the people of antiquity worshipped seven Cabiri and twelve great gods; it is obvious that the Greek and Roman deities, as well as the other pagan gods, really referred to the seven planets and the twelve signs of the zodiac. Finally, we learn from Firmicus, Pliny, and the monuments themselves, that the Egyptians, Greeks, and Romans observed planetary configurations on the four cardinal days, *i.e.* on the days of the vernal or autumnal equinox, or those of the summer and winter solstice, always previous

\* Diodor. Sicul. I., chap. 81, 83: Τὰς περὶ ἐκάστων ἀστρῶν ἀναγραφὰς ἐξ ἑστῶν ἀπίστων τῶν πλῆθει φιλάττουσιν.

† Porphyrius in Jamblichus' De Mysteriis Ægypt. page 7: "Chæremon," says Porphyrius, "alique multi nihil quid agnoscunt, ante mundum nunc adspectabilem, neque alios Ægyptiorum, in ipsis scriptorum suorum exordiis, ponunt Deos præter vulgo dictos planetas et Zodiaci signa."

‡ Aristotle, Metaphys., xi. 8, says: "It is related by the ancients that the planets and constellations are deities;" and in other passages he refers the twelve great gods to the twelve signs of the Zodiac.

§ Plutarch De Is. et Osir, p. 377, says: "There is no difference between the deities of the Greeks and those of the Barbarians—those of the Southern and of the Northern nations."

to the births or historical events, which were to be fixed astronomically.\* From such passages I concluded that all the Egyptian monuments containing certain rows of deities, expressed certain planetary configurations mentioned by the ancient authors, and are the key to all the astronomical monuments of antiquity, and, of course, also the Leeds mummy coffin in question.

In the first place, every one perceives that the coffin, on the left hand of the mummy, exhibits two different classes of deities, one of which, drawn exactly alike, bears each a bushel-measure upon its head. As the bushel, in Coptic *bath*, expresses syllabically the word *abet* (house); it is evident that these deities must signify, as is the case with similar monuments, the houses, or signs of the zodiac, namely, those which were not occupied by a planet. Consequently the other divinities, occurring in this series, were planets. The same composition of planetary and zodiacal deities is to be found on the other side of the coffin.

Moreover, it is known, that the president of the sign Aquarius, the house of Saturn, was called *Neith kor* (Venus Urania); that of Taurus, the house of Mars, *Neith mashi* (Neith genitrix); that of Gemini, the house of Venus, *Selk kel-hoite* (selk textrix vestium); that of Cancer, the house of Mercury, *Nephthis* or *Nepti*; that of Aries, the house of Jupiter, *Tof neit*. Consequently, the houses Nos. 6, 9, 10, 11, which enclose the just mentioned deities, refer to the signs Aquarius, Taurus, Gemini, Cancer; and thus the succession of all the signs, represented on both sides of the coffin, is determined, namely, the signs, adjacent to the head, were on both sides, Libra; and those near the feet of the mummy represented Cancer. This arrangement of the signs is confirmed by the deities, placed in the squares above the head, and under the feet. For, as all sarcophagi, and mummy-

\* Firmicus Matern. Astronomicon libri octo.

cases, representing the zodiac, place the house of the Sun (Virgo) in the square above the head, and that of the Moon (Leo) below the feet; and as our coffin contains in the head-square the image of the solar Isis, the warden of Virgo, it is evident that the signs following Virgo, must stand near the head-square, and so forth. In short, the zodiacal signs on the coffin are simply arranged as follows:—the perpendicular line signifies the place of the winter-solstice.

Cancer. Gemini. Taurus. Aries. Pisces.	Aquar. Capric. Sagitt. Scorpio. Libra.
Leo. ☾    ♀    ♂    ♃    ♅	♄    ♆    ♂    ♀    ♁    ☉ Virgo.
Cancer. Gemini. Taurus. Aries. Pisces.	Aquar. Capric. Sagitt. Scorpio. Libra.

Our inquiry is now, what planets are signified by the figures, which are to be found in the houses destitute of their lords, or wardens. As the images, insignia, names and surnames of the seven planetary gods are also known, the places of the planets are easily made out. Every house, enclosing a planetary god, defines the place of the planet.

The sun-god was called Osiris (the illustrious), and also Horus toto (the king of both the worlds), of which the former was ornamented with a crown, the latter with a solar disc. As these gods appear, on both sides, in the fourth house from Virgo, in the sign Sagittarius, which the Sun then entered on the autumnal equinoctial day; and as all planetary configurations of the ancients were observed on the first day of a new season, it is evident that the Sun stood then in the first degree of Sagittarius, when the first day of the autumn began.

In the same house of Mars, Sagittarius, we meet with the goddesses Isis Amoni (on the left) and Moshi (on the right), both signifying the moon. Consequently the Moon stood then also in Sagittarius.

Further, in the roof of the same house, a sparrow-hawk is visible, which commonly signifies the planet Venus; wherefore Sagittarius contained, at the birth of the defunct, not only the Sun and the Moon, but also Venus.



The third house, Scorpio, encloses, on both sides, the god Thoth, the well known planet Mercury ; and as he is depicted in an opposite direction, Mercury must then have been retrograde in the sign Scorpio.

Furthermore, Saturn, called *Petpe*, and ornamented with two ostrich feathers, stands in the fifth house on the left, the house of Jupiter, Capricornus.

The planet Jupiter was, among others, signified by a four-fold altar, and this emblem and hieroglyphic figure, pronounced *Tati*, we find placed in the house of the Moon (No. 12), consequently Jupiter stood, at that time, in the sign Leo, under the feet of the mummy.

Finally, as Mars, called *Phtha Sochari*, occupies, instead of Thoth, the warden of Libra, this sign (No. 2) ; the conclusion is, that Mars must have been seen in Libra, the house of Mercury.

Thus we have obtained the following planetary configuration, observed on the birth-year of the defunct :—

Saturn, *Petpe*, in Capricornus, the house of Jupiter.

Jupiter, *Tatis*, in Leo, the house of the Moon.

Mars, *Phtha*, in Libra, the house of Mercury.

Sun, *Osiris*, in Sagittarius, the house of Mars.

Venus, *Horus*, in Sagittarius, the house of Mars.

Mercury, *Thoth*, in Scorpio, the house of Venus (retrograde).

Moon, *Isis Amoni*, in Sagittarius, the house of Mars.

Although this catalogue states only the signs in which the seven planets had been observed, nevertheless, as there are not in history two autumnal equinoctial days to be found on which the very same planetary configuration has occurred, those acquainted with astronomical tables will easily succeed in making out the day of the observation. In this respect it is not necessary to go more fully into the particulars of this astronomical inscription.

The Egyptians divided the zodiac not only into twelve

signs of 30 degrees, but also into 36 decuriae, or sections of 10 degrees, and into smaller parts. Each sign contained three decuriae, five horia of different length, and twelve dodecatemoria of  $2\frac{1}{2}$  degrees, each of which was also presided over by a planet, as has been shown in my "Astronomia Ægyptiaca," Pl. 1. Moreover, as often as two or more planets occupied the same sign, the Egyptians indicated not only the sign, but also the decuria, the horion, and, sometimes the dodecatemorion, within the limits of which the respective planets had been observed; and this was effected in the following way. Supposing, *e.g.*, the Moon stood, together with Venus, in the sign Sagittarius, the first, however, in the decuria of Jupiter, the latter in the decuria of Mercury, then the Egyptians took care to place another image of the Moon in one of Jupiter's houses, and another image of Venus in one of Mercury's houses. In the same way, sometimes, also the horion, and the dodecatemorion of a sign, occupied by a planet, were noticed. As the series of the decuria, horia, and dodecatemoria began, in earlier times, with the sign Taurus, which was then the first of the zodiac, it will be an easy thing to say what the other planetary deities, not yet spoken of, mean, and what was the more exact longitude of some planets, indicated in our astronomical inscription.

The following is an explanation of the divinities on the right hand of the mummy, and of the rest on the left,—No. 2, the next to the Virgo, contains the images of Phtha (Mars) and Hathor (Venus) like the opposite side, and Phtha is signed by the same name "Phtha Sachari," but Hathor's name is expressed by the hieroglyphs: face, *i.e.*, *ht*; and heart, *i.e.*, *hr*; together, *hthr*; which give the name Hathor. By this example may be explained the real key to the whole Egyptian literature, so long sought for. The face, in the Coptic, *hot*, expresses syllabically the consonants *ht*; and the heart, in Coptic, *het*; in the ancient dialect, *hert*; like

the English *heart*, the German *herz*, the Latin *cor*, the Greek *kardia*, the Hebrew *keli*, sounds syllabically *hr*. By these very same hieroglyphs (face and heart) the Egyptians expressed the name of the demigod, the Dei-anies Hothare, as the Greeks pronounced the face and the heart, the name of this demigod. As the consonants *ht hr*, correspond with the consonants both in hathor and hothare; the Egyptians, while omitting the vowels like the Hebrews, applied the face and the heart for the purpose of signifying both Hathor and Hothare. The same is the case with the syllabic value of all other Egyptian hieroglyphs, as "Seyffarth's Grammatica Ægyptiaca," has explained in extenso.

Apart from this Hathor or Venus in the house of Mercury, there is another emblem of the planet Venus placed in the house of Saturn, No. 7 on the left hand, the well-known "Horus, the avenger of his father." As Venus stood, together with the Sun and the Moon, in Sagittarius; and as the Egyptians used in such cases to specify the decuria and the horion occupied by a planet, these different images of Venus were to show that she, as standing in Sagittarius, occupied the decuria of Saturn ( $10^{\circ}$ — $20^{\circ}$ ), and the horion of Mercury ( $10^{\circ}$ — $14^{\circ}$ ). Consequently the real longitude of Venus was then  $10^{\circ}$ — $14^{\circ}$  inclusive in Sagittarius.

No. 3. Thoth (Mercury) represented as on the other side, is here accompanied by the legend:—*Amoni mashi moshi emate em beri pe Thotho ef; i.e.,* "Thoth, who led the pious defunct to be joined with the Creator of the world."

No. 4 represents the sun-god, bearing the solar disc, surrounded by the uraeus, whose title is "uro thotho," *i.e.,* "the king of both the worlds." Next to him stands "Moshi," usually ornamented with the ostrich feather, which expresses the same word "Moshi," *i.e.,* the walker or runner, another name for the Moon. Consequently, this representa-

tion of the sign Sagittarius proves again, that the Sun and the Moon had been observed in Sagittarius.

No. 5. The well-known image of Amun (Jupiter) in the shape of a mummy, whose insignia were the double crown, and the name "Samo," *i.e.*, the *Splendent*. He is placed in Capricornus, because this sign was the house of Jupiter.

No. 6. The goddess "*Troe*," the Hecate of the Greeks, distinguished by a beetle upon her head, denotes the Moon in Saturn's departments. As the Moon, together with Venus and the Sun, stood in Sagittarius, the decuria and the horion, in the boundaries of which the Moon had been seen at that time, were to be mentioned. It is for this reason, that a second image of the Moon was placed in this house of Saturn, Aquarius; and a third in the house of Jupiter, Aries; on the left side. The latter deity, ornamented with the head of an ibis, and a crescent upon it, called "*Toth neb zor*," *i.e.*, *Toth*, the regent of the night, is also an emblem of the Moon. As then Sagittarius contains a decuria of Saturn ( $10^{\circ}$ — $20^{\circ}$ ), and a horion of Jupiter ( $15^{\circ}$ — $21^{\circ}$ ); the Moon stood, at that time, in Sagittarius  $15^{\circ}$ — $20^{\circ}$  inclusive.

No. 7 contains the ordinary image of the female Saturn, bearing an ostrich feather, and the title "*Mashi*," *justitia*. She stands in Pisces, because this sign was the house of Saturn.

No. 8. This goddess, bearing a bushel measure, and called "*Tof neith*," signifies constantly Aries, the house of Jupiter.

No. 9. A god, bearing upon its head a flower, which, syllabically, expresses the word "*kom*," the strong one, and accompanied by the name "*Amunphtha*," *i.e.*, the illustrious *Phtha* (Mars) signifies the lord of Taurus, namely Mars, wherefore he is placed in Taurus, his house.

No. 10. This deity, ornamented with the crowned head of the phoenix, and accompanied with the letters B. N. N. O., denotes Venus, the warden of Gemini, in which sign she is

placed. Besides, the names Benno Venus (benus), the Hebrew benoth (genitrix), originate from the same root.

No. 11 is the well-known "Anub" or Anubis, distinguished by a fox-head, the god Mercury, the warden of Cancer, his house. The sign, following Cancer, is Leo, put to the feet of the mummy.

The planetary configurations, thus expressed, are easily computed. It is to be remembered only that the ancients placed, at that time, the vernal equinox between the signs Taurus and Gemini, whilst our planetary tables, of course, take Aries for the first sign. The following computation for 1722 B.C., Oct. 7th, 6h P. T., then the day of the autumnal equinox, is the work of Dr. Lentog, and Professor O. W. Mitchel, at Albany, New York:—

ANCIENT OBSERVATION.	COMPUTATION.
Saturn in Scorpio, $0^{\circ}$ — $30^{\circ}$ .	Scorpio, $21^{\circ}$ 49'.
Jupiter in Cancer, $7^{\circ}$ 30'.	Cancer, $10^{\circ}$ 30'.
Mars in Leo, $0^{\circ}$ — $30^{\circ}$ .	Leo, $27^{\circ}$ 14'.
Sun in Libra, $0^{\circ}$ 0'.	Libra, $0^{\circ}$ —6'.
Venus in Libra, $10^{\circ}$ — $14^{\circ}$ .	Libra, $11^{\circ}$ 37'.
Mercury in Virgo, $0^{\circ}$ — $30^{\circ}$ (retrog.)	Virgo, $16^{\circ}$ 49' (retrogr.)
Moon in Libra, $14^{\circ}$ — $20^{\circ}$ .	Libra, $24^{\circ}$ 48'.

This planetary configuration, depicted on the coffin, proves then, that the minister of Osimanphtha and Ramses was born, not about the year 1450 B.C., as Champollion and Osburn imagined, but in 1722 B.C. And this result harmonises surprisingly with the planetary configurations represented on the sarcophagi of Osimanphtha and Ramses, according to which the former was born in 1730, the latter in 1693 B.C. Consequently their minister was eight years younger than Osimanphtha, and twenty-nine years older than his son Ramses, the last king of the XVIIIth dynasty.

Probably the objection might be raised that a planetary configuration like this may also have occurred in earlier or later times. This objection, however, is easily disposed of.

For, as Saturn does not, on the same day of the year, return to the same place of the zodiac, but after 206 years; Jupiter first after 83, or rather 166 years; Mars after 215 years, the Moon after 19 years, Venus after 4, and Mercury first after 26 years; it is obvious, that this planetary configuration could not happen twice in the lapse of  $206 \times 166 \times 215 \times 19 \times 4 \times 26$  years, that is to say, in several millions of years.

Our mummy-coffin then may be classed for the subjoined reasons as one of the most important monuments of Egyptian antiquity. It confirms the key to the mythology of the Egyptians, Canaanites, Babylonians, Greeks, Romans, and all nations of antiquity, which was, during so many centuries enveloped in impenetrable darkness; it ratifies the key to the astronomical monuments of Egypt, Greece, and Italy, and that to the Egyptian literature, discovered many years previously; it illustrates, by its antiquity, the condition of primeval culture; it corrects, as being 1600 years older than the oldest astronomical observations formerly known, some statements of the present planetary tables, particularly those of the Moon. The Leeds mummy-coffin proves again that astronomy is as old as human society, as Josephus, Aristotle, Cicero, Diodorus, Egyptian papyri, and other authors testify. Formerly, it was believed and taught that no zodiac existed before the year 500 B.C., but here we see that the Egyptians in 1722 B.C., were already familiar with the smallest segments of the zodiac; that they already understood the art of determining the places of the planets to a nicety, and that they knew the motion of the equinoctial points. Now how many centuries prior to 1722 B.C., must have elapsed before astronomy attained to so high a degree of perfection! It dissipates the old fog of Egyptian history, and corroborates mathematically the true history and chronology of the Bible. As regards the latter, let us add a few remarks:—

It is known that, according to the passage 1 Kings vi., 1,

between the exodus and Solomon's temple, only 480 years intervened, or, as the Septuagint says, 440 years. This statement is plainly an error of writing, because it is contradicted by the manuscripts of the Jews in the east, by Josephus, the Fathers of the Church, by the genealogies and the book of Judges itself, according to which we have to read there 880 years, as Prichard's "Egyptian Mythology," has first demonstrated. Further, Moses was born, whilst a new dynasty had begun to reign, as Josephus, Manetho, and the Fathers of the Church testify. The latter of whom relate that the Israelites left Egypt under Amos, the first king of the XVIIIth dynasty; and in Exod. i., 8, we read: "There arose up a new king over Egypt, which knew not Joseph," *i.e.*, not the son of the preceding king, but the first king of a new dynasty, *i.e.*, the XVIIIth. Now, as the last kings of this dynasty and their minister were born in 1730, 1722, and 1693 B.C., and as the XVIIIth dynasty was during 300 years upon the throne, it is evident that, from the exodus to Solomon, really 880 years must have elapsed. The year of the exodus, 1866 B.C., thus determined, is confirmed by many other planetary configurations, by a transit of Mercury, and the beginning of a new phœnix period of 651 years in 1903 B.C., April 7th, under Amos I., the second king of the XVIIIth dynasty, particularly by a remarkable conjunction of Saturn and Jupiter, in Pisces, in 1951 B.C., three years previous to the birth of Moses.

Moreover, as the Abrahamidae and Israelites ruled themselves, during 430 years, in the land of Goshen, and as Manetho and Josephus call them Hyksos, shepherd-kings, who came into Egypt in 2081 B.C., it is obvious also, that Manetho's shepherd-kings in the XVIth and XVIIth dynasties must have been the Abrahamidae and Israelites, that Manetho has mentioned not only as successive, but also contemporaneous dynasties.

Finally, the *Vetus Chronicon*, Herodotus, and even Manetho report, that Menes, the first king, had settled in Egypt, at the beginning of the first canicular period in 2781 B.C. Again, as the tables of Abydos and Karnak, the *Vetus Chronicon* and Eratosthenes, reckon from Menes to Ramses, born in 1693 B.C., only 1100 years; and as the planetary configuration, observed when Menes arrived in Egypt, and preserved on sixteen monuments, refers to 2780 B.C., the conclusion is, that Manetho's dynasties, not mentioned in the tables of Abydos and Karnak, and in Eratosthenes' "Laterculum," were contemporaneous, as the "*Vetus Chronicon*" says expressly. Consequently, the Egyptian history has not begun before "the day of Peleg," 2781 B.C., 666 years after the flood, as Manetho and the "*Vetus Chronicon*" specify. This chronology harmonises as to the year with the statements in the Septuagint, and with the planetary configuration, expressed in the Noachian alphabet, according to which the deluge ended on the 7th day of September (Julian style) in 3446 B.C., 666 years prior to the dispersion of the nations in Peleg's day. In such ways it has been confirmed, what the New Testament, Josephus, all Fathers of the Church, Arabian authors, the actual Hebrew manuscripts in the hands of the Jews in Abyssinia, the old Samaritan Pentateuch, and our best chronologists for two hundred years past have demonstrated, that the rabbis, particularly the apostate Akiba, 120 A.C., fifty years subsequent to the destruction of Jerusalem, have shortened the original chronology of the present Hebrew text of the Pentateuch, in order to demonstrate that Christ had been a false Messiah, being born not 6000, as the Prophets predicted, but 4000 years after the creation. This subject has been discussed *in extenso*, in my "*Chronologia Sacra*;" Leips., 1846; and in my "*Summary of Recent Discoveries*;" New York, 1857.



## EXPLANATION OF PLATES.

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PLATE I.—Ornament of red leather, found amongst the bandages upon the breast of the mummy, impressed with the Royal Cartouches, of Osimanphtha and Ramses Meiamun.

PLATE II.—Fig. 1. The mummy coffin, exhibiting on its side the deities or signs of the zodiac. In front of each figure is a triple-lined inscription, the hieroglyphic characters on which are not copied in the lithograph, from their nature and import being purely mythological.—Fig. 2. The deities or signs of the zodiac as arranged on the opposite side of the coffin.





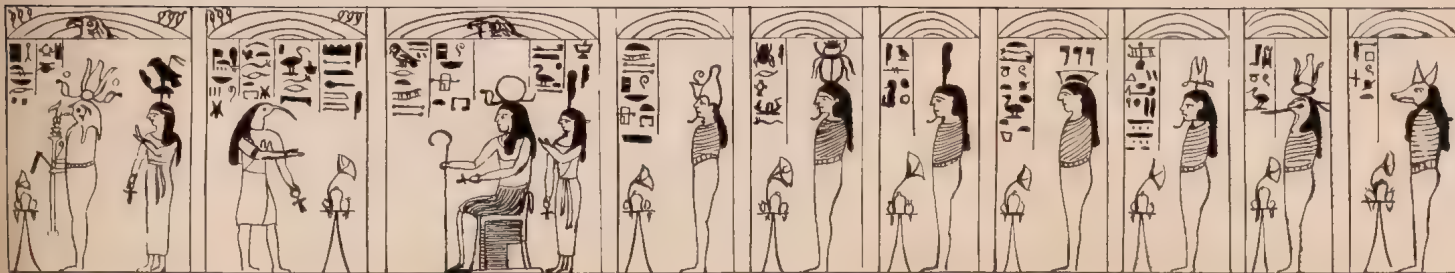


FIG 1

PLATE II



FIG 2





# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-EIGHTH (ANNUAL) MEETING, HELD IN  
ST. GEORGE'S HALL, BRADFORD, ON WEDNESDAY, FEBRUARY 19TH, 1862,  
AT TWELVE O'CLOCK AT NOON.

---

SAMUEL BAINES, Esq., in the Chair.

The Chairman having read a letter from the Rev. Dr. Burnet, Vicar of Bradford, who was to have occupied the Chair, expressing his regret at his inability from indisposition to attend the Meeting, and intimating his desire to be enrolled as a member of the Society, the following gentlemen were unanimously elected as members:—The Rev. Dr. Burnet, Vicar of Bradford; George Ellison, Esq., Birkenshaw; Henry Edwards, Esq., M.P., Pye-Nest, Halifax; C. H. Binstead, Esq., C.E., Wakefield.

The following noblemen and gentlemen were appointed as the Officers and Council of the Society for the ensuing year.

President.

THE EARL DE GREY AND RIPON.

Vice-Presidents.

THE DUKE OF LEEDS.  
THE EARL OF EFFINGHAM.  
THE EARL OF DARTMOUTH.  
EARL FITZWILLIAM.  
LORD WHARNCLIFFE.  
LORD LONDESBOROUGH.  
VISCOUNT GALWAY.  
VISCOUNT MILTON.  
RT. HON. SIR C. WOOD, M.P., BART.  
EDWARD AKROYD, Esq.

JOHN WATERHOUSE, Esq., F.R.S.  
W. B. BEAUMONT, Esq., M.P.  
E. B. DENISON, Esq.  
WM. BECKETT, Esq.  
LORD HOUGHTON.  
J. SPENCER STANHOPE, Esq.  
G. WENTWORTH, Esq.  
J. G. MARSHALL, Esq.  
THOS. WILSON, Esq.





supposed to be derived from the words "Crom," crooked, bent, or inclined, and "leac," stone. Hence it is often, but erroneously, called "Stone of worship," or "altar," ascribing thus the word "Crom" to the stooping or bowing body of the worshipper.

In consequence of its cumbrous obstruction, it has been for the most part removed or broken up for agricultural or other purposes, in the more civilised and cultivated parts of Europe. It is therefore now only found in desolate and secluded situations, except where it has some peculiar local protection. From this circumstance, and especially from its rude and massive proportions, its construction was ignorantly ascribed to supernatural agency. It has been for centuries a great archæological puzzle. But the persevering researches of the Rev. W. C. Lukis and Sir Richard Colt Hoare, and the practical investigations of modern antiquarians, have removed all doubts as to its use; and it is now conceded on all hands, that it has been generally used as a tomb or grave for the dead.

When I resided in Trinidad, about thirty years ago, the mountainous and inaccessible districts of that Island were inhabited by the aboriginal and now nearly extinct tribe of Caribs. I took great interest in observing the habits and character of that curious race of human beings, and no custom of theirs impressed me more than their mode of disposing of their dead. Soon after life departed, and while the body was yet warm, and the limbs pliant, it was tied up into the smallest possible compass. The legs were bound up on the thighs, and the elbows fixed between the knees. The face, which had been previously smeared with some reddish paint, was fastened down upon the open palms of the hands, and the hair thickly greased with some animal oil or fat. The body was then tightly swathed in a long piece of coarse cloth. After these preparations it was left

for a few hours to cool and stiffen, when it was silently removed, and carefully deposited in a narrow and short grave. If a natural crevice in a rock, or a convenient receptacle under one or more large stones could be found near at hand, they always availed themselves of such a secure protection for the remains of their deceased relatives, against the depredations of the ferocious carnivorous animals which infested the surrounding forests.

Now this description would apply to most of the human remains found in our rudest Cromleachs. I am told it would also apply to the condition of the human remains found in the most ancient Mexican graves. The bones are seldom or never found charred, and their position when undisturbed almost always coincides with that of the body of the dead Carib. This is in all probability the most primitive, as it was the most natural way of disposing of the human dead body, in man's savage state, all over the world.

I think we ought therefore to infer that the rudest Cromleach, like the Carib grave, has been of natural or accidental formation. I have seen several which must have been thus formed. There is a remarkable one near the town of Dundalk, in Ireland. It appeared to me to be nothing more than a large granite boulder, which in falling happened to drop upon another, which it split vertically into four large fragments. Upon this accidental tripod, or rather tetrapod, it has reposed, in my opinion, undisturbed since the geological period of the glacial flood. It thus became a ready-made and secure tomb, and I have no doubt of its having been continually made use of for this purpose, from the remotest ages; for it goes even at the present day by the name of "The Giant's Grave." The relics and remains of various and successive races which are occasionally found in such cromleachs may be easily accounted for on this supposition. It is not surprising that these vast masses of rock, so

mysteriously disposed, should produce a general impression of awe and veneration, and that they should come to be regarded as objects of superstition, or even of religious worship, such as that practised by the Druids in these islands, seeing that they are looked upon at this day as a scientific or mechanical puzzle by philosophers and archæologists of all countries.

Of course it is not intended to maintain that all cromleachs were thus naturally or accidentally formed. On the contrary, the greater number, especially of the small ones, were evidently artificial. All that I mean to contend for is, that the original cromleach was formed by nature or accident, and used as a grave for countless ages before its artificial imitation, which ultimately assumed the form of a rude tomb. With reference to those artificial cromleachs in which the superincumbent stone was of extraordinary magnitude, as at Plas Newydd, in the Island of Anglesey, I believe that the great stone was an erratic block dropped upon a gravel or mud bank of diluvial drift, which would subsequently become covered with vegetable soil. By carefully removing this original foundation, and replacing it by rude props of rough stone, such a structure could be easily made without much engineering science or mechanical contrivance. In fact there was a similar block on Lord Anglesey's lawn, within a short distance of the celebrated Druids' Altar, which might be readily converted into a second great cromleach by such simple means.

As the cromleach is found almost in every part of the inhabited world, the circumstance had been adduced as a conclusive proof of an identity of origin of the various races living in these remotely separated countries. Is it not more reasonable to look upon such a coincidence as a curious instance of the identity of the instinctive resources of the human intellect at all times and in all places, under similar

conditions? The bone-pointed lance, the flint arrow-head, and the stone hatchet of the Red Indian, the New Zealander, and the aboriginal inhabitant of Great Britain are frequently identical. I had the honour to exhibit two stone hatchets from the Leeds Museum at the meeting of the British Association at Aberdeen, in 1859. One was found in a limestone cave near Settle, in the West Riding of Yorkshire, with various other ancient British relics. The other was brought from Tahiti. It is difficult to distinguish one from the other; but still more difficult to imagine that the art of fabricating this primitive tool could have been imparted to the New Zealander by the aboriginal Yorkshireman, or, *vice versa*, by the New Zealand savage to the ancient Briton.

The stones of an artificial cromleach are often comparatively light and easily removed. The natural or instinctive resource under such insecure conditions would be to conceal it under a mound of earth or heap of stones as the locality could afford. This is the probable history of the earthen "tumulus," or stone "cairns," perhaps the prototypes of these stupendous pyramidal structures of the more civilised Egyptians. We find them accordingly, like the cromleach, of similar form and construction in the remotest and most widely-separated parts of the globe. This would offer a more simple and natural explanation of those universal erections, than the dreamy visions of certain ethnologists, who will only see in them the vestiges or landmarks of improbable human migrations, of which they offered us no more satisfactory evidence than the ingenious speculations of philologists, who find in language such a plastic material that they can mould it into any form to suit their own preconceived theories.

Amongst the other megalithic wonders, the erection of which have been popularly assigned to supernatural agency, none is more striking than the "Rocking Stone." For ages this supposed structure has been a great archæological

difficulty. From its great weight, and the curious adjustment of its balance, it seems to exhibit an amount of engineering and mechanical skill in its construction which is utterly incomprehensible. Professor Wilson, the well-known author of the "Pre-historic Annals of Scotland," when describing the rocking stone, says:—"There is so strange a mixture of extreme rudeness, and great mechanical skill in these memorials of the remote past, that they will excite greater wonder and awe in the thoughtful mind, than even the imposing masses inclosing the sacred area of Stonehenge. It would I imagine prove a much more complicated problem for the modern engineer, to poise the irregular and amorphous mass on its point of equilibrium, than to rear the largest monolithic group, that now stands to attest the mechanical power which the old builders could command." The theory which I have here advanced for the formation of the primitive cromlech, would readily solve Professor Wilson's "complicated problem," and remove all his mechanical difficulties.

If the glacial flood, of which we have everywhere such manifest indications, had borne away upon its enormous ice-rafts vast masses of rock torn from the abraded sides of the valleys as they drifted through them, these large blocks of stone must have been all again deposited on the bottom of this icy sea, on its increase of temperature and subsidence. Now many of these floating boulders must, as stated before, have fallen upon others, and sometimes thus breaking them, rested securely upon the fragments. Is it unreasonable to suppose that occasionally some may have been deposited quietly upon the very pivot of their centres of gravity, where they might have remained curiously balanced on the retreat of the waters? They would thus become objects of awe and veneration to the savage human creatures who first beheld them, and to all succeeding generations. In fact, we learn that the rocking stone was so regarded by the

Phœnicians, and that their priests took advantage of this superstitious feeling, and, like some modern priests, "improved the occasion," and assigned to these vibrating stones the power of divination. Few of these stones can now be found on their poise in this country, most of them, like the cromleach, having been removed for agricultural or other purposes, or, worse still, thrown over from stupid curiosity. Of course the rocking stone, like the primitive cromleach, may have been frequently imitated by art, especially for religious objects.

Here is a drawing of the celebrated rocking stone of Cornwall, called the "Logan Stone," it does not require any great knowledge of geology or mechanics to come to the conclusion that this was not the work of human hands originally. I say originally, for you all know that it has been thrown over and replaced with great labour within your own time. There is another way in which a natural rocking stone may have been gradually formed. Here is a sketch of what Professor Phillips, the distinguished geologist, calls an "erratic block," near Settle. It is not difficult to foresee that in the lapse of time not very remote the narrow base on which this rock now reposes securely, may be worn away by rain and frost, until the huge mass becomes detached, or poised upon a pivot so small as to allow it to oscillate like a rocking stone.

A short discussion followed the reading of this Paper, when JOHN LUBBOCK, Esq., F.R.S., of London, then proceeded to read the second Paper—

ON THE GEOLOGICO-ARCHÆOLOGICAL DISCOVERIES IN DENMARK,  
SWITZERLAND, AND FRANCE.

Archæology forms the link between Geology and History—the past and the present. If in its more recent portions it is

scarcely distinguishable from history, yet when we pass back to its commencement, we find ourselves to have imperceptibly glided into the domain of Geology, without noticing any boundary to separate the one from the other. The beginning of Archæology being, in fact, but the end of Geology, it is not surprising that they should, in the course of their development, have presented some remarkable analogies.

M. Morlot has well pointed these out in his "Leçon d'ouverture d'un cours sur la haute antiquité, fait à l'Académie de Lausanne." Even, indeed, as the remains of extinct animals were at first supposed to be few and far between, whereas, in fact, the surface of the earth is made up of the dust and skeletons of our predecessors, so the relics of man, long looked upon as rare and exceptional in their occurrence, are gradually presenting themselves in unexpected profusion. Loth, however, to distrust the existing chronology, our antiquaries long referred all the most beautiful and well-made weapons to the Romans, just as all fossils were attributed to the action of the Deluge. Passing on, then, with a graceful compliment to two of our most eminent contemporaries, M. Morlot points out that as Lyell, the reformer of Geology, by studying the changes now taking place on the earth's surface, has explained the results which Geology brings before us, and thus arguing from the known to the unknown, has used the present as a key to unlock the past; so M. Thomsen, by collecting the implements and recording the habits of existing savages, has thrown much light upon the manners and customs of ancient times. Fully recognising the imperfection of the record in the one case as well as in the other, we must guard ourselves against any hasty conclusions and generalisations, but it seems now to be well established that a considerable elongation of the received chronology is required in Archæology as decidedly, though not, of course, to such an extent, as in Geology.

Perhaps, also, we may regard it as, to say the least, highly probable, that in Northern Europe there have been three great epochs in the history of man—primary, secondary, and tertiary—the first of stone, the second of bronze, and the third of iron. This conclusion, which we owe in the first instance to the Northern and especially to the Danish Archæologists, has been much strengthened by the recent researches in the lakes of Switzerland.

It is however probable, that the stone period will require much sub-division, and must be divided into at least two periods; that of the drift on the one hand, and on the other hand, that to which the Danish Kjökkenmöddings and the Swiss Lake Habitations appear to belong.

These Lake-dwellings or “Pfahlbauten,”—a term whose nearest English equivalent is “Pile-works”—were made known to us in the following manner.

In consequence of the extraordinary dryness and coldness of the weather during the winter months of 1853 and 1854, the rivers of Switzerland did not receive their usual supplies, and the water in the lakes fell much below its ordinary level, so that in some places a broad strand was left uncovered along the margin, while in others shallow banks were converted into islands. The water level of this season was, indeed, the lowest upon record. The lowest level marked on the so-called stone of Stäfa was that of 1674, but in 1854 the water sank a foot lower. These unusual conditions, though very unfavourable to navigation, enabled the Swiss Archæologists to make the important discoveries which we are about to bring before our readers.

M. Aeppli of Meilen, on the Lake of Zurich, appears to have been the first to observe, in the bed of the lake, certain indications of human activity, which he justly supposed might throw some light on the history and condition of the earliest inhabitants of the Swiss valleys. In a small bay



between Ober Meilen and Dollikon, the inhabitants took advantage of the lowness of the water to increase their gardens, by building a wall along the new water-line, and slightly raising the level of the piece thus reclaimed, by mud dredged from the lake. In the course of this dredging they found great numbers of piles, of deer-horns, and also some implements. The researches at this place conducted and described by Dr. F. Keller, have been followed by similar investigations in other lakes, and have proved that the early inhabitants of Switzerland constructed some, at least, of their dwellings above the surface of the water, as is done in the present day by savages in various countries, as, for instance, the Papous of New Guinea, whose huts, circular or square in form, are grouped on wooden platforms, elevated a few feet above the level of the water, supported by numerous piles driven into the mud, and connected with the land by a narrow bridge.

This method of construction, indications of which are found in various parts of Europe, was especially mentioned by Herodotus,\* who describes the Pœonians of Lake Prasias, in Thrace, as living in cabins situated on a platform, supported above the water by great piles. Each cabin had a trap-door opening on to the lake, and the whole settlement communicated with the main land by a bridge.

The dwellings of the Gauls are described as having been circular huts, built of wood and lined with mud. The huts of the pileworks were probably of a similar nature. This supposition is not a mere hypothesis, but is confirmed by the preservation of pieces of the clay used for the lining. Their preservation is evidently due to the building having been destroyed by fire, which has hardened the clay and enabled it to resist the dissolving action of the water. These fragments bear, on one side, the marks of interlaced branches,

\*Her. Book V. ch. 16.

while on the other, which apparently formed the inner wall of the cabin, they are quite smooth. Some of those which have been found at Wangen are so large and so regular that M. Troyon feels justified in concluding that the cabins were circular, and from ten to fifteen feet in diameter. Though, therefore, the architecture of this period was very simple, still the weight to be sustained on the wooden platforms must have been considerable, and their construction, which must have required no small labour,\* indicates a considerable population. It would, indeed, be most interesting if we could construct a retrospective census for these early periods, and M. Troyon has made an attempt to do so, though the results must, naturally, be somewhat vague. The settlement at Morges, which is one of the largest in the Lake of Geneva, is 1200 feet long and 150 broad, which would give a surface of 180,000 square feet. Taking the cabins as being 15 feet in diameter, and supposing that they occupied half the surface, leaving the rest for gangways, we may estimate the number of cabins at 311, and if we suppose that, on an average, each was inhabited by four persons, we shall have, for the whole, a population of 1244. Starting from the same data, we should obtain for the Lake of Neufchatel, a population of about 5000. Altogether, 68 villages, belonging to the bronze age, have been discovered in Western Switzerland, and by the same process of reasoning they may be supposed to have contained 42,500 persons; while for the preceding epoch, the population may, in the same manner, be estimated at 31,875.

For a moment it may surprise us that a people so uncivilised should have constructed their dwellings with immense labour on the water, when it would have been so much more easy to have built them on dry land. The first settlers in

\* "Increasing density of population is equivalent to increasing facility of production." Bastiat, *Harmonies of Political Economy*, p. 12.

Switzerland, however, had to contend with the boar, the wolf, the bear, and the urus; and subsequently, when the population increased, and disputes arose, the lake habitations, no doubt, acted as a fortification, and protected man from man, as they had before preserved him from wild beasts.

Switzerland is not, by any means, the only country in which lake dwellings have been used as fortresses. In Ireland, a number of more or less artificial islands, called "Crannoges,"\* are known, historically, to have been used as strongholds by the petty chiefs. They are composed of earth and stones, strengthened by numerous piles, and have supplied the Irish Archæologists with numerous weapons and bones. From the Crannoge at Dunshauglin, indeed, more than 150 cart-loads of bones were obtained, and were used as manure! These lake dwellings of Ireland, however, come down to a much later period than those of Switzerland, and are frequently mentioned in early history.

After having chosen a favourable situation, the first step in the construction of the Lake-habitations was to obtain the necessary timber. To cut down a tree with a stone hatchet must have been no slight undertaking. It is, indeed, most probable that they made use of fire, in the same manner as is done by existing savages in felling trees and making canoes. Burning the wood and then scraping away the charred portion, renders, indeed, the task far more easy, and the men of the stone period appear to have avoided the use of large trees, except in making their canoes. Their piles were imbedded in the mud for from one to five feet, and must also have projected from four to six feet above the water level, which cannot have been very different from at present. They must, therefore, have had a length of from 15 to 30 feet, and they were from 3 to 9 inches in diameter. The pointed extremity which entered into the mud still bears the

\* See Wilde's Catalogue, V. i., p. 220.

marks of the fire, and the rude cuts made by the stone hatchets. The piles belonging to the bronze period being prepared with metal axes, were much more regularly pointed, and the differences between the two have been ingeniously compared to those shown by lead pencils well and badly cut. Dragging the piles to the lake, and fixing them firmly, must have required much labour, especially when their number is considered. At Wangen alone M. Lohle has calculated that 40,000 piles have been used; but we must remember that these were probably not all planted at one time, nor by one generation. Wangen, indeed, was certainly not built in a day, but was, no doubt, gradually added to as the population increased. Herodotus informs us that the Pœonians made the first platform at the public expense, but that subsequently at every marriage (and polygamy was permitted), the bridegroom was expected to add a certain number of piles to the common support. In some localities, as at Robenhausen, on Lake Pfeffikon, the piles were strengthened by cross beams. The pileworks of subsequent periods differ little from those of the stone age, except, perhaps, that they are more solidly constructed. The piles, also, are less decayed, and project above the mud farther than those of the preceding epoch. M. Morlot considers that the horizontal platform rested upon the top of these piles, at such a height as to allow for all ordinary variations in the level of the water. M. Suter, however, supposes that in some cases, at least, the platform was not attached to the perpendicular piles, but rested upon the water, rising and sinking with it. Not only were the debris of their repasts, and other rubbish thrown into the water, but more or less valuable weapons and instruments must have been sometimes lost in this manner, especially as children formed, of course, the usual proportion of the population. Many of the articles presently to be mentioned, were, however, in all probability, engulfed at the destruction of the

Pfahlbauten, some of which were perhaps burnt and rebuilt more than once.

The number of stone implements which have been already found is quite astonishing ; at Wangen in Lake Constance, many hundred weapons of various sorts have been discovered, and a great number also at Moosseedorf, Wauwyl, and Robenhäusen, in none of which places has a single piece of metal been as yet met with, a fact which, taken in connection with the great number of bronze implements which have been collected from other pileworks, clearly indicates that the settlements above mentioned, belonged to the age of stone. Not only, however, is metal absent, and not only, as we have already seen, does the Fauna indicate a greater antiquity, but the stone weapons themselves are less varied and less skilfully made. Most of them are made from rocks which occur in Switzerland, though it is probable that the flint was brought from France. The absence of any great blocks of this valuable material in Switzerland accounts for our not finding any of the large flat axes which are so characteristic of Northern Europe, and especially of Denmark. At Wangen, the stone implements resemble those of Moosseedorf, and are principally formed of indigenous rocks, which, to judge from the fragments scattered about, were evidently worked up at these two places. The stone implements found in the settlements belonging to this earliest period consist of hammers, axes, knives, saws, lance-heads, arrow-heads, corn-crushers, and polishing blocks. Some of the hammers were made of serpentine with a hole pierced through one end, and are, like all pierced stones, of very great rarity, belonging perhaps only to the end of the stone period. Some of them are cylindrical, others more cubical in shape.

The axe was pre-eminently *the* implement of antiquity. It was used in war and in the chase, as well as for domestic purposes, and great numbers have been found, especially at

Wangen, (Lake of Constance), and Concise, (Lake of Neuchatel). With a few exceptions they were surprisingly small, especially when compared with the magnificent specimens from Denmark; in length they varied from six inches down even as low as one, while the cutting edge had generally a width of from 15 to 20 lines. Flint was sometimes used, and nephrite, or jade, in a few cases, but serpentine was the principal material. Most of the larger settlements were evidently manufacturing places, and many spoilt pieces and half finished specimens have been found.

The knives may be considered as of two sorts. Some differ from the axes, principally in having their width greater than their length. In other cases they were made of flint flakes. In this manner also were obtained the saws, which in addition had their edges somewhat rudely dentated; they were fixed into handles of wood by some sort of cement; but we do not find in Switzerland any of the semilunar saws, which are frequent in Denmark.

The arrow-heads were made of flint, or in some cases of rock crystal, and were, as in Ireland, of three principal sorts, between which, however, there were a great many varieties. There are also found rounded stones, pierced with one, or sometimes with two holes. The use of these is uncertain, but they may perhaps have been used to sink fishing lines.

“Waste not, want not,” is a proverb which the Lake-dwellers thoroughly appreciated. Having caught any wild animal, except the hare, they ate the flesh, used the skin for clothing, picked every fragment of marrow out of the bones, and then in many cases, fashioned the bones themselves into weapons. The larger and more compact ones served as hammers, and, as well as horns of the deer, were used for the handles of hatchets. In some cases pieces of bone were worked to a sharp edge, but they can only have been used to

cut soft substances.\* Bone harpoons, poignards, arrow-heads, and javelin heads also occur, and pins and needles of this material are very common. Teeth also, and particularly those of the wild boar, were used for cutting, and were also, in some cases, worn as ornaments or armlets. There can be little doubt that wood was also extensively used for different purposes, but, unfortunately, most of the implements of this material have perished. A wooden mallet, however, was found at Concise.

For our knowledge of the animal remains from the pileworks we are almost entirely indebted to Prof. Rüttimeyer, who has published two memoirs on the subject. The bones are in the same fragmentary condition as those from the Kjökkenmöddings, and have been opened in the same manner for the sake of the marrow. There is also the same absence of certain bones and parts of bones, so that it is impossible to reconstruct a perfect skeleton even of the commonest animals.

The total number of species amounts to about 66, of which 10 are fishes, 3 reptiles, 17 birds, and the remainder quadrupeds. Of the latter, eight species may be considered as having been domesticated, namely, the dog, pig, horse, ass, goat, sheep, and at least two species of oxen. The bones very seldom occur in a natural condition, but those of domestic and wild animals are mixed together, and the state in which they are found, the marks of knives upon them, and their having been almost always broken open for the sake of the marrow, are all evidences of human interference.

Human bones occur in the pileworks but very seldom, and may no doubt be referred to accidents, especially as we find that those of children are most numerous. One mature skull was, however, discovered at Meilen, and has been described

\* According to Sir E. Belcher, however, sharpened pieces of horn are used by the Esquimaux in the preparation of flint weapons.

by Professor His, who considers that it does not differ much from the ordinary Swiss type. And while his work was in the press, M. Rütimeyer received from M. Schwab four more skulls, two of which were obtained at Nidan-Steinberg, one at Sutz, and one from Biel.

M. Troyon has a very interesting chapter on the different modes of burial; he points out that the disposition of the corpse after death had a deep meaning, and is perhaps of greater importance than the nature of the tomb, which must in many cases have depended upon that of the materials which came to hand. The Greeks generally burnt their dead; considering fire as the means of purification, while the Persians shrank from such an act, regarding fire, according to Herodotus, as a deity. Other nations, looking upon the earth as the universal mother, returned into her bosom the remains of their dead, fortunately ignorant of the deduction that as we brought nothing into the world so we can take nothing out of it, and regarding it therefore as a sacred duty to bury with the departed his most useful weapons and most beautiful ornaments. This belief seems to have been almost as general as the hope of a resurrection, and even among the Jews we find a trace of it in the words of Ezekiel (ch. xxxii., v. 27). "And they shall not lie with the mighty that are fallen of the uncircumcised, which are gone down to hell with their weapons of war."

In tombs of the stone age the corpse appears to have been almost always, if not always, buried in a sitting position, with the knees brought up under the chin, and the hands crossed over the breast. This attitude occurs also in many Asiatic, African, and American tombs.

Making allowance for the marine animals, such as the seals and oysters, the cockles, whelks, &c., the fauna thus indicated by the remains found in the Swiss lakes, agrees remarkably with that which characterises the Danish Kjökkenmöddings,



and belongs evidently to a far later age than that of the celebrated stone hatchets, which were first made known to us by the genius and perseverance of M. Boucher de Perthes.

Instead of the elephant and rhinoceros we find in the later or second stone period, in that namely of the Kjökkenmödding and "Pfahlbauten," the urus and bison, the elk and the red deer, already installed as monarchs of the forests. The latter indeed, with the boar, appears to have been very frequent, and to have formed a most important article of food to the Lake-dwellers.

The aurochs or European bison, seems to have disappeared from Western Europe even earlier than the urus. There is no historical record of its existence in England or Scandinavia. We have no notice of the existence of the elk in Switzerland during the historical period. At present it inhabits Prussia and Lithuania, Finland and Russia, Scandinavia and Siberia, to the shores of the Amoor. The ibex disappeared from most of the Swiss Alps, perhaps not much later than the elk. It lingered longest in the West. The extermination of the bear, like that of the ibex, seems to have begun in the East, and not yet to be complete. The fox, the otter, and the different species of weasels are still the common carnivora of Switzerland, and the wild cat, the badger, and the wolf still occur in the Jura and the Alps, the latter in cold winters venturing even into the plains; the beaver on the contrary has at last disappeared. The roedeer still occurs in some places.

The fauna thus indicated is certainly very much what might have been expected. We find most of the species which characterise the post-tertiary epoch in Europe. Some of the larger ones have since fallen away in the struggle for existence, and others are becoming rarer and rarer every year, while some maintain themselves even now, thanks only to the inclemency and inaccessibility of the mountainous regions

which they inhabit. The gradual process of extermination, which has continued ever since, had however even then begun.

Taken as a whole, therefore, the animals of the Swiss pileworks belong evidently to the fauna which commenced in post-tertiary times with the mammoth, the rhinoceros tichorhinus, the cave bear, and the fossil hyæna. These extinct species appear to have co-existed in Europe with all of its present indigenous inhabitants; it was, indeed, long supposed that man belonged to a subsequent period, but recent investigations have shown that he is no exception to the rule.

While, however, we must regard the fauna of the stone age as belonging to the same zoological epoch with that of the later drifts on the one hand, and the present time on the other; we cannot forget that the immense time which has elapsed since the end of the tertiary period, has produced great changes in the fauna of Europe. In this post-tertiary era the pileworks occupy, so to say, a middle position. Distinguished from the present fauna of Switzerland in the possession of the urus, the bison, the elk, the stag, and the wild boar, as well as by the more general distribution of the beaver, the bear, the wolf, the ibex, the roe, &c., they differ equally from the drift gravels in the absence of the mammoth, the rhinoceros, the cave bear, and the cave hyæna.

The evidence derived from the distribution of the domestic animals is perhaps more satisfactory. The sheep is present even at Moosseedorf, though not so numerous as at the Steinberg. On the other hand, the horse is frequent at the Steinberg, while at Moosseedorf only a single tooth was discovered, and even this had been worn as an amulet or an ornament, and may have been brought from a distance. Finally, the domestic hog of the present race is absent from all the pileworks of the stone period, excepting perhaps

the one at Wauwyl, and becomes frequent only at the Steinberg.

If succeeding investigations confirm the conclusions thus indicated, we may perhaps conclude that the domestic animals, which were comparatively rare in the stone period, became more frequent after the introduction of bronze, a change indicating and perhaps producing an alteration of habits on the part of the inhabitants.

Rare, indeed, as they may have been, oxen, horses, sheep, and goats could not be successfully kept through the winter in the climate of Switzerland, without stores of provisions and some sort of shelter. A pastoral people, therefore, must have reached a higher grade than a mere nation of hunters. We know, moreover, in another manner, that at this period agriculture was not entirely unknown. This is proved in the most unexpected manner, by the discovery of carbonised cereals at various points. Wheat is most common, having been found at Meilen, Moosseedorf, and Wangen. At the latter place, indeed, many bushels were found, the grains being united in large thick lumps. At other times the grains are free, and without chaff, resembling our present wheat in size and form, while more rarely they are still in the ear. Ears of the *Hordeum hexastichon* L. (the six rowed barley) are somewhat numerous. This species differs from the *H. vulgare* L. in the number of rows and in the smaller size of the grains. According to De Candolle, it was the species generally cultivated by the ancient Romans, Greeks, and Egyptians. In the ears from Wangen, each row has generally ten or eleven grains, which however are smaller than those now grown.

Still more unexpected was the discovery of bread, or rather cakes, for leaven does not appear to have been used. They were flat and round, from an inch to 15 lines in thickness, and, to judge from one specimen, had a diameter of four or five inches. In other cases the grains seem to have been

roasted, coarsely ground between stones, and then either stored up in large earthenware pots, or eaten after being slightly moistened. A similar mode of preparing grain was used in the Canary Islands at the time they were conquered by Spain, and even now constitutes the principal food of the poorer classes. In what manner the ground was prepared for the cultivation of corn we know not, as no agricultural implements have as yet been found except sickles; it is probable however that bent stakes supplied the place of the plough.

Carbonised apples and pears have also been found at Wangen, sometimes whole, sometimes cut into two, or more rarely into four pieces, which had evidently been dried and put aside for winter use. The apples are more frequent than the pears, and have been found not only at Wangen, but also at Robenhausen in Lake Pfeffikon, and at Concise in Lake Neufchatel. Both apples and pears are small and resemble those which still grow wild in the Swiss forests. No traces of the vine, the cherry, or the damson have yet been met with, but stones of the wild plum and the *prunus padus* have been found. Seeds of the raspberry and blackberry, and shells of the hazel nuts and beechnuts occur plentifully in the mud.

From all this, therefore, it is evident that the nourishment of the dwellers in the pileworks consisted of corn and wild fruits, of fish, and the flesh of wild and domestic animals. Doubtless also milk was an important article of their diet.

The pottery of the stone age presents nearly the same characters in all the settlements. Very rude and coarse, it is generally found in broken pieces, and few entire vessels have been obtained. The potter's wheel seems to have been unknown, and the baking was very imperfect. The form was frequently cylindrical, but several of the jars were rounded at the base, and without feet.

Several of the vessels are ornamented with simple markings, generally mere impressions of the finger or of the nail. Neither in the stone, nor in the bronze period, do we ever find either in the pottery, or on the bronze weapons, any representation, however rude, of an animal; the ornamentation being generally confined to straight or curved lines, forming in many cases a very elegant ornament. One vase, however, which was found at Wangen, is distinguished by more elaborate ornaments, the lines being evidently intended to represent leaves.

The lakes on which pileworks of the stone era have as yet been found, are Constance, Zurich, Bienne, Neufchatel, Geneva, Inkwyl, Nussbaumen, Pfeffikon, Moosseedorf, and Wauwyl. Settlements of the bronze period existed on the Lakes of Geneva, Luissel, Neufchatel, Morat, Bienne, and Sempach, but none have as yet been found on Lake Constance. It has been supposed from this that the age of stone lasted longer in Eastern than in Western Switzerland, and that flint and serpentine were in use on Lake Constance long after bronze had replaced them on the Western Lakes. We can hardly suppose that the inhabitants of Inkwyl and Moosseedorf in Berne, who imported flint from France, can have been ignorant of the neighbouring civilisation on the Lake of Bienne. Perhaps, however, settlements of the bronze age may yet be found on the Lake of Constance; but as the question now stands, pileworks of the metallic period are peculiar to Western and Central Switzerland. The constructions of the latter period are more solidly built, but do not otherwise appear to have differed materially from those of the stone age. They are often, however, situated farther from the land and in deeper water, partly no doubt on account of the greater facility of working timber, but partly also, perhaps, because more protection was needed as the means of attack were improved. The principal implements of bronze are

swords, daggers, axes, spear-heads, knives, arrow-heads, pins, and ornaments. The number of these weapons which have been discovered is already very great.

From the settlement at Estavayer, in Lake Neufchatel, the following collection of bronze implements has been obtained :—

Pins with large spherical and ornamented heads . . . . .	36
Pins with ordinary heads . . . . .	92
Knives . . . . .	26
Bracelets . . . . .	15
Sickles . . . . .	5
Axe . . . . .	1
Hook . . . . .	1
Chisel . . . . .	1
Small rings . . . . .	27
Buttons . . . . .	2
Dagger blade . . . . .	1
Arrow head . . . . .	1
Pieces of spiral wire . . . . .	6
<hr/>	
Making altogether . . . . .	214 objects of bronze.

Again at Morges (Lake of Geneva) forty-two bronze hatchets and thirteen pins have been found. From the Steinberg M. Schwab has obtained five hundred bronze hair-pins, besides other instruments of the same metal. These are of the same type as those found in other parts of Europe, and the swords are characterised, as usual, by the small space allowed for the hand. They were, however, made in Switzerland, as is shown by the discovery at Morges of a mould for celts, and at Estavayer of a bar of tin.

The pottery of this period was more varied and more skilfully made than that of the stone age, and the potter's wheel

was already in use. As neither copper nor tin occur in Switzerland, the possession of bronze implies the existence of commerce. It is difficult to say from whence the copper was obtained, but Saxony and Cornwall are the only parts of Europe which produce tin. It is, however, possible that Asia may have supplied both the one and the other. The presence of amber shows that there must have been a certain amount of communication with Northern Europe.

The pileworks of Switzerland appear to have become gradually less numerous. During the stone age they were spread over the whole country. Confined during the bronze era to the Lakes of Western Switzerland, during that of iron we find them only on the Lakes of Biemme and Neufchatel. In these settlements not only has a new substance made its appearance, but the forms of the implements are different. We have indeed copies of the bronze axes made in iron, just as we found before that the early bronze celts were copies of the still earlier stone axe, but these are exceptional cases. The swords have larger handles and are more richly ornamented; the knives have straight edges; the sickles are larger; the pottery is more skilfully made and is ornamented with various colours; the personal ornaments are also more varied, and glass for the first time makes its appearance.

After this period we find no more evidences of Lake habitations on a large scale. Here and there indeed a few fishermen may have lingered on the half-destroyed platforms, but the wants and habits of the people had changed, and the age of pileworks was at an end.

We have, however, traced them through the stone and bronze down to the beginning of the iron period. We have seen evidences of a gradual progress in civilisation, and improvement in the arts, an increase in the domestic animals, and proofs at last of the existence of an extended commerce. We found the country inhabited only by rude savages and we

leave it the seat of a powerful nation. Changes so important as these are not effected in a day; the progress of the human mind is but slow; and the gradual additions to human knowledge and power, like the rings in trees, enable us to form some idea how distant must be the date of their commencement. So varied however are the conditions of the human mind, so much are all nations affected by the influence of others, that when we attempt to express our impressions, so to say, in terms of years, we are baffled by the complexity of the problem, and can but confess our ignorance. Occasionally indeed we obtain a faint glimmer of light, but the result is only to show us obscurely a long vista, without enabling us to define any well-marked points of time. Thus in Denmark we found three periods of arborescent vegetation, corresponding to the three epochs of human development, and we know that the extermination of one species of forest tree and its replacement by another is not the work of a day. The Swiss archæologists, however, have attempted to make an estimate somewhat more definite than this, founded on certain alluvial deposits at the point where the Torrent of the Tinière falls into the Lake of Geneva, near Villeneuve, from which M. Morlot deduces an antiquity of from 3,000 to 4,000 years for the bronze period, and 5,000 to 7,000 years for the stone period.

Far earlier, however, even than these are the remains discovered by M. Boucher de Perthes, and first described in a work "*De l'industrie primitive, ou les arts et leur origine*," which appeared in the year 1846. In this he announced that he had found human implements in beds unmistakeably belonging to the age of the drift. In his "*Antiquités Celtiques et Antédiluviennes*" (1847), he also gave numerous illustrations of these stone weapons, but unfortunately the figures were so small and rude, as scarcely to do justice to the originals. For seven years M. Boucher de Perthes made few



converts; he was looked upon as an enthusiast, almost as a madman. At length, in 1853, Dr. Rigollot, till then sceptical, examined for himself the drift at the now celebrated St. Acheul, found several weapons, and believed. Still the new creed met with but little favour; prophets are proverbially without honour in their own country, and M. Boucher de Perthes was no exception to the rule. At last, however, the tide turned in his favour. Dr. Falconer, passing through Abbeville, visited his collection, and made known the result of his visit to Mr. Joseph Prestwich, who, accompanied by Mr. John Evans, immediately proceeded to Abbeville and examined carefully not only the flint weapons, but also the beds in which they were found. For such an investigation our two countrymen were especially qualified: Mr. Prestwich from his long examination and great knowledge of the more recent strata; and Mr. Evans as having devoted much study to the stone implements belonging to what we must now consider as the second, or at least the more recent, stone-period. On their return to England Mr. Prestwich communicated the results of his visit to the Royal Society\* (May 19, 1859), while Mr. Evans described the implements themselves in the Transactions of the Society of Antiquaries (1860).

Shortly afterwards Mr. Prestwich returned to Amiens and Abbeville, accompanied by Messrs. Godwin Austen, J. W. Flower, and R. W. Mylne. In the same year Sir Charles Lyell, whose opinion on the subject was naturally expected with great interest, visited the now celebrated localities. In 1860, I made my first visit with Mr. Busk and Captain Galton, under the guidance of Mr. Prestwich, while Sir Roderick Murchison, Professors Henslow, Ramsay, Rogers, Messrs. H. Christy, Rupert Jones, James Wyatt, and other geologists followed on the same errand. Soon after his return, Mr. Prestwich addressed

\* Phil. Transact. 1860.

a communication to the Academy of Sciences through M. Elie de Beaumont, in which he urged the importance of these discoveries, and expressed a hope that they would stimulate “les géologues de tous les pays à une étude encore plus approfondie des terrains quaternaires.” The subject being thus brought prominently before the geologists of Paris, M. Gaudry, well known for his interesting researches in Greece, was sent to examine the weapons themselves, and the localities in which they were found. M. Gaudry was so fortunate as to find several flint weapons *in situ*, and his report, which entirely confirmed the statements made by M. Boucher de Perthes, led others to visit the valley of the Somme, among whom I may mention M.M. de Quatrefages, Lartet, Collomb, Hebert, de Verneuil, and G. Pouchet.

In the “Antiquités Celtiques,” M. Boucher de Perthes suggested some gravel pits near Grenelle at Paris, as being, from their position and appearance, likely places to contain flint implements. M. Gosse, of Geneva, has actually found flint implements in these pits, being, I believe, the first discovery of this nature in the valley of the Seine. In that of the Oise a small hatchet has been found by M. Peigné Delacourt at Précy, near Creil. Dr. Noulet has also found flint weapons with remains of extinct animals at Clermont, near Toulouse. Nor have these discoveries been confined to France. There has long been in the British Museum a rude stone weapon, described as follows:—“No. 246. A British weapon, *found with elephant's tooth*, opposite to black Mary's, near Grayes inn lane. Conyers. It is a large black flint, shaped into the figure of a spear's point.” Mr. Evans tells us, moreover, (l. c. p. 22) “that a rude engraving of it illustrates a letter on the Antiquities of London, by Mr. Bagford, dated 1715, printed in Hearne's edition of Leland's Collectanea, Vol. I. 6. p. lxiii. From his account it seems to have been found with a *skeleton* of an elephant in the presence

of Mr. Conyers." This most interesting weapon agrees exactly with those found in the valley of the Somme. In the museum belonging to the Society of Antiquaries, Mr. Evans found, on his return from Abbeville, some specimens exactly like those in the collection of M. Boucher de Perthes. On examination it proved that they had been presented by Mr. Frere, who found them with bones of extinct animals in a gravel pit at Hoxne in Suffolk, and had well described and figured them in the *Archæologia* for the year 1800. Again, twenty-five years ago, Mr. Whitburn, of Godalming, (see *Prestwich, Geol. Jour.* August, 1861), examining the gravel pits between Guildford and Godalming, remarked a peculiar flint, which he carried away and has since preserved in his collection. It belongs to the "drift" type, but is very rude. Thus this peculiar type of flint implement has been actually found in association with the bones of the mammoth on various occasions during nearly a hundred and fifty years! While, however, these instances remarkably corroborate the statements made by M. Boucher de Perthes, they in no way detract from the credit due to that gentleman. In addition to the above-mentioned, similar hatchets have been found in Suffolk, Kent, Bedfordshire, and Hertfordshire. In the first of these counties Mr. Warren, of Ixworth, obtained one from a workman in a gravel pit near Icklingham, and he subsequently found another himself. Finally, Mr. Evans himself, near Abbots Langley, in Hertfordshire, has picked up on the surface of a field a weathered hatchet with the top broken off, but otherwise identical in form with the spear-head-shaped specimens from Amiens and Herne Bay.

But why, it may be asked, should the history of this question be so recounted? Why should it be treated differently from any other scientific discovery? The answer is not difficult. That the statement by Mr. Frere has been forgotten for half a century; that the weapon found by

Mr. Conyers should have lain unnoticed for more than double that time; that the discoveries by M. Boucher de Perthes have been ignored for fifteen years; that the numerous cases in which caves have contained the remains of men together with those of extinct animals, have been explained away; are facts which show how deeply rooted was the conviction that man belonged altogether to a more recent order of things, and, whatever other accusation may be brought against them, geologists can at least not be said to have hastily accepted the theory of the co-existence of the human race with the now extinct Pachydermata of Northern Europe.

The questions to be decided are as follows:—

1st. Are the so-called flint implements of human workmanship, or the results of physical agencies?

2ndly. Are the flint implements of the same age as the bones of the extinct animals with which they occur?

3rdly. Are we entitled to impute a high antiquity to the beds in which these remains occur?

4thly. What are the conditions under which they were deposited?

To the first three of these questions an affirmative answer would be given, almost unanimously, by those geologists who have given any special attention to the subject. "For more than twenty years," says Prof. Ramsay, "I have daily handled stones, whether fashioned by nature or art, and the flint hatchets of Amiens and Abbeville seem to me as clearly works of art as any Sheffield whittle."\* Still it might be supposed that they were forgeries, made by the workmen to entrap unwary geologists. They have, however, been found *in situ* by Messrs. Boucher de Perthes, Henslow, Christy, Flower, Gaudry, Pouchet, Wyatt, and others. One seen, though not found, *in situ*, is thus described by Mr. Prestwich. "It was lying flat in the gravel at a depth of 17 feet from the

\* Athenæum, July 16, 1859.

original surface, and  $6\frac{1}{2}$  from the chalk. One side slightly projected. The gravel around was undisturbed, and presented its usual perpendicular face. I carefully examined the specimen, and saw no reason to doubt that it was in its natural position, for the gravel is generally so loose, that a blow with a pick disturbs and brings it down for some way around; and the matrix is too little adhesive to admit of its being built up again as before with the same materials. . . . I found also afterwards, on taking out the flint, that it was the thinnest side which projected, the other side being less finished and much thicker.”\* Neither in my first visit, nor this spring, when with Mr. Prestwich and Mr. Evans, I made another careful examination of these localities, was I so fortunate as to find any implement *in situ*. But evidence of this nature, though interesting, is unnecessary; *the flints speak for themselves*. Originally of a dull black, they have been more or less discolored and their surfaces are generally stained yellow or white, according to the nature of the beds in which they have been lying. As this discoloration follows the contours of the present surfaces, it is evident that the alteration of colour has been subsequent to the manufacture. The weapons have a glossy surface, and a lustre very unlike newly broken flints. In many cases also they have an incrustation of carbonate of lime and small dendritic markings. Moreover, it must be remembered, that when M. Boucher de Perthes’ work was published, the weapons therein described were totally unlike anything then known. Since that time, however, not only have similar implements been found in various parts of England and France, but as already mentioned it has since come to light that similar weapons were in two cases actually described and figured in England many years ago, and that in both these instances they were found in association with the bones of extinct

\* Phil. Trans. 1860, p. 292.

animals. On this point, therefore, no evidence could be more conclusive.

It has, however, been suggested that though the worked flints are really found by the workmen in the mammaliferous gravel, they may perhaps be comparatively recent, and have gradually inserted themselves from above by the force of gravity. A few minutes' inspection, however, of the beds containing and overlying the flint implements of the Somme will assure any observer that they are entirely destitute of the imagined crevices, and are moreover altogether too compact and immovable to admit of any such insinuation or percolation of surface objects. Taking all these circumstances into consideration, it cannot be doubted that the flint implements really belong to the same age as the sands and gravels in which they occur.

Perhaps the most striking peculiarity of these weapons is, that they are never polished, not a single specimen having presented a trace of grinding; while, on the other hand, the implements of the later stone period, those which occur in burial-places, river beds, &c., are always carefully polished.

As regards their form, they are grouped by Mr. Evans under three heads:—

1. Flint flakes, apparently intended for arrowheads or knives.
2. Pointed weapons, analogous to lance or spear heads.
3. Oval or almond-shaped implements, presenting a cutting edge all round.

The flakes offer no special peculiarities, and similar articles have been used by savages in all ages and countries, where flint or obsidian was obtainable. The implements of the other two forms, which, however, pass almost imperceptibly into one another, are on the contrary quite unlike any of those belonging to the last or polished stone-period. The nearest approach to them is made by the small and rude

implements found in the Danish Kjökkenmöddings, but these again have a peculiar form, and would be at once distinguished by any experienced observer. During my last visit to Abbeville, I was much interested by finding, in the museum of M. Boucher de Perthes, a few small hatchets, which, both in shape and size, very closely resembled those which are found in the Danish Kjökkenmöddings, but all of these belonged to the later or post-elephantine period. It is, I think, probable that similar axes will be found in other countries, but that they have generally escaped notice hitherto on account of their rudeness.

Up to the present time no bones of men have been found in the strata containing the flint implements. This, though it has appeared to some so inexplicable as to throw a doubt on the whole question, is, on consideration, less extraordinary than it might at first sight appear to be. If, for instance, we turn to other remains of human settlements, we shall find a repetition of the same phenomenon. Thus in the Danish refuse-heaps, where worked flints are a thousand times more plentiful than in the St. Acheul gravel, human bones are of the greatest rarity. In this case, as in the Drift age, mankind lived by hunting and fishing, and could not therefore be very numerous. In the era, however, of the Swiss lake habitations, the case was different. M. Troyon estimates the population of the "Pfahlbauten" during the Stone age as about 32,000; in the Bronze era, 42,000. On these calculations, indeed, even their ingenious author would not probably place much reliance: still, the number of the Lake villages already known is very considerable; in four of the Swiss lakes only, more than 70 have been discovered, and some of them were of great extent: Wangen, for instance, being, according to M. Lohle, supported on more than 40,000 piles. Yet, if we exclude a few bones of children, only five skeletons have been obtained from all these

settlements taken together. The number of flint implements obtained hitherto from the drift of the Somme valley, is not estimated at more than 3,000; the settlement at Concise alone (Lake of Neufchatel) has supplied about 24,000, and yet has not produced a single human skeleton. (Rapport à la Commission des Musées, October 1861, p. 16.) Probably this absence of bones is almost entirely attributable to the habit of burying; the instinct of man has long been in most cases to bury his dead out of his sight; still, so far as the drift of St. Acheul is concerned, the difficulty will altogether disappear if we remember that *no trace has ever yet been found of any animal as small as a man*. The larger and more solid bones of the elephant and rhinoceros, the hippopotamus, ox, and stag remain, but every vestige of the smaller bones has perished. Till we find the remains of the dog, boar, roe-deer, badger, and other animals which existed during the drift period, we cannot much wonder at the entire absence of human skeletons.

In all the other places where flint implements have occurred they have been very rare (except perhaps at Hoxne), and though the ascertained mammalian fauna is not everywhere quite so restricted as at St. Acheul, still very few small animals have as yet occurred.

I have as yet but partly answered the second of the two questions with which we started. Even admitting that the flint hatchets are coeval with the gravel in which they occur, it remains to be shown that the bones of the extinct animals belong also to the same period. With reference indeed to two of those ordinarily quoted as belonging to this group, there may still be some little doubt. It seems very questionable whether any remains really belonging to the cave-bear have ever occurred in these beds, as will presently be mentioned, and though a few tusks of the hippopotamus have been found, yet (as this genus never occurs in the



corresponding beds of Germany) it is possible that they may have been washed out of some older stratum. But as regards the elephant and the rhinoceros the case is different. There is not the slightest reason to doubt that they really belong to this period, and, in the case of the rhinoceros, we have the evidence of M. Baillon that the bones of the hind leg of a rhinoceros were found at Menchecourt, in their relative situations, while the rest of the skeleton was discovered at a little distance. In this case, therefore, the body must have been entombed before the decay of the ligaments. Sir Cornewall Lewis, however, in his interesting and able, even if unsatisfactory work, on the Astronomy of the Ancients, argues that even if we must give an affirmative answer to the two first questions, and admit the coexistence of man in Western Europe with the mammoth and tichorhine rhinoceros, still we may do this by bringing these animals down to a later period, as well as by carrying man back to an earlier one.

Fairly admitting this, let us now, therefore, turn to the physical evidence of the case, and see how far this will enable us to give any, and if so what, answer, to the third of the above questions. In this part of the subject I shall be principally indebted for my facts to Mr. Prestwich. But I may perhaps be permitted to mention that though the following statements are given on his authority, I have verified almost the whole of them for myself, having had the advantage of visiting, with him and Mr. Evans, many localities, not only in the valley of the Somme, but also along the banks of the Seine and its tributaries.

A section at St. Acheul, near Amiens, the upper layer of vegetable soil having been removed, presents the following strata :—

1. A bed of brick earth from four to five feet in thickness, and containing a few angular flints.

2. Below this is a thin layer of angular gravel, one to two feet in thickness.

3. Still lower is a bed of sandy marl, five to six feet thick, with land and fresh water shells, which though very delicate, are in most cases perfect.

4. At the bottom of all, and immediately overlying the chalk, is the bed of subangular gravel in which the flint implements are found.

In the early Christian period this spot was used as a cemetery: the graves generally descend into the marly sand, and their limits are very distinctly marked, an important fact, as showing that the rest of the strata have lain undisturbed for 1500 years. The coffins used were sometimes made of hard chalk, sometimes of wood, in which latter case the nails and clamps only remain, every particle of wood having perished, without leaving even a stain behind. Passing down the hill towards the river, all these strata are seen to die out, and we find ourselves on the bare chalk; but again at a lower level occurs another bed of gravel, resembling the first, and capped also by the bed of brick earth which is generally known as loëss.

These strata, therefore, are witnesses; but of what? Are they older than the valley, or the valley than they? Are they the result of causes still in operation, or the offspring of cataclysms now, happily, at an end. If, indeed, we can show that the present river, somewhat swollen perhaps, owing to the greater extension of forests in ancient times, and by an alteration of climate, has excavated the present valley, and produced the strata above enumerated, then "the suggestion of an antiquity for the human family so remote as is here implied, in the length of ages required by the gentle rivers and small streams of eastern France to erode its whole plain to the depths at which they now flow, acquires, it must be confessed, a fascinating grandeur, when, by similitude of

feature and geology, we extend the hypôthesis to the whole north-west frontiers of the continent, and assume, that from the estuary of the Seine to the eastern shores of the Baltic, every internal feature of valley, dale, and ravine—in short, the entire intaglio of the surface—has been moulded by running waters, since the advent of the human race.”

Taking the section at St. Acheul, and commencing at the bottom, we have first of all the subangular gravel throughout which, though especially at the lower part, the flint implements occur. A similar bed may be found here and there all along the valley of the Somme; at St. Acheul it is about 90 feet above the present river level; at Moulin Quignon, near Abbeville, the same; while at Picquigny and at Cæsar’s Camp, near Liercourt, we found it at a height of 150 feet. Though only occurring in places, this gravel is so similar in composition and contents, that we seem justified in assuming it to have been at one time continuous; and we may almost take the section, as representing generally a section taken anywhere across the valley, only bearing in mind that through the action of subsequent causes, the gravel and the beds covering it have been in most cases removed. Nor is this a phenomenon peculiar to the Somme. During our last excursion we visited many gravel pits holding a similar relation to the Seine, while Mr. Prestwich in his recent communication to the Royal Society extends the same statement to many other rivers in England and France, the greatest height of the gravel above the present river level varying however in different cases. At St. Acheul and in several other places this bed of gravel, which for the future we will call the *high level gravel*, is separated from the *low level gravel* by a bare tract of the underlying rock. We do, however, sometimes find beds at intermediate levels, and must, therefore, consider the upper level and lower level gravels as the extremes of a continuous series, rather than as

strata separated by an intermediate and different condition of the valley.

The mammalia found in this upper level gravel are but few; the Mammoth, the *Rhinoceros tichorhinus*, with species of *Bos*, *Cervus*, and *Equus*, are almost the only ones which have yet occurred at St. Acheul, but beds of the same age in other parts of France have, in addition, supplied us with remains of the Bear, of a species of Tiger, of the *Hyæna spelæa*, *Cervus tarandus prisceus*, of a species of Dog, of the Musk Ox, and the *Hippopotamus*. The Mollusca, however, are more numerous; they have been identified by Mr. J. G. Jeffreys, who finds in the upper level gravel 43 species, all of them land or freshwater forms, and all belonging to existing species. It is hardly necessary to add that these shells are not found in the coarse gravel, but only here and there, where quieter conditions, indicated by a seam of finer materials, have preserved them from destruction. Here, therefore, we have a conclusive answer to the suggestion that the gravel may have been heaped up to its present height by a sudden irruption of the sea. In that case we should find some marine remains; but as we do not, as all the fossils belong to animals which live on the land, or inhabit fresh waters, it is at once evident that this stratum, not being subaerial, must be a freshwater deposit.

This, therefore, appears to indicate a change in the course of the river, and gradual excavation of the valley, which, by supplying the floods with a lower bed, left the waters at this height with a gradually diminishing force and velocity.

Having briefly described the strata at St. Acheul, let us now visit some of the pits at the lower levels. At about thirty feet lower, as for instance at Menchecourt, near Abbeville, and at St. Roch, near Amiens, where the gravels slope from a height of about sixty feet down to the valley, we find almost a repetition of the same succession: coarse subangular

gravel below, finer materials above. So similar, indeed, are these beds to those already described, both in constitution and in the animal remains they contain, that it will be unnecessary for me to give any further description of them.

Finally, the lowest portion of the valley is at present occupied by a bed of gravel, covered by silt and peat, which latter is in some places more than twenty feet thick, and is extensively worked for fuel. These strata have afforded to the antiquaries of the neighbourhood, and especially to M. Boucher de Perthes, a rich harvest of interesting relics belonging to various periods. The depth at which these objects are found has been carefully noted by M. Boucher de Perthes.

“Prenant,” he says, “pour terme moyen du sol de la vallée, une hauteur de 2 mètres audessus du niveau de la Somme, c’est à 30 à 40 centimètres de la surface qu’on rencontre le plus abondamment les traces du moyen-âge. Cinquante centimètres plus bas, on commence à trouver des débris romains, puis gallo-romains. On continue à suivre ces derniers pendant un mètre, c’est à dire jusqu’au niveau de la Somme. Après eux, viennent les vestiges gaulois purs qui descendent sans interruption jusqu’à près de 2 mètres audessous de ce niveau, preuve de la longue habitation de ces peuples dans la vallée. C’est à un mètre plus bas, ou à 4 mètres environ audessous de ce même niveau, qu’on arrive au centre du sol que nous avons nommé Celtique, celui qui foulèrent les Gaulois primitives ou les peuples qui les précédèrent;” and which belonged therefore to the ordinary stone period. It is, however, hardly necessary to add that these thicknesses are only given by M. Boucher de Perthes “comme terme approximatif.”

The “Antiquités Celtiques” was published several years before the Swiss Archæologists had made us acquainted with the nature of the Pfahlbauten; but from some indications given

by M. Boucher de Perthes, it would appear that there must have been, at one time, lake habitations in the neighbourhood of Abbeville. He found considerable platforms of wood, with large quantities of bones, stone implements, and handles closely resembling those which come from the Swiss lakes. These weapons cannot for an instant be confounded with the ruder ones from the drift gravel. They are ground to a smooth surface and a cutting edge, while the more ancient ones are merely chipped, not one of the many hundreds already found having shown the slightest trace of grinding. Yet, though the former belong to the stone age, to a time so remote that the use of metal was apparently still unknown in Western Europe, they are separated from the earlier weapons of the upper level drift by the whole period necessary for the excavation of the Somme Valley to a depth of more than 100 feet.

If, therefore, we get no definite date for the arrival of man in these countries, we can at least form a vivid idea of his antiquity. He must have seen the Somme running at a height of, in round numbers, a hundred and fifty feet above its present level. From finding the hatchets in the gravel up to a level of a hundred feet, it is probable that he dates back in Northern France almost, if not quite, as long as the rivers themselves. The face of the country must have been indeed unlike what it is now. Along the banks of the rivers ranged a savage race of hunters and fishermen, and in the forests wandered the mammoth, the two-horned woolly rhinoceros, a species of tiger, the musk ox, the reindeer, and the urus. Yet the geography of France cannot have been very different from what it is at present. The present rivers ran in their present directions, and the sea even then lay between the Somme and the Adur, though the channel was not so wide as it is at present. Gradually the river deepened its valley; ineffective, or even perhaps constructive, in autumn and

winter, the melting of the snows turned it every spring into a roaring torrent. These floods were probably more destructive to animals even than man himself; while, however rude they may have been, our predecessors can hardly be supposed to have been incapable of foreseeing and consequently escaping the danger. While the water at an elevation of 150 feet above its present level, as for instance at Liercourt, had sufficient force to deposit coarse gravel; at a still higher level it would part with finer particles, and would thus form the loëss which, at the same time, would here and there receive angular flints and shells brought down from the hills in a more or less transverse direction by the rivulets after heavy rains.

At length the excavation of the valley was completed; the climate must have approached what it is now, and whether from this change, or whether perhaps yielding to the irresistible power of man, the great Pachydermata had become extinct. Under new conditions, the river, unable to carry out to sea the finer particles brought down from the higher levels, deposited them in the valley, and thus raised somewhat its general level, checking the velocity of the stream, and producing extensive marshes, in which a thick deposit of peat was gradually formed. We have, unfortunately, no reliable estimate as to the rate of formation of this substance, but on any supposition the production of a mass more than 20 feet in thickness must have required a very considerable period. Yet it is in these beds that we find the remains of the stone period. From the tombs at St. Acheul, from the Roman remains found in the peat near the surface of the ground, at about the present level of the river, we know that fifteen hundred years have produced scarcely any change in the configuration of the valley. In the peat, and at a depth of about 15 feet in the alluvium at Abbeville, are the remains of the stone period,

which we know from the researches in Denmark and Switzerland to be of an age so great that it can only be expressed in thousands of years. Yet all these are subsequent to the excavation of the valley; what antiquity then are we to ascribe to the men who lived when the Somme was but beginning its great task? No one can properly appreciate the time required who has not stood on the heights of Liercourt, Picquigny, or on one of the other points overlooking the valley: nor, I am sure, could any geologist return from such a visit without an overpowering sense of the change which has taken place, and the enormous time which must have elapsed since the first appearance of man in Western Europe.

But *were* these the first settlers in Europe? M. Lartet answers in the negative, and ingeniously attempts to construct a Palæontological Chronology. (Ann. Sci. Nat. iv.; Ser. V. xv. 6217.) The great cave bear (*Ursus spelæus*) has been frequently found associated with man in caves, but its remains have, according to M. Lartet, not yet been found in the river drifts. The species is indeed quoted by Messrs. Buteux and Ravin, on whose authority it is also given by Messrs. Prestwich and Evans; but M. Lartet, after careful examination, not having been able to find the specimen originally attributed to this species, concludes that the *Ursus spelæus* perished at an earlier period, and that the *Hyæna spelæa* and the *Felis spelæa* belong only to the earliest beds of the drift. The caves, therefore, in which these animals have been found associated with the remains of men, indicate, he thinks, a still greater antiquity for the human race.

Negative evidence in Palæontology must indeed always be regarded with suspicion, but I may at least be permitted to repeat the opinion that it is not in a northern country and in a cold climate that we shall find the first traces of man. No barbarous nation would choose such an abode; civilised



man, indeed, may prefer a temperate region, favourable to the exercise both of mind and body ; but the savage will go where he can most readily satisfy savage wants ; he will not, therefore, betake himself to temperate, still less to Arctic regions, until driven there by increasing density of population.

But are we justified in concluding that even the cave men were the earliest human settlers in Western Europe ? Surely not. The whole history of Palæontology is a standing protest against such an assumption. We have not indeed as yet the materials to decide the question, but if we were to express any opinion on the subject, it would seem more philosophical to imagine that the genus *Homo* dates back to a period as ancient as the other widely-spread genera of Mammalia ; and that wherever the bones of deer, elephants, horses, oxen, and dogs are to be found, there we may fairly expect ere long to discover also the remains of man.

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ON THE HISTORIC INCIDENTS CONNECTED WITH LINCOLN  
HEATH. BY THE REV. EDWARD TROLLOPE, M.A., F.S.A.,  
PREBENDARY OF LINCOLN.

On a former occasion I brought before you "The Alluvial Lands and Submarine Forests of Lincolnshire," and now I have selected that of "Lincoln Heath." Duty compels me to cross Lincoln Heath very frequently—twice every two months, besides on other occasions : this must be done, whether winds or calms prevail—whether deep snows envelope the road, or clouds of dust rise up from it—whether the sun forces me to throw aside all superfluous covering, or the cold to hug my cloak and wrapper with grim energy. I have, therefore, seen the Heath not only often, but under all aspects, which has perhaps led me to make what I can out

of it from all possible sources as a means of cheering me when crossing its dreary expanse, and these materials I am about to place at your disposal. The Heath, as you are well aware, extends almost from Sleaford to Lincoln in an irregular pear-shaped form about sixteen miles long. Its surface is by no means flat, for in the first place it rises gradually from under the "Oxford" clay stratum on the east, and terminates in a steep ridge as it sinks suddenly towards the "lias" district on the west; but besides this, its whole surface consists of a series of gentle undulations resembling those of the Atlantic after a storm, and the straight white road topping these in succession on its way northwards, does not very inaptly represent the foamy track of some vast steam-ship, such as the Great Eastern leaves behind her in calm weather, while the shadows of the little clouds passing over the surface of the Heath, just as they do on the real ocean, add to the correctness of the comparison. But now let us see what our subject is really made of by slicing in two one of its ridges. Beneath a thin layer of light soil, from 9 to 18 inches in depth, we shall find a thick stratum of limestone, belonging to what geologists call the series of the "great oolite." At some very remote period, and during countless centuries, water was gradually depositing the limy particles with which it was charged on the clay beneath it, until it formed a coating many feet in thickness, sometimes sympathising with the undulations of the subsoil, and sometimes drifting into its deeper hollows, so as to cause a considerable degree of variation in its thickness. It has also been subjected to other subsequent disturbing causes, from the pent-up powers of the earth's deeper recesses. A remarkable example of this may be seen in the second railway-cutting between Sleaford and Grantham, where an upward thrust from below is exhibited, forming a rounded eminence beset with fissures, now filled in with earth that

has been washed in from the surface. Such is a brief sketch of the geological features of Lincoln Heath.

The first of the incidents connected with the Heath refers us to the *Celts or ancient Britons*, who, after circling away from the east through the southern parts of Europe, at length emerged from the dense forests of Kesteven, then teeming with wolves, and probably with bears and beavers, as well as with countless varieties of birds that have now long since become extinct. A British stronghold then certainly existed at Lincoln under the name of "Caer Lin," and at Sleaford several British brass "celts" or axe-heads, and one of stone, have been discovered, showing that the same people occupied this extremity of the Heath as well as the other; but, before it was brought into cultivation, many other clearer traces of the Britons were scattered over its surface, such as raised circles, indicative of their habitations, trenches for their defence, as at Scopwick, and tumuli or mounds, marking their last resting places. These, I believe, have now all been levelled by the plough, but in another part of the county I have myself had the satisfaction of discovering some eight or nine raised circles of earth, once doubtless topped by British huts, viz., in the parish of Tetney; and from a spot still nearer, viz., Billinghamay, I have secured a brass sword of the usual leaf-shaped form used by the Britons and other early peoples. In vain did the British tribes of Lincolnshire war against that great invading nation which eventually swept over the face of this fair island and secured its dominion, and which will constitute the second incident of the Heath, and connected with "Rome." It was probably rather more than one hundred years after Cæsar's first invasion of England before Lincolnshire began to feel the hard yoke that had previously been experienced in the south, but at length the firm tramp of the 6th Roman Legion was heard marching from one extremity of this

county to the other, with victory always in front, and nothing but slavery in the rear. Then a large colonial city arose at Lincoln, termed "Lindum Colonia;" and here, on the southern extremity of the Heath, was a smaller settlement, chiefly on the site of the Old Place, where at times many Roman coins have been found, and also others near the site of the Castle. But the Heath itself was scored with the impress of the Roman rule, the evidences of which remain to the present time.

Near Caistor, in Northamptonshire, one of the four great Roman roads, "the Ermin-street," was divided into two, the one represented by the modern road from Deeping to Bourn, but branching off at Graby bar is now called Mareham-lane, and was formerly continued past the Old Place, crossing the Heath at Coggleford Mill, Leasingham Moor, and thence passed along the eastern edge of the Heath by Ruskington, Ashby, Blankney, Metheringham, Dunston, Nocton, Potterhanworth, and Branston to Lincoln. In the parish of Ashby a tessellated pavement was discovered some years ago, forming the flooring of a Roman house, and much Roman pottery at Potterhanworth when some building was going on there under the direction of the late Incumbent. This, however, was only a minor or occupation road, the great military road forming the main branch of the Ermin-street, following the present line of the North road from Stamford to Colsterworth over Witham Common, by Ponton, Cold Harbour, and Londonthorpe to Ancaster, and thence over the Heath, in a straight northerly direction, to Lincoln. At Ancaster was a permanent military station of the usual square form, surrounded by a deep ditch, and a bank of corresponding height. Here very many Roman coins have been found, and on one occasion a mass weighing two stones on the premises of Mr. Eaton; but the most remarkable reminiscence of the Romans there is a group of the "Dea

Matres," or beneficent local presiding deities, who were supposed to bring good fortune to those that honoured them. This piece of sculpture was found in Ancaster church-yard, with a small incense altar before it, just as it was left by the Romans. Through Ancaster and over the Heath hurried the Emperor Constantine on his way to York, for the purpose of joining his father, Constantius Chlorus, in that city, then called Eboracum, and either then or on his return a complimentary inscription was set up by the way side, just as we now erect arches of evergreens to celebrate the advent of royal or other popular personages to our respective localities or towns. But at length the power of the Roman Empire was shaken, and all its life's blood was, as it were, forced to retire from its extremities to sustain its central vitality; and Britain, feeling her weakness when deprived of her bold and hardy masters, saw the last Roman Legion leave her shores with regret, knowing that other invaders were ready to pour in upon her soil, with whom our next incident is connected, viz., "the Saxons." They had circled away from Asia like the Celts, but took chiefly a more central course, thus peopling Germany, until they arrived on the shores of the German Ocean and the Baltic. Thence three tribes, the Angles, the Jutes, and the Saxons, made incursions upon our shores before the departure of the Romans, and after that event gradually got possession of nearly the whole of England, carrying on a war of eradication against the poor Britons, who at length were alone to be found in the hills of Cumberland, the fastnesses of Wales, and the wilds of Cornwall. Of these the Angles possessed themselves of Lincolnshire, and their traces are still revealed both at Lincoln and about Sleaford and Ancaster: no doubt then but what the Heath witnessed the marchings and countermarchings of that people many a time, although I am not aware that any of their traces

have been actually discovered upon its surface. I could have brought some of their weapons for your inspection, but these are much decayed; they consist of swords, spear heads, knives, and the large bosses of their shields. These were found in making the railway hence to Boston, very near the spot where the line crosses the town street; and although it was reported to me that "some of Oliver Cromwell's old soldiers had been found there, *bagonets* and all," I soon had the pleasure of finding out that these relics were a thousand years older than had been anticipated, and that from them might be gathered what was the character of the weapons used by our Anglo-Saxon forefathers. One object, however, that was found at Ancaster, is of undoubted Saxon make, and probably a "coffin," for when discovered it contained the remains of a human being, whose body had been burnt—in fact all that could be collected from the funeral pile; but amongst these was one little object of considerable interest, namely, half of a bone hair comb, in a perfect state of preservation, and as I have found similar half combs in other Saxon funeral vases in this vicinity,—this by no means being a solitary instance of the kind,—I believe that the other halves of these were preserved by the sorrowing relatives of the deceased as reminiscences, because they were certainly never deposited in the urns whole, and because the fractures are as fresh as on those days of mourning when they were originally made.

A different people now rules in England over its Saxon population—the "Norman Conquest" has taken place; but as William I. never passed over the Heath, although he was at Lincoln, we can not raise up the shadow of his memory in connection with our present subject. Pass we on then to the year 1200, when a remarkable sight was witnessed on the Heath. It is nearly the end of November (the 23rd), and precisely 662 years ago. The Heath is veiled with a dense

fog, as though it were covered by a pall, whose folds thicken as they sink into the hollows beneath it. But I see one streak far darker than any other in the Ancaster valley, and it appears to be moving upwards along the High dyke! Surely that can not be a fog, for I see lights sparkling in the midst of it? No; it is a funeral procession—a great and good man has died in London, and now his body is on its way for interment at Lincoln; last night it rested at Ancaster; now a solemn chant rolls mournfully over the Heath northwards of that point, and from the midst of kneeling groups of villagers I see a long procession of priests and choristers filing onwards, headed by one bearing a golden crucifix, veiled with their black drapery; next are four bearing lighted lanterns fixed on the ends of poles, then another priest carrying a veiled silver crosier or Bishop's staff, and then follows a coffin on an open carriage covered by a black pall, ornamented by one large silver cross reaching from one end of it to the other, and lastly more ecclesiastics terminate the procession. Who is it that is thus honoured, and for whom is the largest bell at Ancaster now tolling? It is for Hugh, the celebrated Bishop of Lincoln, Hugh of Avalon, near Grenoble, who was specially invited by Henry II. to come over to England for the purpose of founding the first Carthusian Monastery at Witham, and was afterwards consecrated Bishop of Lincoln; Hugh—who boldly resisted wrong when it was attempted even by his Royal patron and his successor, the impetuous 1st Richard; Hugh—the builder of a great part of the Cathedral at Lincoln, and who laboured with his own hands at the work; Hugh—who was regarded as a saint by those who lived in his days, and as one who could work miracles. A King is waiting to aid in carrying his body to the grave when it reaches Lincoln, and he shall be assisted by three archbishops, fourteen bishops, more than a hundred abbots, and innumerable earls and barons. These shall place the

body reverently in the grave before the altar of St. John the Baptist, on the north side of the Cathedral; but it will not rest there, for Hugh's reputation as a Saint shall rise; and 80 years later, in the presence of another King, his body shall be placed in a silver coffin, and that beautiful feature of the Cathedral, commonly called "Angel Choir," shall be built, chiefly for the purpose of containing this precious deposit; nor shall the brother of so holy a man be forgotten, for in the town of Sleaford two days after the burial of Bishop Hugh, will King John confirm to Peter de Avalon two Knight's fees at Histon, in Cambridgeshire.

"*The Templars.*"—The next Heath view brings us to the date 1338, when Edward the 2nd had lately become King of England. It is a cold windy January morning, and there is snow upon the Heath; already this lies deeply in the hollows, is curling over like foam from the sides of banks, and is tailing away in light drifts from every bush; but yet at a point upon the Heath, some six miles northwards of Sleaford, there is a stir among men, and I hear a clinking like that of some small streamlet imprisoned beneath the ice, yet gurgling onwards. But it is no water that makes that noise: it is produced by countless little steel rings clashing against each other, and now I see its origin before me. First a score of archers ride on, and then a reverend personage follows, preceded by one bearing a white wand; and then a long train of knights clad in chain armour from head to foot, covered with gaily emblazoned surcoats; but some only of these are fully armed, the others wearing white mantles with a red cross upon the left breast, bearing no weapons; and these are followed by a considerable number of men-at-arms. What means all this? It is John de Cormel, the Sheriff of Lincolnshire, aided by twelve knights and their forces, who has just seized the Knights Templars at Temple Bruer, and is carrying them off to the Claxgate prison at Lincoln. That functionary had first been sworn by



one of the King's clerks to obey all and every such commands as he may receive from his Sovereign, and then a writ was instantly served on him ordering him to capture all the Knights Templars at their establishment upon the Heath suddenly and unexpectedly. William de la More, therefore, the last Preceptor of Temple Bruer, and at the same time the last Grand Prior of all England, is gazing now for the last time upon the circular church and the great pile of buildings that hitherto belonged to his order; his eye is resting fondly awhile upon one small square tower within which was his private chapel before he leaves all behind—that tower that still remains, and serves to indicate the site of this once great Templar Preceptory. Originally the Templars constituted an order, founded in 1118, that was sworn to defend all pilgrims on their way to Jerusalem; and as the Abbot of the convent of the Temple afforded them some accommodation in the first instance, they from that circumstance were called “Templars.” At first the order was very poor, but it soon became so popular that lands and money were showered upon it from all directions, until its wealth led to its corruption and to jealousy on the part of the nobles of England, as well as on that of the 2nd Edward. Temple Bruer was founded by the Lady Elizabeth de Cauz (temp. Henry 2nd), and in after days possessed lands or tenements in almost all the surrounding parishes, amounting together to upwards of 10,000 acres. For sixteen years will King Edward keep these lands thus wrested from the Templars, and then he will bestow them upon another very similar order—the Hospitallers, or Knights of St. John, who after repeated quarrels about the respective boundaries of their lands with the Delalaunds of Ashby, will in their turn be compelled to disgorge their possessions at the spoliating command of Henry 8th.

“*John, King of France.*”—And now let us suppose that fifty-one years have rolled away since the dissolution of the

Templar establishments, but that we are still upon the Heath, near the High-dyke. It is the 4th of August, 1359, a period of the year when sportsmen are now preparing for campaigns against the grouse on our northern moors ; but England had three years before the above-named date captured other game, and now I see the most precious of those spoils upon the Heath. First advance two local hired guides on horseback, then twenty-two archers, followed by four knights in conical helmets, chain gorgets, and plate armour covered with gaily emblazoned surcoats. But then appear three remarkable personages ; the one on the right, in full armour, I perceive from his heraldic bearings to be William Baron d'Eyncourt ; but who are the other two ? The one, on that noble white horse regally trapped, clothed in violet velvet trimmed with ermine and relieved by a wide hip-band of gold set with costly gems, is John the Good, the captive King of France, and that fine spirited lad who rides upon his left, clad in light blue velvet powdered with golden fleurs de lys, is his son Philip, who, like the steed he bestrides, is impatient at being compelled to trot gently along in his place, when both feel the firm but elastic turf of the Heath beneath them. Let him have patience, however, for presently he shall be free once more, and shall, as Philip the Bold, become the founder of the second Ducal House of Burgundy, without those English men-at-arms behind him, with which the present procession closes. In vain was the personal bravery of the King and his son exhibited on the battle-field of Poitiers, when he with 60,000 men was defeated by 8,000 English ! Fighting to the last, he and that young Prince now beside him were nearly smothered by the crowd of their enemies eager for their capture, but at length yielding to Denis de Morbec they lived to grace the triumphant entry into London of their great victor the Black Prince ; and now they must abide awhile at Somerton Castle, and the King must beguile his captivity with books, music, chess,

and backgammon, the Prince with hawking and coursing on the Heath. I could tell you many anecdotes of their doings in this county, having made myself intimately acquainted with their habits, but I will mention only one to show how different were the manners of the 14th century from those of the 19th. One day the King's Lincoln tailor, Tassin de Breuil by name, came over to Somerton with a new suit, or to receive orders, or at all events on business, when the Royal captive said, "Mr. Tassin, I want a coat;" but instead of ordering his measure to be taken, he added, "Sit down Tassin, and I will play you a game at backgammon for one;" so the King and the tailor sat down to the game, and his Majesty of France most properly lost it, for there still stands in the Royal accounts the following item:—"Lost, at backgammon, to Tassin de Breuil, a 'cote-hardi,' *i. e.* an overcoat!" But while we laugh, let us not forget that noble act of King John of France, who after his return to his own domains, upon the flight of some of the hostages rendered up to England as security for his promised ransom, immediately once more crossed the Channel and delivered himself up to Edward of England; nor one of his noble sayings in connection with that act: "If justice and good faith should be banished from all the rest of the world, these ought ever to be found in the hearts as well as on the lips of Kings."

"*Funeral of Richard Plantagenet, Duke of York.*"—It is now a hot day in July (the 27th), in the year 1466, and again a grand funeral procession is crossing the Heath, but on this occasion it is coming from Lincoln southwards towards Grantham, where the mourners will rest awhile; and strange to say this is the funeral of one who has been dead for six years. Two knights in plate armour, covered with black surcoats, advance first, followed by a troop of horse; next a long train of priests follow, one of whom bears a veiled crucifix, and others massive wax lights, while they chaunt

a solemn dirge for the dead ; then is borne a banner emblazoned with the Royal arms, surmounted by a Ducal coronet, and then follows the coffin raised upon a lofty car drawn by seven horses, and covered by a canopy of black, powdered with crowned initials in silver ; but the most conspicuous ornament of this car is a figure of an angel in silver placed in front of it. Does this express a hope that he whose body it overshadowed had obtained a crown immortal ? Not so ; but that had he lived he would have worn an earthly crown—that of England ; for it is the remains of Richard Plantagenet, Duke of York, who was slain at the battle of Wakefield, that are now being transported from St. John's Priory, at Pontefract, to their final burial-place at Fotheringhay. But who follows as chief mourner ? One whose face would have been handsome but for its villanous expression, and whose figure we can at once see is deformed, notwithstanding the drapery he has skilfully thrown around his person : this is Richard Duke of Gloucester, who shall be King, after he has become the murderer of his brother's children ; and as Richard 3rd, of evil memory, shall lose his kingdom and his life on Bosworth Field. Such was one of the reminiscences of the fearful wars of the Red and White Roses ; from the effects of which this county was comparatively speaking tolerably free, although one of my own name, I regret to say, proved a fearful scourge to it immediately after the battle of Wakefield, to which I have already alluded. The victorious Lancastrian army, to whom Queen Margaret had promised the spoil of all the counties south of the Trent, was under the command of Sir Andrew Trollope, whose terrible doings are thus described by the chroniclers Stowe and Speed, and the historians Hollingshed and Peck :—“ Andrew Trollope, Grand Captain, and as it were leader of the battle, with a great army of Scots, Welshmen, and other strangers, besides the northern men, destroyed the

towns of Grantham, Stamford, Peterborough, Huntingdon, Royston, Melbourn, and in a manner all the towns by the way unto St. Albans, sparing neither abbeys, priories, or parish churches, but bore away crosses, chalices, books, ornaments, and other things whatsoever was worth the carrying, as though they had been Saracens and no Christians."

"*Henry VIII.*"—A very different view is now revealed. 'Tis something like a bridal party, rather than a funeral, that now appears on an early August day when the short scanty herbage of the Heath is brown from the heat, and its distant undulations are apparently quivering beneath the rays of the sun, the very rabbits with which it abounds so plentifully declining to appear upon its surface until the shadows of its scattered bushes and numerous ant-hills begin to lengthen as the day draws on. And now a blaze of scarlet flashes forth to add to the heat of the scene, for 50 men in short coats of that brilliant hue, trimmed with black and gold, advance on horseback with grand halberts in their hands, rich like themselves with scarlet and gold. Then follow other personages glittering with jewels, and then come a most remarkable pair—the one upwards of six feet in height and bulky beyond proportion, mounted on a steed of commensurate size: his features were probably once good, but now his vast expanse of face is scarcely relieved by his short light-red hair, and although his complexion is naturally exceedingly fair, his face at present is of one uniform deep rosy hue, for he is exceedingly hot, and his steed fully sympathises with him in that respect. His vest is of white satin slashed and puffed, and rich with embroidery of gold and small pearls: his short coat is of murrey-coloured velvet, edged with minever: round his neck is a wide jewelled collar of immense value, and on his head is a flat black velvet cap, ornamented with a curling white feather and a cluster of diamonds. His expression indicates a strong will and an

imperious temperament, but his face is now beaming also with unmitigated delight as it turns towards his companion, who is in every respect his opposite. This is a pretty but a very little lively lady in her first youth, who might well be the daughter, but really is the wife of him who rides beside her. A semicircle of large pearls edges her head-dress in front above her plainly-parted hair, and this terminates behind in a veil of silver gauze that floats over her shoulders: her tightly-fitting robe is of blue satin decorated with single diamonds round the top, in conjunction with golden embroidery: her hanging sleeves are trimmed with minever, and round her neck is a collar of the purest pearls, interspersed with great diamonds. The large man, I need perhaps scarcely say, is Henry VIII., the little lady, Catherine Howard, who has been his fifth wife for just a year. Henry is now on his way to York for the purpose of meeting there his nephew, the King of Scotland. He has held a Council at Sleaford, and will dine at Temple Bruer in the half-ruined buildings of the old chivalrous order of the Templars; and he will enter Lincoln still more brilliantly habited, as will the Queen. After a while he will again cross the Heath on his return, coming from the residence of Wymbish, of Nocton, to this place, where he will receive the Portuguese Ambassador; but within six months that young gay smiling wife of his, on whom he now gazes with such rapture, will find a grave within the precincts of the Tower, for at his own desire her head will have been struck off, and she will have shared the same dreadful fate that was experienced by one of her predecessors—Ann Boleyn.

“*Charles I. and the Civil Wars.*”—And now let us suppose that another century has passed away, and let us look upon a third cavalcade crossing the Heath towards Lincoln, but from a different point, namely, Grantham. First a single trooper appears in a steel cap, back and breast plates,

mounted on a thick-set steed; then two more; and next half a dozen trumpeters, to whose instruments are attached small banners embroidered with the arms of England and France. But who is he that now advances? A personage of middle size, but commanding mien and handsome features; on either side of whose pale lofty brow, and melancholy features, terminating in an auburn pointed beard, hang waving curls of dark brown hair until they rest upon his rich lace collar; his person is nearly covered by a large black velvet cloak, relieved only by one glittering ornament on the left shoulder, but when this envelope partly opens, a still more brilliant decoration is seen beneath, hanging from his neck by a wide blue riband. It is Charles I. on his way to Lincoln for the purpose of interesting the people of this county in behalf of the Royal cause. Let him then pass by—let his few attendant nobles follow—let the captain of the guard in his suit of half-armor and his sword drawn, trot on; let his troopers two after two follow him, with their steel caps glittering in the sun, and let us mark the issue of the King's mission. The citizens of Lincoln will profess to be loyal, but next year their loyalty will be sorely tried—the war between the Parliament and King Charles will have begun, when Lincoln will declare for the former, and Grantham for the latter. Then the Parliamentary Commissioners will hurry over the Heath to seize the Grantham Corporation plate, and bands of their party will follow for the purpose of plundering such gentlemen's houses as may be supporters of the royal cause, when poor Mr. Dymocke's house, near Metheringham, will meet with peculiar attention at their hands, because he is the Royal champion, and nothing will be left in it, the servants' clothes, down to the poor cook's working dress being ruthlessly carried off. But a change is at hand: Grantham has been seized by Col. Cavendish for the King, where he is joyfully received, and Belvoir Castle is occupied by Sir Peregrine Bertie; in vain does the

Parliament party send a detachment across the Heath from Lincoln, under Major Drake, who is forced to retire, and is imprisoned on his return on account of his failure; but a second attack, under Lord Grey, is successful, and Grantham changes masters for a time. Then the war takes another turn, and Colonel Cavendish (March 23rd, 1643) again captures Grantham, thus enabling the Judges to follow, who hold an assize there for the trial of offenders, and especially of those who had taken a part in the plundering before alluded to. And now Sleaford comes on the tapis, for thence a Parliamentary force of 800 horse under the Earl of Lincoln, Lord Willoughby of Parham, and 200 dragoons under Hotham attempt to take Grantham; but their intention is known, Cavendish is on the alert, he has laid an ambush in Belton-lane, and there his foes begin to drop by scores, so that they fly—first to Ancaster—fighting as they fly, and thence disperse themselves wildly over the Heath; but a third of the force is captured, and amongst these are the two Members for Boston, Sir Anthony Irby and William Ellis. But once more the fortune of war changes. A regiment has been raised in Huntingdonshire, and its captain now advances into Lincolnshire, takes Croyland, that had been previously long held by Captain Welby, and fights the Royalist troops on the same ground in Belton as before, but now with most complete success, so that he is able to send the following letter to the Metropolis, directed to William Lenthall, the then Speaker of the House of Commons—“ Sir: God hath this evening given us a glorious victory over our enemies; they were, as was informed unto me, 21 colours of horse troops, and three or four of dragoons. It was late in the evening when we drew out our forces, consisting of about twelve troops, whereof some of them so poor and broken that you shall seldom see worse. With this handful it pleased God to cast the scale of victory on our side. For often we had stood a little above musket



shot, the one body from the other ; and the dragoons having fired on both sides for the space of half an hour or more ; they not advancing towards, we advanced to charge them, and advancing our whole body after many shots on both sides (but their bullets still flew over our heads and did us no harm), we came on with our troops a pretty round trot, they standing firm to receive us ; but after about half an hour in that posture, and some great shot spent on both sides, our men most violently and resolutely marched up and fiercely charged on them. Whereupon their hearts instantly failed them : a spirit of trembling came upon them, and they were immediately routed and ran all away, and we had the execution of them, two or three miles out at least ; and I verily believe that some of our soldiers killed two or three men apiece in the pursuit. The true number of men slain we are not certain of, but by creditable report, and estimate of our soldiers, and by what I myself saw, there were very little less than a hundred slain and mortally wounded, and we lost but two men at the most on our side. We took forty-five prisoners, besides divers of their horses and arms, and rescued many prisoners whom they had lately taken of ours, and we took four or five of their colours, and so marched away to Lincoln." And who do you think was the writer of this letter, and whose name is subjoined?—Oliver Cromwell!

“*The Dangers of the Heath,*” which forms the concluding portion of my subject. And now are you prepared for a scene of horror,—for a fearful contest for life on the heath between a knight and a witch? Long had one of those dangerous creatures haunted this locality some centuries ago (so says the legend) ; sometimes she was seen cowering over a fire emitting a blue unearthly light, and sometimes flitting bat-like through the shades of night intent on mischief towards man and beast, when a certain knight made a vow that he would rid the heath of so great a pest.

When watering his horses, therefore, at that little pond at Ancaster formed out of a portion of the old Roman ditch, and now shaded by a widely spreading willow, he prayed that the horse best calculated to bear him safely during his coming adventure might give some token to that effect; upon which a grand steed, termed "Bayard," tossed up his head wildly and neighed again and again. On that horse then is our hero of the moment now mounted and on his way to the witch's usual place of resort. Soon he sees a mysterious light proceeding from a deeply-recessed hollow in the rock, whence rushes out a haggard creature with glowing yellow eyes, long grey hair streaming in the wind, and bony hands and feet armed with pointed claw-like nails, who deals him many a buffet. In vain does he cut at his assailant with his trusty sword, for she is like a gutta-percha figure, and his weapon is only blunted by his blows, until at last, with one tremendous blow, he succeeds in wounding her, but at the same time snaps his sword in two! Then, maddened by pain, the witch has sprung upon poor Bayard's back behind the knight, intending to tear him from his horse, but the good steed flies, and still faster as the witch's claws deepen in the shoulders of the knight and the flanks of the horse; when happily the former calls to mind a cross road near at hand, and if he can but reach this he is safe. He pulls the left rein, therefore, and away away bounds Bayard in that direction, until with one prodigious effort he clears the point of junction, and the witch falls dead before the leap is accomplished. The spot where this scene is said by tradition to have occurred is still called "Bayard's Leap." But real deeds of violence have been many times perpetrated on the heath. One was long recorded in the nave of Lincoln Minster to this effect: "Here lies John of Ranceby, formerly Canon of this church, who was with malice prepense nefariously slain on the 'Haythe' (spelt thus) in the year of our Lord 1388 by William ———. God have mercy upon

his soul." The surname of the murderer had been effaced either by accident or design. In latter times it was men's purses rather than their lives that were in great danger on the heath—from highwaymen, by which it was infested. Even in the last century the Windmill House in a parish called Leasingham, I am told, was a favourite place of assemblage for these gentlemen of the road, as they were termed, and that little hollow on the Lincoln road in Dunsby parish, now marked by a row of cottages, was the most common scene of attack upon travellers. But there were natural dangers arising from the character of the heath in olden days. When no well-kept roads traversed it, and it could boast of still fewer houses upon it than at present, poor folks were often lost upon its dreary expanse, and some died from prolonged exposure to cold and wind and snow on the heath. In my own parish register are several evidences of such misfortunes; within a space of 53 years 9 poor travellers having apparently just reached Leasingham, on the southern confines of the heath, to die. They run as follows in the list of burials:—"Elizabeth Ping, a stranger;" "Susanna Ellis, a traveller;" "Dolton Pickworth, a poor stranger;" and sometimes even still shorter, such as "A travelling woman," or "A travelling man," without a name at all, yet these speak of unknown sufferings as well as of unknown persons. Two remarkable instances of thank-offerings for preservation from starvation on the heath still throw light upon this point: the first is connected with Blankney, where a small field was left to the parish by a female whose life had been saved through the tolling of its church bell, on condition that that bell should be rung every evening at 8 o'clock. The other case is connected with Potterhanworth, where 23 acres of land, called Culfrey-lands, were left by a traveller who had been rescued from the heath by hearing the sound of Potterhanworth church bell, on condition that that bell should be tolled every evening, at

10 minutes to 7, by the oldest parishioner who had not received parochial relief, and who was to have the proceeds of the land as his fee. But at length a greater benefactor was found in the person of Sir Fras. Dashwood, who erected Dunston Pillar, and placed upon its summit a large glass lantern that was lighted every night for the purpose of guiding benighted travellers on their way across the heath. And no doubt it served that purpose well, but yet it did not always enable people to get to their own homes in safety, especially when they had been carousing at the Green Man club, formerly much frequented by the gentry of the neighbourhood, and when far more liquor was unhappily consumed than now, for it is recorded that two of these on their way towards Lincoln, after they had been assisted into their carriage, and their coachman had been previously assisted into his box, thought it prudent to give him the following directions:—"John, be sure you keep the pillar light upon your right, and then we shall get home safe," before sinking into sleep. But when they awoke and found the sun was rising, and that they were still near the Pillar, and still in their carriage instead of being in their beds, one of them called out, "Why, John, where are we? Upon which John answered, "Oh, its all right, sir, the light is still upon my right;" and so it was, for he had been circling round it all night, and was not much nearer home than when he began to drive.

And here I will conclude, happy if I have been able to add anything to your stock of information respecting the Historical Incidents connected with a large and important district in an adjoining county.

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## GEOLOGICAL EXCURSION.

It having been suggested that if the members of the Geological and Polytechnic Society of the West Riding

of Yorkshire, were to follow the example of those of the Manchester Geological Society, and hold occasional field-days, for examining the Geological peculiarities of the different districts in the Riding, much information of an important and practical nature might be obtained. An Excursion was, therefore, arranged for Wednesday, September 3rd, 1862, to assemble in the Museum of the Philosophical and Literary Society of Halifax, at 10 o'clock in the morning, to which the members of the Manchester Geological Society were invited by circular. The meeting of the associated Societies accordingly took place at the appointed hour, but owing to the unfavourable state of the weather was not so numerously attended as was anticipated. There were present Messrs. E. W. Binney, F.R.S., Horsfall, Parker, Hodgson, F.G.S., A. Knowles, and Atkinson, from Manchester; the Chevalier W. P. Barbel de Morny, Captain of the Imperial Corps of Mines of Russia; A. H. Green, F.G.S., of the Geological Survey of Great Britain; Pickup, of Burnley; Chatwood, of Bury; John Waterhouse, F.R.S., Dr. Alexander, Leyland, and Ward, of Halifax; S. Baines, of Lightcliffe; H. Briggs, of Overton, near Wakefield; P. O'Callaghan, B.A., Thomas Wilson, M.A., and H. Denny, of Leeds; Edward Brooke, Jun., of Huddersfield; R. Carter, C.E., J. Richardson, C.E., of Barnsley; J. Richardson, of Southowram; and Ezra Woodhead, of Low Moor.

After examining with much interest the collection of fossil Coal Plants belonging to the Museum of the Halifax Philosophical Society, and some remarkably fine specimens peculiar to the Halifax bed, sent for exhibition by different gentlemen in the neighbourhood, the party proceeded to inspect the Swan Banks Colliery, which is situated on the side of a hill overlooking the town of Halifax. Here two beds of Coal crop out, known as the soft and hard beds, the former 1 foot 5 inches in thickness, and lying about 45 yards above the millstone grit; the latter 2 feet in thickness, and

25 yards above the soft bed. The black shale composing the roof of the second seam, contained numerous examples of goniatites, nautilus, orthoceratites, aviculo-pecten, &c. From the position of the seams of coal between the upper millstone grit and the Elland flag stone, which is an equivalent of the upper or upholland flags of the Lancashire coal-field, the Manchester Geologists recognised them as identical with that part of the lower or Rochdale series of Lancashire, an interesting fact as connected with the coal-fields of the two counties.

Mr. Richardson's extensive collection of Yorkshire coal plants at Southowram was visited and inspected with much interest and attention by the party; and from thence they proceeded to the well-known flagstone quarries at *Southowram* and *Hipperholme*, where some extraordinary large flags were in process of being lifted out or raised from their bed. Here, however, the company could not linger long, having been kindly invited to partake of a sumptuous repast at one o'clock, considerably provided for them at Holroyd House, the hospitable mansion of Mr. and Mrs. Baines. At two o'clock the party started by rail for Low Moor, where they were divided into two parties by separate attractions. The inspection of the well-known local coal seams and the extensive Ironworks of the Low Moor Company; one of these parties went down under the guidance of Mr. Woodhead, and examined the better bed and the black bed coal seams, with their accompanying bands of ironstone; the other was politely accompanied over the Ironworks by L. Wickham, Esq., one of the proprietors, where the casting of cannon and the various processes of the manufacture of the celebrated Low Moor Iron were exhibited and explained to the visitors, who then adjourned to the Railway Hotel, where dinner had been provided, which brought the day's proceedings to a highly satisfactory conclusion.

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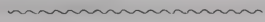
# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE FIFTY-NINTH (THE ANNUAL) MEETING, HELD IN  
THE PHILOSOPHICAL HALL, LEEDS, ON THURSDAY, MAY 28TH, 1863,  
AT THREE O'CLOCK IN THE AFTERNOON.



P. O'CALLAGHAN, Esq., B.A., in the Chair.

James Hamilton Richardson, Esq., was elected a member.

Mr. W. S. Ward, the Honorary Secretary, read the  
annexed financial report for the past year :—

### STATEMENT OF RECEIPTS AND EXPENDITURE

OF THE GEOLOGICAL AND POLYTECHNIC SOCIETY OF THE WEST RIDING OF YORKSHIRE.

From May 1st, 1862, to May 3rd, 1863.

DR.		£. s. d.	CR.		£. s. d.
By Subscriptions—			Messrs. Baines, on account, for		
From 1 Member for 1860	.....	0 13 0	Printing	.....	20 0 0
" 31 "	1861	20 3 0	To the Philosophical Society for		
" 83 "	1862	53 19 0	Rent of Museum Room	.....	20 0 0
" 5 "	1863	3 5 0	" Collecting Subscriptions	.....	2 9 0
			" Lithographing & Printing Plates	.....	3 15 0
			" Postage Stamps	.....	0 17 0
			" Subscription to the Palaeontological Society	.....	1 1 0
			" Assistant Secretary on account	..	29 13 0
			" Sundry Accounts	.....	0 5 0
		<u>£78 0 0</u>			<u>£78 0 0</u>

The following noblemen and gentlemen were elected as the Officers and Council for the ensuing year.

### President.

THE EARL DE GREY AND RIPON.

### Vice-Presidents.

THE DUKE OF LEEDS.	EDWARD AKROYD, Esq.
THE EARL OF EFFINGHAM.	JOHN WATERHOUSE, Esq., F.R.S.
THE EARL OF DARTMOUTH.	W. B. BEAUMONT, Esq., M.P.
EARL FITZWILLIAM.	E. B. DENISON, Esq.
LORD WHARNCLIFFE.	LORD HOUGHTON.
LORD LONDESBOROUGH.	J. SPENCER STANHOPE, Esq.
VISCOUNT GALWAY.	G. WENTWORTH, Esq.
VISCOUNT MILTON.	J. G. MARSHALL, Esq., F.G.S.
RT. HON. SIR C. WOOD, M.P., BART.	THOMAS WILSON, Esq., M.A.

### Council.

HENRY BRIGGS, Esq.	R. CARTER, Esq., C.E.
DR. WM. ALEXANDER.	T. W. EMBLETON, Esq.
H. C. SORBY, Esq., F.R.S.	REV. DR. BURNET.
HENRY HOLT, Esq.	DR. SCHOLEFIELD.
BENTLEY SHAW, Esq.	WM. CHADWICK, Esq.
T. P. TEALE, Esq., F.L.S.	SAMUEL BAINES, Esq.

### Secretary.

WM. SYKES WARD, Esq., F.C.S.

### Honorary Curators.

J. G. MARSHALL, Esq.	T. W. EMBLETON, Esq.
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### Local Secretaries.

H. C. SORBY, Esq., Sheffield.	BENTLEY SHAW, Esq., Huddersfield.
HY. BRIGGS, Esq., Wakefield.	RICHARD CARTER, Esq., Barnsley.
DR. ALEXANDER, Halifax.	THE REV. DR. BURNET, Bradford.
DR. SCHOLEFIELD, Doncaster.	DR. PALEY, Ripon.

The following Papers were then read :—

ON THE RISE AND SUPPRESSION OF THE TEMPLARS IN YORKSHIRE. BY THE REV. JOHN KENRICK, M.A., F.S.A., OF YORK.

[As this paper is about to be published *in extenso* by the Yorkshire Philosophical Society, before whom it was originally read, only an abstract of it is here given.]

The object of this paper being the local not the general history of the order of Templars, I shall not enter into the circumstances of its foundation, but confine myself to its



extension in Yorkshire, with especial reference to the neighbourhood of the place in which we are assembled.

In this county they had been enriched by grants from several noble houses—De Brus, Mowbray, de Ros, and Lacy. Their lands in the North Riding they had derived chiefly from the two first, those in the West from the two last. Robert de Ros, the second lord, brother-in-law to Walter Espec, the founder of Rievaulx Abbey, gave them Ribston, Hunsingore, Cattal, and Walsford. The De Lacy's, lords of the Honour of Pontefract, whose possessions extended not only through many parts of England, but to Wales and Ireland, were great benefactors to the order. From them they derived the church of Kellington, Whitkirk, Skelton, and Newhusum, now Temple Newsome. William and Roger de Hastings gave them the lands of Hurst, near Snaith, which still retain the name of Temple Hurst, and some interesting remains of the house and chapel.

England was divided under the Templars into a number of Balliæ, Eborascire being one of them; and in places where their possessions were important they had preceptors, *i.e.*, receivers of their rents and revenues, answering to the commendators, or commanders, in the continental countries. Their residences were called preceptories. Ribston, Temple Hurst, and Temple Newsome were preceptories, and the last mentioned was the most considerable of their establishments in Yorkshire. Traces of their dominion are still found in Leeds. The bridge leading to Temple Newsome is called Timble, (that is according to Thoresby) Temple-bridge. Many houses exhibit the cross pattee of the Templars, as a proof of their exemption from the liability to grind at the soke-mill.

In looking through the survey of their Yorkshire possessions, one is struck with the variety and minuteness of their sources of revenue. Besides bovates and carucates of land,

we find mention of tolls, culture from wind and water mills, advowsons of rectories, houses and tenements, services from tenants in ploughing and sheep-shearing. Tributes of fowls and eggs, and sucking-pigs are not overlooked. They had also valuable immunities, being exempted from all aids to the crown and all local dues, such as lastage and stallage, and even from tithes. In the thirteenth century, which may be considered as the culmination of their prosperity, they are said to have possessed 9,000 manors and 15,000 lordships in various parts of Europe. They were also a body of considerable political importance; the master of the Temple held his head high among the aristocracy of the kingdom, and was summoned to parliament along with the abbots and priors.

Yet in the midst of this apparent prosperity, causes tending to their ruin were secretly at work. In the course of this century, three Crusades had been undertaken, all without success, and the recovery of the Holy Land had been shown to be hopeless. The wealth of the Templars had filled their hearts with the pride which is the forerunner of destruction. No order in the state had any sympathy with them. Their haughty manners and their contempt for the humbler classes made them obnoxious to the people; the clergy were jealous of their privileges, which sometimes interfered with their own spiritual monopoly. Sovereigns dreaded their power. But their great source of danger was their wealth, which tempted monarchs who wanted money for their own purposes of pleasure or ambition. Rumours too were in circulation, probably not altogether unfounded, that immoral practices and infidel doctrines were prevalent among them.

Their fall was brought about by the co-operation of the Pope Clement V. and Philip IV. of France. In consequence of what is called the Great Schism of the West, the Papal See had been removed to Avignon, and the Pope was the creature of the French king. In the Council of Vienne,

which begun its sittings October 1st, 1310, a variety of charges were brought against the Templars. The jurisprudence of that age was conducted upon principles so contrary to justice and humanity that it is impossible to decide on the amount of their guilt. They were submitted to torture, under which many expired protesting their innocence; many confessed their guilt, some of whom revoked their confession, protesting that it had been wrung from them by extremity of suffering. The order was suppressed, and their possessions awarded to the Knights Hospitallers, who however obtained only a small part of them, and that not without much remonstrance from the Pope to the King of France.

Philip wrote to Edward II. of England, calling on him to arrest the Templars throughout his dominions. Edward replied to the Pope, maintaining that they had not laboured under any imputation either of unsound doctrine or corrupt morals. On the receipt of a letter from the Pope however, informing him of the result of the trials in France, he issued an order for their apprehension and the sequestration of their goods. This order was carried into execution, and Papal commissioners were sent to preside at the trial. The proceedings of the tribunal in London may be seen in Mr. Addison's work on the Knight-Templars. Grenefeld, who was then Archbishop of York, had just returned from Lyons, where he had received consecration from Clement V., and he summoned a provincial council which met at York, on May 19th, 1310. All the Templars who could be laid hold of in the northern counties had been seized and were kept in custody in York Castle. The preceptor of Temple Newsome was among them. Their depositions had been taken by the Archbishop, assisted by the Bishop of London, and were read before the Council, which consisted of the bishops of the province, the heads of the religious houses,

and some learned doctors and lawyers. The Templars denied the charges against them, and the evidence on which they were condemned was hearsay. But they seem to have been aware that their destruction was determined upon, and on being brought up, to the number of 24, with William de Grafton, Preceptor of Ribston, at their head, they all and each confessed that they could not purge themselves from the scandals imputed to them, and implored re-admission into the Catholic Church. They were then conducted to the south door of the Minster, and having taken an oath to observe all the mandates of the Church, they received absolution. Out of their possessions, which were sequestered, an annual stipend was allotted to them, and they were distributed among the monasteries, there to perform their penance.

From the records of the proceedings of the commissioners who were appointed to survey and take temporary possession of the estates of the Templars—Adam de Hoperton, Alexander de Cave, and Robert de Amcotes—it appears that on December 1st, 1311, they inspected and scheduled the contents of Temple Hurst and Temple Newsome. They were well stocked and furnished, but the inventory shows little of the splendour and luxury in which the Templars are supposed to have lived. The King granted both these properties to the Lord D'Arcie, whose descendant forfeited them by taking part in the Pilgrimage of Grace. Temple Newsome was then granted to Lord Lennox, the father of the unfortunate Darnley. It was subsequently granted to the Duke of Richmond, and in consequence of his extravagance was sold to Sir Arthur Ingram. In the representatives of this family the property still continues, but the mansion exhibits no trace of the preceptory of the Templars.

ON THE MICROSCOPICAL STRUCTURE OF MOUNT SORREL SYENITE,  
ARTIFICIALLY FUSED AND COOLED SLOWLY. BY H. C.  
SORBY, ESQ., F.R.S, F.G.S., &C., OF SHEFFIELD.

My object in bringing forward this subject is more to exhibit the specimens themselves than to give any thorough description of their structure. This would be very difficult, except aided by numerous careful drawings, and would even then fall far short of what can be seen at once by inspecting the thin sections with the microscope.

I am indebted to Mr. James G. Marshall, F.G.S., of Headingley House, Leeds, for the material used in my microscopical inquiries. He melted in some cases above a ton of the rock, and allowed it to cool very slowly. I have prepared thin sections of various specimens, and I may remark that the facts I am about to describe form part of a wider inquiry in which I have for some time been engaged, and that I have already studied, and shall still further most carefully study, the comparative structure of various kinds of igneous rocks in their natural state, and after having been fused and slowly cooled. However, not to take up time with such general remarks, I will at once proceed to describe the structure of the Mount Sorrel Syenite, and of the products derived from it by fusion.

The rock operated on is a mixture of reddish felspar, clear green hornblende, and quartz, along with some opaque mineral, evidently in a greatly altered state, perhaps originally pyrites or magnetic oxide of iron. The felspar is in very distinct crystals, but has often caught up much hornblende; and the quartz fills up the spaces between the other minerals, or is curiously crystallized along with the felspar, so as to form a microscopic "graphic granite," or "hebraic felspar;" and it is especially important to bear in mind that the quartz contains very many *fluid-cavities*,

nearly filled with water, as described in my paper in the *Quarterly Journal of the Geological Society*, (Vol. XIV., p. 453) and, in accordance with the principles therein explained, they indicate that the rock was consolidated under a very great pressure. These fluid-cavities show the spontaneous movement of the bubbles which they contain, better than those I have seen in any other rock.

I am to a considerable extent prepared to admit that in the experiments made by Mr. Marshall there was some separation of the constituents, and that consequently the comparison with the natural rock is not everything that could be wished. The hornblende melted more easily than the quartz and felspar, and a portion of those minerals has risen upwards, and thus the whole was not thoroughly incorporated. However, the general character of the product obtained by the fusion of a granite of the Vosges, which, along with other most interesting specimens of similar substances, has been kindly sent to me by M. Delesse, of Paris, shows that, even if we must make some allowance for a change in composition, the difference between the artificial and natural stone is not dependent on that cause alone, but that an explanation must be sought for in the very different circumstances under which they were formed.

In some parts of the product obtained on fusing 11 cwts., which appear to have cooled more quickly than the rest, very curious concretions, composed of radiating crystals of black oxide of iron, have been formed, scattered about in the black glassy basis, which has been deprived of its iron and rendered colourless in their immediate vicinity, so that, when seen with the microscope, they present a very curious appearance, in fact, if such a comparison may be allowed, they look very much like annular eclipses of the sun. Some of these concretions are larger than the rest, and contain in the centre crystals of another substance. In other portions of the same

mass the crystals of black oxide of iron have assumed most beautiful forms, strikingly like some ferns or minute fir trees, and deposited on these are small crystals of a nearly colourless mineral, inclosed in a glassy basis, which is the uncrystallized residue. The structure of different portions of a mass of 23 cwts. fused and slowly cooled differ very materially. Some parts consist of a black glass containing irregular, spherical, radiate groups of crystals, varying in size up to a diameter of about half an inch. These are so opaque that their internal structure cannot be well seen, but on the surface, penetrating into the surrounding glass, are many objects of a most curious character, far more like organic bodies than the crystals we are accustomed to see in rocks. Some are extremely like the antennæ of insects, rising from bases which have curious curved outlines, and from the extremity of which they protrude like the plumose tentacles of some organic bodies. There are also many hair-like groups, twisted into such forms that any one who did not know how they had been formed would certainly conclude that they were of organic origin. In another portion of the same mass some parts are glassy and some stony. In the glassy parts are beautiful groups of crystals of black oxide of iron, often in the form of most elegant and highly ornamented crosses. The stony part also contains them, and they were formed before the crystals whose development caused the whole mass to have a stony character. The structure of the line of junction of the glassy and stony parts is very instructive, and shows the manner in which first one and then another kind of crystals was produced. In the more stony portion, at some distance from the glassy, the crystals of black oxide of iron were not invariably generated before all others, but colourless prisms or plates of another mineral were first formed, and afterwards the two were developed contemporaneously. I have carefully studied similar crystals

in basalt artificially fused and cooled slowly, and both in form and optical properties I found that they agree so closely with the small crystals of labradorite found in some natural igneous rocks, that I cannot see why, until facts prove the contrary, we should not consider them to be that mineral.

Comparing then the artificial products with the natural rock we clearly perceive that there is no kind of similarity. The rock was fused and slowly cooled, but the resulting mass differs as much as it well could; and, when it does to some extent resemble a natural rock, it is more like a basalt than a syenite or granite; and in fact its structure is almost identical with that of some of the stony masses obtained by fusing basalt or basaltic lavas. I am, therefore, led to conclude that the conditions under which the natural rock was in a more or less fluid state and the artificial was melted were very different, as is especially shown by the quartz in the syenite containing so many fluid-cavities, holding portions of the water which was present when the rock was consolidated. This water, an intense pressure, and a far more gradual cooling, all of which we are unable to imitate successfully, probably suffice to explain the total difference in the structure of the natural and artificial products. At the same time, I must contend, that the making of such experiments, and the microscopical examination of the resulting masses, is likely to lead to a far better knowledge of igneous rocks than we at present possess.

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NOTICE OF AN APPARENTLY UNDESCRIBED FOSSIL PLANT, FROM  
THE CARBONIFEROUS SANDSTONE, NEAR LEEDS. BY MR.  
HENRY DENNY, A.L.S.

The palæontologist, whose labours are confined to the vegetable kingdom, has far greater difficulties to encounter, and far less satisfaction as to the accuracy of his conclusions,



than he whose investigations embrace the higher forms of organised beings. The difference arising not only from the tissues of plants being less enduring, and their several portions or organs more disjointed and separated, but also from the majority of them belonging to genera either extinct or whose true analogues are doubtful at the present day. For instance, if we take such genera as *Sigillaria*, *Halonia*, *Bothrodendron*, *Ulodendron*, *Megaphyton*, *Sternbergia*, and *Calamites*, their true position is unknown. The terminal extremities and the roots have been found in only one of these genera, that of *Calamites*; and the roots and stems only of another, *Sigillaria*. What do we know of the foliage of any of the above genera? Actually nothing with certainty! Fronds and stems are frequently found associated in the same matrix, but never united; and though portions of large fronds of *Pecopteris*, *Neuropteris*, and similar ferns occur in abundance, we do not observe any stems of sufficient size to have elevated them, unless some of the former genera have been the supporting media, which is very doubtful. My friend, E. W. Binney, Esq., of Manchester, who has worked with great zeal in the Lancashire coal field, was the first, I believe, satisfactorily to demonstrate that *Stigmaria* is the radicular portion of *Sigillaria*, with numerous stringy fibrils, or rootlets, radiating from its surface, which was a most important and interesting discovery. But allowing that he has been fully justified in his conclusions by the examination of numerous specimens, there yet appears an anomaly in the root of this plant difficult to reconcile, as it is without an analogue in the vegetable kingdom. I allude to the quincuncial scars on the surface of *Stigmaria*, with their nipple-shaped centres, which appear to have afforded articulating media by which the flat, leaf-like fibrils have been attached to the caudex. Now, in the first place the regularity of origin in these appendages, if really fibrils,

is directly opposed to the generally received definition of a root, *i.e.* "That its fibres obey no fixed order of arrangement;" and, secondly, the apparent indications of articulate or movable fibrillæ, if such has been the case, is, I believe, without a parallel. From a fine example discovered at Dukinfield, Mr. Binney has also determined a singular character in this plant, which has long presented a difficulty I could not solve;—that the upper portion of the stem, probably all that was above the surface of the ground, had the perpendicular parallel lines which characterise *Sigillaria*. The lower portion of the stem beneath the soil, and the main radicular branches extending to the secondary and tertiary bifurcations, a gnarled, and ruggedly striated appearance; and, finally, the terminating radiculæ, the quincuncial areolæ, and fibrillæ of the *Stigmaria*. There is yet, however, another point to determine. What was the nature of the extremities of the radiculæ? As amongst the hundreds of specimens that have passed under my observation, I have never seen one with the terminal portion. It is, therefore, an interesting point to ascertain whether this also differs in character from the other parts of the plant.

My attention has been called to this question by having recently obtained, from a sandstone quarry, near Leeds, the terminal portion of a plant possessing well-marked and peculiar characters, somewhat resembling those of *Stigmaria* at first sight, but, when closely examined, apparently distinct. The specimen to which I allude is smaller than I have ever seen any of the *Stigmaria*, being only about two inches in diameter. In the smaller and more perfect specimens of the latter, the circular scars, as I have already observed, are generally arranged in quincuncial order, though varying much in the distance at which they are placed from each other; but without any connecting lines. In the specimen recently obtained, its first peculiarity consists in having a





HALF SIZE

conical termination, like *Calamites* ; secondly, in the quin-  
 cuncial scars being united by elevated lines, producing a  
 lozenge-shaped pattern, unlike any plant with which I am  
 acquainted ; thirdly, in the scars being elevated above the  
 surface, while in *Stigmaria* they are depressed below it.  
 Hence the question arises, has this specimen been the ter-  
 minal portion of one of the tertiary radicles of the *Stig-  
 maria* ? If so, it is another important acquisition to our  
 knowledge of the structure of that plant. Or has it been  
 the terminal portion of the stem of a solitary plant having  
 a growth like *Calamites*, and like it possessing the same  
 ambiguity of character, as to whether it was an *Aphyllous*  
 succulent plant like *Stapelia*, or bearing narrow acicular leaves  
 like the larch, from each circular scar, which is highly probable ?  
 (See plate I.) In *Calamites* a uniformity of external structure  
 pervades the whole plant. The termination of the stem,  
 like that of equisetum, is conical ; and the root, which is  
 lateral in position, resembling a Rhyzoma, terminates some-  
 what abruptly, exhibiting, however, the transverse, or annular  
 lines, so characteristic of the genus, but in closer approxima-  
 tion, and each gradually less in circumference towards the  
 centre or extremity.

As considerable diversity occurs in the sizes, form, number,  
 and distance of the scars on different specimens of the so-  
 called *Stigmaria*, is it not probable that two distinct plants,  
 or rather roots, may have been confounded under the general  
 name of *Stigmaria* ? That some noble specimens in the  
 museum of the Leeds Philosophical and Literary Society,  
 which exhibit the first branching of a large bifurcate  
 root, have been such there cannot be doubt. But that  
 they were the caudex, giving origin to the smaller and  
 numerous fragments of the common *Stigmaria*, appears very  
 doubtful ; since, in the quarries from Headingley Moor, from  
 whence they were obtained, I have never seen or heard of a

fragment of *Sigillaria* being found which, if it had ever been in the sandstone with the roots, ought to have been as carefully preserved. We have, however, very fine slabs of *Lepidodendron orbovatum*, and, also, very large stems, with a slightly longitudinally corrugated surface, or a somewhat pustular appearance, either of which is just as likely to have arisen from the dome-shaped, radiated roots referred to, as *Sigillaria*. I suspect the difference in external configuration of some specimens of fossil plants in other respects nearly related is mainly depending upon the simple circumstance, whether the impression preserved is that of the external or internal surface of the cortical envelope, which will differ materially, for notwithstanding the labours of Brongniart, Lindley, Hutton, Hooker, and others, our knowledge of fossil botany is still very imperfect; and it is not improbable that, as greater facilities are afforded for examining extensive collections, containing specimens in different states of preservation and at various periods of growth, it will be found necessary to reduce the number of genera and species at present recognised. The probability is, evidence may thus be obtained that several supposed distinct species are, in reality, only different portions of the same plant. An instance of which has recently been presented to the Museum of the Leeds Philosophical and Literary Society, which consists of a specimen of *Calamites*, with the upper portion having the character of *Approximatus*, and the lower that of *Cannæformis*.

# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE SIXTIETH MEETING OF THE SOCIETY, HELD  
IN THE TOWN HALL, RIPON, ON THURSDAY, APRIL 1ST, 1864,  
AT TWO O'CLOCK IN THE AFTERNOON.

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DR. PALEY having been called to the Chair, read a letter from the noble President, the EARL DE GREY AND RIPON, who was to have presided on the occasion, explaining that in consequence of his having received a telegram from London, he was obliged to leave Studley that morning, in order to be present at a Cabinet Council Meeting the next day.

The CHAIRMAN, after briefly stating the origin and objects of the Society (on this its first meeting in Ripon), announced the following gentlemen for election as Members of the Society :—

REV. W. C. LUKIS, M.A., F.S.A., Wath Rectory.

REV. J. C. ATKINSON, Danby, near York.

WILLIAM EWART GOTT, Esq., Wyther Grange, Leeds.

JOHN RHODES, Esq., Leeds.

SAMUEL JACKSON, Esq., Leeds.

RICHARD REYNOLDS, Esq., Leeds.

MILES STAVELEY, Esq., Slenningford, near Ripon.

CAPTAIN PATTISON, St. Agnesgate, Ripon.

CHARLES HUSBAND, Esq., Ripon.

The following Papers were then read :—

ON THE CONDITION OF THE PRIMÆVAL INHABITANTS OF THE BRITISH ISLANDS, AS EVIDENCED FROM THE REMAINS OF THEIR WEAPONS, IMPLEMENTS, UTENSILS, PERSONAL ORNAMENTS, &c., &c. BY P. O'CALLAGHAN, ESQ., B.A., HONORARY SECRETARY OF THE YORKSHIRE ARCHITECTURAL SOCIETY, AND HONORARY SECRETARY OF THE PHILOSOPHICAL AND LITERARY SOCIETY OF LEEDS.

It is probable, that in such a numerous and highly respectable meeting, and more especially assembled as it is, in this Cathedral City, there may be some who, on purely religious grounds, would hesitate to believe that the primæval condition of man could have been that of an ignorant savage. I will, therefore, beg leave to remind those of my hearers who may be thus influenced by conscientious scruples, that we are told by their highest of all authorities, that there was a time before Zillah, the wife of Lamech, had borne to him “Tubal Cain, the instructor of every artificer in brass and iron.” In that dismal time, the primitive arts must have been rude and simple in the extreme, and human invention little more than the uninstructed efforts of human instinct. Through this rude and savage state all nations appear to have passed. For we find from their antiquarian remains, that the Chaldeans, Hindoos, Chinese, Egyptians, Assyrians, Persians, Greeks, and Romans, had what archæologists call a “stone period.” A time, in fact, when they used flint flakes, stone hatchets or celts, bone and horn implements, and personal ornaments of shells, teeth, or pebbles. The Cromleach, or simple tomb of unhewn stone, is found of a similar form and construction, on the banks of the Ganges, the Euphrates, the Yellow River, the Nile, and the Danube, as it is seen on the banks of the Seine, the Thames, and the Shannon ; and the relics of human art, which are discovered from time to



time in these earliest receptacles of the dead, appear to be so nearly alike in all countries, as to exhibit an identity of barbarism in man's primæval condition all over the world. The close of this dark period seems to have been every where contemporaneous with the introduction of the knowledge of the metallic arts. Indeed, some of what are called the aboriginal races of the human family, are even yet existing in this state of primitive ignorance. I had occasion, not long ago, at one of the Soirées of the Philosophical Society of Leeds, to shew a curious illustration of this fact, in the close similarity, amounting nearly to identity, of two stone hatchets, one found in a cave near Settle, in this county, and the other, a modern importation, from the Island of Tahiti. I brought this matter under the notice of the British Association at Aberdeen, and it gave rise to an interesting discussion. The Esquimaux, South Sea Islanders, Caribs, and many savage nations besides, make their rude weapons of wood, shell, bone, or flint, like our own progenitors; and examples of these singular coincidences might be multiplied to any extent.

Let us then consider the earliest remains of man's rude weapons in these islands, the stone hatchets, or celts. We find these of such various forms, that an attempt has been made by that distinguished Danish antiquary, Worsæe, to give them (from this point of view), a chronological classification.

It is not my intention, on this occasion, to discuss this curious question, but I have no doubt that an interesting classification might be made in that way, by which a certain progress in art could be traced even through this remote era. Amongst primitive people, the transition from the tool to the weapon was very natural, in fact, the same implement served both purposes. The stone hammer could have been used as a war-mace, and the stone hatchet as a battle axe. The flint arrow-heads are as various, and apparently progressive in art as the celts.

The method of making these flint weapons was for a long time a mechanical puzzle. Mr. Catlin, the celebrated American traveller, gave me a wonderful account of his visit to the workshop of an Indian, who made arrow-heads, in the rocky mountains. It was quite a romantic story. He told me that the secret of the manufacture was concealed with the most religious care, and that the door of the wigwam in which this trade was carried on, was vigilantly guarded by an armed sentry. He told me also, that this mysterious profession was held in the highest estimation, and hereditary, and that these cunning workmen were looked upon as priests. Sir William Wylde, in writing upon this subject, says, "The trade of the gun-flint-maker gives but a faint idea of the process by which such specimens of exquisite workmanship could have been fashioned."

However, Sir Edward Belcher, in his last voyage to the arctic regions, not only saw the whole process of making flint arrow-heads, but easily acquired the art himself, and shewed it to us all, at the meeting of the British Association at Oxford. The simple tool employed for this purpose, is nothing more than a small bone, about three inches long, with a little piece of horn, or chert, fastened into it, near the end. With this rude instrument resting upon a wooden block, or bench, the flint-flake was readily converted into an arrow or spear-head, by nipping little chips off it. If Mr. Catlin or Sir William Wylde could have seen the beautiful series of flint arrow-heads which I have the pleasure to exhibit on this occasion, and which have been all made at Bridlington, in your own county, by the celebrated "Flint Jack," their speculations as to their mysterious fabrication would have been brought to a ludicrous conclusion.

In addition to these stone and flint weapons, and tools, we find associated with them sling stones of various sizes and forms; necklaces of perforated stones, shells, or small pieces

of amber. Little bits of bone, and teeth, are also found strung together for the same purpose. Pins, and skewers of wood or bone, to tie up the hair, and fasten the dress with, are likewise often found with such articles. The stone implements used for domestic purposes are of the simplest kind, especially those for crushing and triturating the kernels of nuts, and subsequently (but after a long interval) for grinding the corn. Of the latter, we have several good specimens in the museum of the Leeds Philosophical Society, one of which was found by myself, built into the garden wall of a farmhouse, near Cookridge Hall. There is no doubt but that weapons, and implements of all sorts, were made of wood at the same time, and even before this stone period. But from the perishable material of which they were composed, few could be accidentally preserved till now. However, some are occasionally turned up in the peat, where they appear to have been deposited as vessels containing butter or fat. The peat moss seems to have been used as a cellar or larder, before the discovery of the curative property of salt, or even the knowledge of the existence of that abundant mineral in this country. For the Greek historians tell us, that salt was one of the imported articles, brought by the ancient merchants, and used by them as barter for our native metallic products. Butter, cheese, and tallow, are frequently found sunk deep in the Irish bogs, sometimes in large masses, converted into a sort of stearine, although generally every particle of the wooden vessel which contained this substance had utterly disappeared. Mr. Wilson, in his "Pre-historic annals of Scotland," does not seem to have been aware of this curious fact, for he writes, at page 31, "Mr. Joseph Train mentions having seen a ball of fat, or bannock of tallow, weighing twenty-seven pounds, found in the peat-moss, and which, no doubt, was a mass of adipocere, *indicating the spot where some large animal had perished in the moss.*" This is about the most

absurd explanation that ever was offered, for this very common find of a mass of stearine preserved in the peat. Only fancy, a *Urus*, or *Bos primigenius*, floundering in a quagmire, and sinking down to suffocation, and after the lapse of countless ages, being converted—hide, horns, bones, and flesh—into twenty-seven pounds of adipocere! and this most wonderful chemical change to have been produced in a peat-bog, the most antiseptic substance in nature.

Rude boats or canoes, scooped from the solid trunks of trees, are often found in these peats, gravel, or ancient waterbeds. Sometimes their short and clumsy paddles are found buried with them, and in rare instances, a rope or cable made of moss or heather, attached to a stone close by, clearly shews us the primitive means of anchorage, for these first attempts at naval architecture and navigation. A very perfect specimen of one of these primæval boats has been lately found in the valley of the Aire, and presented, through me, by Mr. Hartley (the owner of the land in which it was discovered) to the Leeds Museum. However, as boats of very simple construction have been improvised, especially in remote and inaccessible districts, and used long after the Roman occupation of this island, they cannot, as a class, be fairly called pre-historic.

In 1843, the Rev. Thos. Foster presented to the Royal Irish Academy, an ancient wooden table and dish, and communicated the following notice of them:—"The wooden table and dish to which this notice relates, were dug up in a peat-bog, near the road leading from Donaghy, in the County Tyrone. They were found about ten feet beneath the surface. With the dish was a large heap of hazle nuts. Each article was scooped out of a solid piece of wood, apparently fir. The table is of an oblong shape, with the ends curved inwards towards the centre. The four short legs, about four and a half inches high, are in the shape of truncated cones, and

about four inches thick. They are connected at their bases, except on one side, by a low rim about an inch high; in the longest side of which are two holes, capable of admitting a cord or thong. The dish was a long oval, four or five inches deep. In the edge of one side are two holes, answering exactly to the holes in the table. From these particulars, it may be inferred that the table was used by persons who squatted on the ground, and that the dish, when not in use, was attached to the table, so that both could be carried away, slung over the back. The workmanship of these primitive utensils is rude in the extreme, and indicates a low degree of civilisation in the people who used them." Now, what was the probable condition of the poor owners who had evidently lost these utensils? They had been, most likely at the time, squatting over their little autumnal gathering of hazle nuts, the provident horde for their precarious winter's subsistence. Possibly they might have been indulging in hilarious enjoyment, at this primæval harvest home, when their happy laughter was suddenly interrupted by the bounding rush of some ferocious carnivorous beast, attracted to the place by their incautious merriment. How changed is the aspect of the country where such a horrible scene must have been of frequent occurrence. The gigantic forest trees have grown and fallen, and grown again. The hazle thicket, with its bountiful crop of winter fruit, has withered, decayed, and grown over and over again, upon that interesting spot, until after the long lapse of unrecorded centuries, the accumulation of dead vegetable matter, even by the pressure of its own weight, has been formed into a dense mass of peat several yards in depth.

I shall now pass on to the most interesting phase of our pre-historic condition; the period intervening between the introduction of the metallic arts and the Roman invasion. Although we are frequently told that the Britons, at the time

of the Roman invasion, were in the lowest state of barbarism, in fact, little better than painted savages, my own belief, notwithstanding, is, that the Britons, even in these remote times, had made greater progress in civilisation than is generally supposed. What historians tell us of the rapidity of their military evolutions, the destructive effects of their war-cars, armed with scythes, and the extraordinary agility of this novel description of cavalry, shew us clearly an advance in constructive art and military discipline, little if at all inferior to the great conquerors of the world.

It is quite impossible, from our present knowledge, to say how, or when, the metallurgic arts were first introduced into these islands. But it is evident that they must have made a great revolution in the condition of the people, and a great advance towards civilisation. It is probable that gold and copper had been known, and partially used here, long before the importation of foreign art in their conversion into manufactured articles. Gold, though usually found in small quantities, is more generally diffused perhaps than any of the evident metals. The stream-gold, which is generally first discovered in every auriferous region, is always found glistening on the surface. The most manifest, as it is the most beautiful of all the metals, and probably the most abundant in the first instance. It is not unreasonable to suppose, that in these metalliferous Islands gold may have been readily converted into personal ornaments, even before the importation of the foreign art of smelting it. We must, therefore, look upon rudely formed personal ornaments of gold, as amongst the most ancient metallic relics in these islands. Some of the plates and rough bars of gold, which from their rudeness must have been about the earliest specimens applied to this purpose, appear to have been made simply by a stone hammer. From the great quantity of ancient golden articles found in these islands—and especially in Ireland—

this precious metal must have been far more abundant in those remote times than it has been within the period of authentic history. According to the Irish annals, gold mines were first worked in that county, in the reign of Tigernach, the 26th King of Ireland. He caused a person of the name of Theodore, in the county of Wicklow, to make pins of gold to fasten the garments of men and women about the neck, a beautiful and effective substitute for the bone and wooden skewer previously used for that purpose. He is supposed, on the most received chronological computation, to have died about the year 784 before Christ. Minemon, who lived a century later, is said to have been the first Irish King who decorated the necks of his nobles with gold collars, or torques, and even with armlets and bracelets of gold. Although these annals were at one time inconsiderately assumed to be of doubtful authority, they have been latterly accepted with more confidence, on account of the frequent discoveries of external corroborative evidence supporting them, especially in foreign countries. At all events, it is a curious coincidence, that we find pins, brooches, and collars, or torques, amongst the most ancient articles fabricated from gold and silver in these islands. I am sorry that I cannot shew you any of those relics; I fear they are too costly to be presented to our museum, at Leeds; and we are, as yet, too poor to purchase them. It cannot be expected that I should, on this occasion, enter into a detailed notice of the numerous and various ancient golden articles found in these islands. However, there is one of so much interest, and the history of which is so curious, that I cannot overlook it here.

It appears that a mound had stood for ages in the corner of a field, at a place called Mould, in Flintshire. This barrow was called "The Hill of the Fairies," and it was always looked upon as an object of superstitious fear by the peasantry of the neighbourhood, who took good care to avoid

its hallowed precincts after night. It happened, notwithstanding, that an old woman was obliged to pass too close to it one evening after dusk, in the autumn of 1833. This old lady positively declared that she then saw, slowly moving across the barrow, a spectral figure clothed in a coat of gold, which shone like the sun. This strange story made such a commotion in the neighbourhood, that the owner of the land determined on removing the mound altogether. At one part of the mound he found rude urns of unbaked pottery, containing burnt bones. But on excavating to the bottom, what was his astonishment, when he came upon a human skeleton, wrapped round the chest with a corslet of the purest gold, embossed with an ornamentation of superior design and workmanship. I am sorry to say that this precious relic was valued only for its intrinsic worth, for it was at once broken up and sold. It has, however, been since recovered piecemeal, and gradually put together, so that you all can see it now, nearly complete, in the British Museum.

Another obvious use to which the precious metals were early and naturally applied, was their conversion into money. Of such coinage the gold ring money of Ireland is probably the most ancient, as it is the most curious. It appears to be similar to what is supposed to have been the Phœnician coinage, and identical with what is used by their descendents at the present day in the neighbouring parts of Africa. It was for a long time supposed that there was no metallic coinage in Great Britain, before its introduction by the Romans, and that the rude silver coins of Cunobeline were made in imitation of Roman money, if not actually fabricated by Roman workmen. But Mr. Evans has satisfactorily shewn, and it is now generally admitted, that the concave coin formerly called "dish money," and other types, were in use in this country and the Channel Islands long before the Roman occupation; indeed, in times too remote for con-



jectural date, as some of them resemble the most ancient coins of the Mediterranean. When we consider that copper is usually found in a state requiring little smelting, so that it could be readily formed into weapons, and tools, to replace those of stone, we must conclude that it preceded the use of iron in England, if not in every country. Iron on the contrary, seldom, in its mineral state, bears any resemblance to a metal, and it is smelted slowly, and with difficulty, under a great heat.

The weapons and tools of the Assyrians, as seen in the Nineveh paintings, seem to be made of some yellow metal. The Egyptian paintings also shew the sculptors and stone cutters working with yellow tools; while a variety of bronze weapons found in their sepulchres, attest their early use of that compound metal. We know that bronze cannot be made without tin or zinc; and that tin is invariably the alloy in ancient bronze. Where, then, did the Assyrians and Egyptians get their tin for this purpose? There is every reason to suppose that it came from Cornwall, through France and Spain, to the Mediterranean and Red Sea; and that this earliest commerce with England was carried on principally by Phœnician merchants. Herodotus, as you all know, calls these islands the "Cassiterides," or Tin Islands; and that distinguished mineralogist, Berzelius, asserts that from the isolated geographical distribution of this metal, England must have been the only source from whence the most anciently civilised nations of the world could have procured this necessary material for the fabrication of their bronze tools and weapons. How difficult, then, must it be to make even an approximate calculation, as to the extremely remote period when bronze superseded stone in these islands. Indeed, it seems to me to be very doubtful whether the metallic arts were not introduced into the British Islands, even before the Romans themselves became acquainted with them. Coins of the

Ptolemys, and other Egyptian relics, have been dug up from time to time in Cornwall. In 1850, two bronze bulls were discovered in making a deep cutting, in the town of Penryn. They are evidently representations of the Egyptian God Apis. Even so lately as 1853, a bifrontal bust of the God Isis, was turned up in making an excavation in the town of Exeter. It is extraordinary, that although Cornwall and the Scilly Islands, as we are assured, had been resorted to from very remote times by the Phœnician merchants, chiefly for tin and furs, in exchange, as Strabo tells us, for pottery, metal implements, and salt, that they should have left no trace of themselves or their language in this island. In Ireland, on the contrary, they are supposed to have left us their gold ring money, and a great variety of articles in gold and bronze. It is also a curious coincidence, that the mining districts of England and Wales, after having been vacated by the Phœnicians, should have been subsequently occupied (as Mr. Thomas Wright has shewn), by an immigration from northern Gaul, who introduced the Armoric language of the Bretons into these localities, where it is at this day the vernacular of the lower class and the peasantry. The Druid religion appears to have been towards its close confined to this people; and when it was driven out of northern Gaul, its last stronghold was in Wales, and the neighbouring island of Anglesey. But this is a garrulous digression, which I have no right to inflict upon you, especially after enduring such a dull paper on a dry subject, with so much considerate indulgence. For this great kindness, I beg you, therefore, to accept my grateful acknowledgments.

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In a discussion which followed the reading of this Paper, Mr. W. HARRISON, of Ripon, stated that a fine specimen of gold ring money had been found in the centre of a cairn of stones, in 1818, in a field on the Lindrick farm, close by

Studley Park. It was very heavy, and supposed to be worth about £32. The late Mr. Robert Harrison, of Lindrick, gave it to the late Mrs. Lawrence, and Lord de Grey exhibited it at a meeting of the Society of Antiquaries; but where it was now the present noble owner of Studley was not aware. Two very beautiful gold armlets had also been found in or near Swinton Park, but, sad to say, they had been stolen from the Hall. Their appearance, however, was preserved in an engraving, which will be found in Mr. Fisher's forthcoming work on Mashamshire.

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The CHAIRMAN next called upon the Rev. J. C. ATKINSON, of Danby in Cleveland, to read the second Paper—

ON CERTAIN RESULTS FROM BARROW DIGGINGS IN CLEVELAND.

The investigations, consequent on which are the results and inferences stated below, have all been made in one definite portion of the district usually known as Cleveland; the definite portion in question being limited to the moorland part of the several parishes of Danby, Guisborough, Skelton, and Westerdale,—an area comprising probably 35,000 to 40,000 acres. These investigations are by no means as yet complete, either as regards the existing traces of ancient occupation, or those of ancient interment. Perhaps all that can be said of them is that what has been done has been done carefully, and that at least something in the way of results has been obtained.

Before proceeding to describe such of these results as furnish the special subject-matter of this paper, it may not be inexpedient to notice, as briefly as possible, the more striking geographical features of the district which has furnished the objects of investigation. To this end, I must ask my readers to conceive a deep valley of no great width, whose general direction is from east to west, and which at

its easternmost limit branches out into two lesser terminal valleys, one directing itself towards the south-west, the other to the north-west. Conceive further that this valley on its south side throws off, so to speak, several smaller or sub-valleys, each with its own peculiar stream—or *beck*—running along its depth into the great receiving stream of the main valley, and with its own especial distinctive prefix to the general designation of *Dale*. The barriers which separate these minor valleys, each from the other, are narrow promontory-like ridges, with moorland surfaces, and a medium height of 1,200 to 1,300 feet. Ancient ramparts and entrenchments are found on all these ridges without any exception. What variation there is depends mainly on the different degrees of skill and care apparently employed in constructing the various defences in question, and partly, on their varying nature. Thus, the most westerly ridge has a regularly formed camp, with very extensive earthworks of uncertain intention, upon its extremity. This is Crown End in Westerdale. The next ridge, on the terminating spur of which the first Norman fortress in the district seems to have been reared, had probably before that furnished in the same place the site of a Celtic fastness, and is besides, in two several places much higher up and about three-quarters of a mile apart, crossed by a strong vallum and fosse. The next, that between Danby and Fryup Dales, has had, or has yet (besides many smaller walls, the object or purpose of which it is now hard to surmise), four separate entrenchments drawn across it, the most southerly consisting in part of a double vallum and intermediate trench, but its western half composed of three strong vallums with two intermediate trenches. The ridge next to the east of this, again, has two walls, with—as I lately found good reason to conclude—the site of a Celtic settlement between. The next, again, was very strongly fortified, and, as I believe, with a system

of exterior defences, as well as barriers nearer home ;—and so on.

Of the defences which lie to the north of what I must call our “sub-district,” I do not purpose to say more than this,—that I have not yet had the opportunity of working them out so thoroughly as the others, but that while they appear, from the nature of the ground, less systematic as a whole (although equally, or perhaps more, extensive in at least one particular locality), yet their general character or dimensions are not such as, in any degree, to modify what I wish to remark concerning those on the south ; which, indeed, have been mentioned here only that I may have the opportunity of making the remarks thus adverted to.

Two or three years since, having been invalided and sent away from home, I had the opportunity of looking at various earthworks, camps, and entrenchments of, I suppose, undoubted British or Celtic origin, situate in Berkshire and Somersetshire. The contrast between these, and those I was so familiar with at home (and now under mention) was just this :—that the Cleveland bulwarks and strongholds might have been put bodily into the fosse of the South of England entrenchments, and not have done so very much towards filling it up as to have been any astonishing help to a storming party. Just so again, a friend whom I had taken to see some of these Cleveland remains, and who was familiar with ancient works of like purpose in other parts of the North of England, made a precisely similar remark touching the relative magnitude of the remains in question. Or again—the noted Scamridge dikes in the East Riding :—I believe all the ramparts and intrenchments in Cleveland put together would scarcely form an equivalent, in point of magnitude and development, to these lines alone.

My inference from these facts and comparisons is as follows. The Cleveland defences, as raised against assailants

at all, must have been raised against strangely less formidable assailants than the Northumberland, East Yorkshire, Berkshire, and Somersetshire entrenchments. But certainly not less formidable in respect of bodily strength, for many of the masses of rock or stone, moved and placed in the construction of the specified defences, are such in size and weight as fairly to task the strength of as many of the existing dwellers in the district as can lay to their hands to help, and even with the appliances of gavelock and pick. Less formidable, therefore, in point of numbers or equipment,—nay, rather in numbers *and* equipment,—and specially as regards the last, as it appears to me. For I fancy ten men of Robin Hood's band, with their steel-headed shafts shot to a hand's breadth at three or four score yards, would have been a sore over-match for ten times their number of flint-arrow armed Celts, so long as they could choose their own distance, which, as attacking intrenchments, would always be at their own discretion; while it would have been perilous indeed, in the face of such assailants, for the defenders to leave their cover and seek to decide the matter by a rush, and a hand-to-hand conflict.

I pass from this topic, for the present, to dwell a little in detail on the memorials of this ancient race of fastness-builders, which are preserved for us in their burial-places; many of them, indeed, equally specimens of building with the still remaining ramparts; all of them constructed on precisely the same principles, and out of precisely the same kind of materials, as the ramparts themselves—piles of stone-fragments consolidated and heaped over with earth.

I think that I may say I have a kind of personal acquaintance with from seventy to eighty large tumuli or barrows, and I suppose some hundreds of small ones; and with the interior of not a few of either kind. The local

name for them is *houes* or hills: and as there is a peculiar appropriateness in the term *houe*—it is of northern or so-called Danish origin, and means a hill raised over the dead, a very common expression in the old Norse records being “And so and so was *houed* in such and such a place”—I shall, for the most part, use that word, or the word *grave-hill*, in preference to either *tumulus* or *barrow*.

The larger *houes* vary in dimensions from two-and-a-half or three feet, to twelve or fourteen feet in height; and from thirty to ninety feet in diameter. One very large pile of the kind in my district can scarcely be less than one hundred and fifty to one hundred and eighty feet across. Perhaps, if an average measurement were desired, forty-five to fifty feet over, by four-and-a-half to six feet in height, might be given as such, at all events approximately. The smaller *houes* are twelve to eighteen or twenty feet over, by one-and-a-half to two feet high. These latter are, without any exception, so far as my experience—and that of more than one fellow-labourer in the same field—goes, entirely barren of any remains certainly betokening an interment. Composed of stones roughly piled together, often by the side of, or above, a large rock slab that has been a fixture in the soil since the day it was dropped in its place by the hitherto suspending ice, and with the sand from the moor-surface heaped over them and interpenetrating the whole structure, it is only the presence of divers small fragments of charcoal which gives any hint beyond that furnished by the shape of the pile and by analogy, that they have been raised for sepulchral purposes. The only work of man’s hand that I have seen procured from one of them was a remarkably fine specimen of the so-called “thumb-flint.” Another barrow-digger, after opening a very considerable number, told me that he had only in one instance obtained anything from one of these small *houes*, and that was a small and rude urn.

To go back to the larger grave-hills—all of them, with scarcely a single exception, have been at some time or other opened at the centre, and the excavation having been continued to the original moor-surface, in only far too many instances proofs are not wanting to shew that the central, and, doubtless, the original interment has been reached, and ruthlessly destroyed on the spot. Thus, to particularise one case—which may serve as an illustration of a vast number—in the course of April in last year, I was busy about opening a grave-hill of fully average size, situated on the moor near Waupley. Careful sinking on the north flank revealed a layer of fine sand, some inches thick, smoothly laid over a mass of stone fragments, placed together so as to make a level platform of some 30 feet or so in diameter. In the centre there had been, as it eventually appeared, a carefully constructed stone Cist, covered with one large, long flag-stone. But the removal of the upper surface and the soil beneath it, in proximity to the centre, disclosed, long before the Cist was reached, the fact that two urns had been broken there at some not very recent period, and their sherds thrown confusedly amid a quantity of soil which was not now in the place it originally occupied. On reaching the Cist this circumstance was only too fully explained. Other fragments of the urns, and considerable quantities of calcined bones and charcoal were mixed up throughout the earthy matter now filling the Cist: while the covering stone was left standing upright at the west end, just as the former excavators had left it after raising it from its covering position, and obtaining access to the relics it had protected so long.

The fact that the urns and their contents had been treated thus regardlessly and ruthlessly shews conclusively enough that these former investigations to which our Cleveland Grave-hills have been subjected, were not made by the



antiquary, nor indeed by any one who had a sufficient amount of human sympathy or common knowledge either to care about, or be aware of, the interest and value attaching to such monuments of a departed age and race. The fact is, as there is scarcely any reason to doubt, that not mere ignorant curiosity even, but simply the expectation of meeting with buried treasure was the moving impulse which directed the tools of these investigators. Nor is the idea that these grave-hills do—at least, may—contain hoarded treasure, by any means extinct even yet among the dwellers in our far away, little-instructed country side. On one occasion last year, I only obtained permission to examine a houe on a lately enclosed portion of the moor, and now belonging to a neighbouring freeholder, on condition of turning over to him any and all the gold I might find within; and on other occasions I have been saluted in mid-labour with the question, “Was I laiting goud?” or, after its close, “Had I fun any goud?”

In some few instances, the gold-seeking examination seems to have been quite baffled—disappointed, it always would be, of course; but baffled—by the fact that the deposit in those cases had not been placed exactly in the centre. Thus, in two separate instances—both on the Skelton Moor—and in a third, on the Guisbro’ Moor, the deposit happened to lie from three-and-a-half to five feet west of the centre; and thus, though the central opening had been sunk to within a short distance of the interments, they had escaped detection: and fortunately so; for two of the urns thus reserved to reward the labour of a later seeker, are, alike through their character and the circumstances attending their deposit, invested with a peculiar kind and degree of interest.

But though the Cleveland Grave-hills have thus suffered, what all archæologists with one consent must term, wanton violation and plunder as regards their central portion and

deposit, still there is scarcely one of them of anything approaching medium size but has been the receptacle of later interments; not a few of such later interments being such as, either from the manner in which they have been made, or from their own peculiar character—possibly from both conjoined—to be of singular interest to the archæologist; perhaps even, eventually, to the ethnologist also.

I will now try to give as succinctly as possible some of the results on which the statement just made is founded. And first, I will refer to the investigation of a very large houe on the Skelton Moors, which cost me the labour of five days, with four men at work each day. The proofs of former opening at the centre were only too unmistakable, and although no sherds or fragments of calcined bone were discovered in any stage of the excavation, yet a very careful examination made over an area of several feet in diameter about the central part of the basis, left no reasonable ground of doubt that the original deposit, whatever it might have consisted of, was gone. However, at a point twenty feet to the south of the centre, there was found—what, if I may apply an architectural term, might be called—an inserted cairn, of about five feet in basal diameter, and three feet high, flanked all round by large flat slabs of stone, and capped with another. In the very centre of this I found a roughly fashioned incense-cup (so called), accompanying a considerable deposit of calcined bones, and the remains of some large flint implements, which had flown to pieces in the burning. Near the southernmost edge of the cairn, and enveloped in clay, I found a small urn, of red ware like the cup, accompanying another deposit of burnt bones, and with three jet beads embedded in the clay, but in actual contact with the urn. The natural inference was that the remains in the latter case were those of a female, and that, as covered by the same cairn, and so, “not divided in death,” this man and this woman

had been very nearly connected in life; probably husband and wife.

But further:—below the entire mass of this cairn there lay the *debris* of another, and of course, an earlier urn and its contents: and these were disposed, not so as simply to suggest the idea of accidental or unintentional damage; but were scattered as well as broken; and more, a long stone, about four inches thick by six or seven in width, was set up edgeways upon the strewed bones and pottery, so as to divide one portion from another.

Here then, there were three chronological steps:

1st. The original deposit over which this great hill was raised.

2nd. The interment which had been violated.

3rd. The construction of the inserted cairn: and besides this distinct chronological sequence, there were also the tokens of something more than mere careless indifference in the treatment of the second burial;—of what seemed to me actual spiteful usage.

Next, a little to the west of the inserted cairn, there was found an urn of really majestic dimensions—24 inches high, by  $17\frac{1}{2}$  across the mouth—the space in which actually occupied by the contained bones was scarcely more than what “a feed of corn” might appropriate in a bushel measure.

In all, and inclusive of the finds already named, there were no less than nine secondary interments found in the southern flank of this house; two of them consisting of calcined bone with no accompaniment of urn or flint (one of them, however, very carefully protected by three successive overlying flag-stones of considerable dimensions); and one comprising three vases, all of the incense-cup type, all of them evidently deposited empty,—one, the largest, six inches in diameter, containing only a single calcined human tooth; and another—the second in size, and beautifully marked—carefully closed

by the apposition of a flat flake of charcoal to its mouth. Bones without urns, and urns without bones—rede it who may.

Again, in a comparatively small cairn, with a very slight covering of earth, at a point some six or seven feet south of the centre, I find, as soon as I reach the level of the moor, many fragments of an urn, accompanied by portions of calcined bone. Still there was no token of modern disturbance in this case. On the contrary, all such tokens were, in a marked manner, wanting. Whoever had broken that urn and spilled its contents had done so before the stones which covered the whole had been piled as they were before I commenced to remove them. Soon, on continuing the excavation, it was clear that these tokens of a former burial were not limited to the surface of the ancient moor; they continued to be found as inch by inch the search was prosecuted downwards; until, at last, on removing a small flat stone, set obliquely, the edge of a buried urn became apparent. Over this urn, below it, all round it, in its old, old resting place, the ashes of a former burial and the sherds of their containing vase were found, thrown in, as one could not but remark, in a kind of studious disarray. The buried urn, on being carefully disinterred, was found to be entire, excepting only a slight abrasion of part of the mouth; to be quite diverse in details of shape and markings from any hitherto found in the district; and to contain, besides a modicum of calcined bones, a small vase of barrel-shape, placed bottom upwards about mid-depth, and with one of its sides closing the mouth of an incense-cup laid sideways. Both these last-named vases were empty.

Yet again, in a houe on the Skelton moors (the examination of which is yet incomplete),\* and showing sad signs of

\* The examination has been completed since this was written, and has yielded a total of ten urns, more or less complete, besides the fragments of at least six others.

mutilation about the centre and on one side, there was found, inserted in the open stonework which constituted at least all the southern half of the hill, a small urn, in very fair preservation, but encompassed above and on either side with the fragments of an earlier urn: the fragments being of such a size and in such connection that I was enabled to reproduce its original form and dimensions from them.

I pause here to submit that these instances are entirely distinct from the mere casual finding of detached pieces of broken pottery in the substance of a gravehill, or in the nearer vicinity of the deposit. Broken flints and broken pottery are, if not the usual accompaniments of hill-burial, yet at least by no means uncommon characteristics, and few houses in our district but give evidence to the prevalence of the custom of scattering either or both at some one stage or more of the process of raising the pile. But in the cases I have cited, there was much more than this. There was the urn of a former burial broken, and its contents—presumably the ashes of a former occupant of the hill-sepulchre—dispersed; and broken and dispersed systematically in connection with another inserted urn and interment. Would it be—*could* it be—that they were the remains of an ancestor; of a chieftain of the same tribe; of any noted man of the same tribe, though older by several generations; that were dealt with in this fashion? Nay, surely not. Assuming that time enough had elapsed to allow the actual place of deposit of any departed chief of bygone generations to have been forgotten, yet there is no analogy, no presumption to suggest, and many considerations of divers kinds to negative, the supposition that, if accidentally come upon in preparing a last resting-place for the remains of a newly departed worthy, those of his predecessor would be treated as common or without sanctity, much less pertinaciously dealt with as

only fit to be the contemned accompaniments of the more recent interment.

It seems to me an almost inevitable conclusion that the central urn must have been that of a conquering intruder, and the surrounding fragments those of a former chief of the conquered tribe, whose burial hill, consecrated by the use, and the pious regards, and possibly the superstitions of a series of generations, had been thus, by the right of the strong hand, appropriated, and its hitherto venerated contents made subservient as accessories to the, even in death, savage pride and insolent triumph of the conqueror.

Another interesting find was made on the East side of a houe, of some thirty-five feet in diameter, and at a point about eight feet distant from the centre. It consisted of two large urns placed not simply side by side, but in actual contact with each other. The larger of the two, of a form occurring only infrequently in our Cleveland Grave-hills, and which I have no knowledge of as occurring any where else, contained only calcined bones, and fragments of a bone pin or two: but in the other, on removing the covering stone which protected the mouth, there was at once seen a small, but beautifully wrought battle-axe or war-hammer, of fine-grained granite, polished. Below this, and covered by a considerable quantity of ordinary soil from the moor, which must have been placed where it was found at the time of interment, was a small, rudely formed incense-cup, inverted and empty; and amid the calcined bones below that, portions of four bone pins, and a peculiar article or ornament, consisting of a cylindrical piece of bone  $\frac{2}{8}$  inch in diameter, and about  $1\frac{3}{4}$  long, adorned with a spiral line running along its entire length, and perforated crosswise as well as lengthways.

I believe I am fully justified in speaking of this as a very interesting find; inasmuch as, independently of the number of articles found in the closest relative connection, the fact

that one of these articles was not only a polished stone implement, but actually contained in a cinerary urn, is a matter of no little significance. It is usual to assign polished stone implements to a late, at least comparatively late epoch : and two authorities in the archæological world on hearing of the occurrence of this hammer, at once, without even the formality of calling a witness—so to speak—on the other side, pronounced that it decided the date of the interment to be late Celtic. I venture to differ with both, and have since had the satisfaction of hearing from one that he considers my reasons as not without force, and that in fact he is, by other considerations, very much shaken in his convictions on the entire subject.

But without any intention of discussing the question at length, I am brought by it to a brief notice of the probable age of the sepulchral memorials which it has been my lot to work among. And

1st. Let me observe, that no trace whatever of a metal implement or ornament has been found, either by myself or by a man who, without authority, opened ten or twelve grave-hills in the same division of Cleveland some six or eight years since.

2nd. That scarcely any interment has been found without proofs of the presence, at cremation, of stone or flint implements or weapons (or both).

3rd. That some of these implements or weapons were of the rudest possible description ; one or two, indeed, taken with my own hands from the urn itself, so awkward, almost uncouthly mis-shapen, that, if met with accidentally, I should not have ventured to pronounce them objects of human use and application, much less the productions of human art.

4th. That the only utensil hitherto found in the district, and applicable to grinding or cognate purposes, is of the open dish form, of which two, or perhaps three specimens, with

one or more of the appertaining rubbers, are preserved in the Dublin Museum, and are assigned by Mr. Wilde, in his admirable catalogue, to an age anterior to that in which Querns came into use. The one I have, when found, had the rubber or muller with it, which was described to me by the finder as like "a mason's mell:" but most unfortunately it was lost before I heard of it.

5th. That the remains of flint fabrics—and I have been remarkably fortunate in lighting upon two deposits of considerable extent, which can scarcely be regarded in any other light than as suggestive of a local manufactory—shew a very sufficiently rude state as connected with a supply of cutting or penetrating implements.

6th. That the still existing traces of human residence, sufficiently numerous and intensely interesting (though I fear I have no space to notice them otherwise than thus in passing), are, without any exception, such as to speak very intelligibly of a period when the constructive arts and appliances were of a remarkably low grade: the residences in question having been merely circular excavations in the ground; few of them with any pretence even of an inner or lining wall; presenting in most instances no sign of anything like symmetrical arrangement; the only proofs of the presence of the genius which culminates in the architect having been supplied, probably, by the presence of a low conical roof of rough poles overlaid with ling, rushes, and sods.

7th. And I must also here recall attention to what was advanced above concerning the entrenchments, camps, or other earthworks, which are met with so commonly throughout the district, and to the inferences furnished by them as to the equipment of those who made and manned them.

I am quite aware that there is a failure of strict logical or positive proof to connect the construction of the earth-



works in question with the builders of the grave-hills under notice. But while identity of construction, at least identity of principles and materials of construction, on the one side, may at least suggest a like date, and the same race of constructors, it would appear to be a rather captious style of criticism which, with nothing whatever even to suggest, and much less to support, a contrary theory, would seek to dispute that point. I therefore take it for granted: and I assume that, while the general tendency of all these facts and considerations conjointly is to assert for even the youngest or most recent of these interments,—proved to demonstration to have been successive, and in some instances, doubtless, not closely so in point of time,—a highly remote antiquity, this conclusion no less than that stated a moment since assigns the tumuli themselves to an even much more remote antiquity.

And this assumption in both its parts I believe to be fully borne out, speaking generally, by the character of the pottery found in them. It is certainly a singular circumstance that while, amongst the urns I have succeeded in collecting, two in particular commend themselves to the accustomed, almost to the simply observant, eye as presumably the most ancient in the number, alike on account of a peculiar but not easily describable character of the biscuit, their greater thickness, not to say clumsiness of fabric, and their obviously ruder look,—these are just those urns which were taken from the central parts of their respective hills; which, in other words, were doubtless the original deposits over which these houses were raised. And what is, perhaps, equally remarkable, is that the singularly rude stone relics just now adverted to were found covered by one of these two urns.

With respect to the other urns at large, one would feel no little difficulty in deciding which was the least old; or, at least, which of them shewed decided signs of any real increase of artistic skill employed in their manufacture.

There may be more elaborate patterns and devices on some than on others, but it is the same unimproved and unimproving genius which has in all cases prompted and executed them.

Taking the vases altogether, there seems to be no mode of characterising them more suitable than that adopted by the late Mr. Bateman, when speaking of the lot which were (as above noticed) surreptitiously obtained from certain houses on our moors, and which, after the death of the man who obtained them, passed into that eminent collector's hands. "I can assure you," he wrote, "that every object thus found is of primæval, or, as commonly termed, Celtic date, and of a relatively early period in that indefinitely ancient age."

I am, therefore, more inclined to estimate the age of the war-hammer noticed above by the unvarying character of the pottery of the entire neighbourhood, and the other contemporaneous remains, than to assign an exceptional era to the containing pottery from the article which in this particular case was found enclosed: and I am inclined to believe that just as the Greek coins infinitely surpass the Roman in point of art and finish;—nay, even the later Greek are not equal to the earlier of the same group; and while it is no unusual circumstance to find early brasses, from about the fourteenth century which are fine and good, many of the latest, or those about 1580 to 1600 being relatively poor or even comparative scratches; so, when once the art of fabricating flint and stone weapons had passed out of its first and empirical stages, and the perfectly shaped and nicely adapted instrument was become producible at will, that the next stage was to polish and otherwise complete and beautify the result of the moulder's skill. Nor do I believe that such care and pains-taking in the formation of the implements of war and the chase would pass away before the accomplished introduction of infinitely more perfect cutting instruments, no longer fashioned with tedious toil out of so intractable a

material as stone, not simply superseded alike the old arts and the old implements, but rendered their continued use alike vain and absurd. I suppose that many, perhaps the more part, will dissent from these views. And for that reason principally I think it desirable to add that within the last few weeks I have seen an urn which was taken, late last autumn, from a barrow in Northumberland, and which singularly resembles that one of mine which contained the hammer; resembles it in general shape, ware, ornamentation, and appearance, differing mainly in respect of somewhat superior size; and which contained among other things not specially indicative of age, a small fragment of what once had been probably a bronze pin. Perhaps, also, it is only fair to add that the urn which I found in such intimate association with mine and, as noticed, of marked or peculiar form, would certainly be placed, as regards presumptive age, from its material, marking, and general appearance, high up among the entire collection of secondary urns.

I had purposed adding a series of remarks on the structure, exceedingly varied and in many respects extremely interesting, of the grave-hills themselves; as also upon several ascertained grave-rings, and some apparently quite barren grave-hills. But I am fully aware that I have already, if anything, exceeded the limits assigned me; and therefore, however reluctantly, I forbear.

On the whole, I conclude that while some of the phenomena adduced seem to hint not obscurely at a succession, once or more frequently repeated, of occupants of the district, the general bearing of the combined facts goes to shew that the most recent interment met with in this portion of Cleveland, dates back more than twenty-five centuries; while with respect to the earliest, they seem to me to pertain to an era so remote, that a century or two more or less makes no practical difference.

“OBSERVATIONS ON THE DISTRIBUTION OF THE EXTINCT BEARS OF BRITAIN, WITH ESPECIAL REFERENCE TO A SUPPOSED NEW SPECIES OF FOSSIL BEAR FROM IRELAND.” BY HENRY DENNY, A.L.S., CORRESPONDING MEMBER OF THE ACADEMY OF SCIENCES OF PHILADELPHIA, &c.

Having lately had an opportunity of examining the skulls of two remarkably fine specimens of extinct British bears, my attention was naturally led to their identification, and also to the various localities in this country and on the Continent, in which the remains of fossil *Ursidæ* have been found. For amongst the revelations of geology none are more remarkable, require more careful investigation, or more cautious deduction, than the local distribution of plants and animals, at remote periods of the earth's history.

In northern latitudes, for instance, we find the fossil Fauna and Flora, bearing the characters of those of southern countries, and the marine exuviæ of southern seas. While in Southern latitudes, on the contrary, we find no remains of animals or vegetables or shells belonging to the northern, but those only which have, or are now, inhabiting the neighbouring lands and seas! Facts in direct opposition to the long cherished theory of the universality of Diluvial Currents, a cause supposed clearly to account for the occurrence of tropical forms of organized beings in temperate climes, to which they had been borne in the catastrophe of a general deluge: a theory by no means conclusive, and which it is not my intention to discuss. If, however, we come nearer our own times in a geological point of view, and examine the distribution of the contemporary Mammalia of the Tertiary Epoch, an equally difficult problem presents itself, that of the localisation of certain Genera of animals similar to what we find at the present day. As for instance, the Marsupials to Australia and America; the

Sloths to South America ; the Antelopes and larger Pachyderms to Africa and Asia ; the Giraffe to Africa ; the Camel to Asia ; the Alpaca and its kindred to South America ; the Ostrich to Africa ; the Cassowary to Asia ; the Emu to Australia ; the Rhea to South America ; and the Apteryx to New Zealand ; the Gorilla to Africa ; the Orang Outan to Borneo.

And though in most of these instances we can trace a peculiar and beautiful adaptation of organization in the animals to the countries they have been destined to inhabit, yet there are apparent exceptions to this rule, which our present limited knowledge will not enable us to explain. For instance, the localization of extinct Mammalia cannot be accounted for from peculiarity of climate, proper supply of food, or Physical Geography alone, as the limestone caves of Somersetshire and Yorkshire are equally suited to both Hyænidæ and Ursidæ ; and as Mr. Boyd Dawkins well observes, the grassy downs and plains of Yorkshire and Somersetshire are equally suited to the ox and the horse. But if we examine the fossil remains of Herbivorous Mammalia, a local distribution is observed which has not depended upon any cause with which we are cognizant. For while the remains of the Bovidæ occur in greater abundance in all the Yorkshire caves, those of the Equidæ preponderate in the West of England, as at Oreston and Wokey Hole. So that the ox preponderated over the horse in Yorkshire, at the same time that horses were more abundant than oxen in the plains of Somerset.

And again, when we examine the remains of the extinct Carnivora the same difficult problem presents itself as regards the two genera I have already alluded to, the bears and hyænas, which although found throughout Europe in the drift gravel or in caves, are not equal in point of numbers, England differing from the rest of Europe in the

proportion of its ancient bears as compared with its hyænas, the two being reversed in the Island and on the Continent.

In the caverns of Germany, Westphalia, and Hungary are numerous remains of the genus *Ursus*, and scarcely any of the hyæna. In that of Kuhloch, which is in a perpendicular cliff on the left flank of the gorge of the Esbach, opposite the Castle of Rabenstein, and in size and proportion nearly equal to that of a large church, there are hundreds of cart-loads of black animal dust, entirely covering the whole floor to a depth averaging six feet at least, and which, if multiplied by the length and breadth of the cavern, exceeds 5,000 cubic feet. The whole of this mass has been again and again dug over, says Dr. Buckland, in search of teeth and bones of bears, which it still contains abundantly. The quantity of animal matter accumulated on this floor is so great that many hundreds, or even thousands, of bears must have contributed their remains to make up this appalling mass of the dust of death; and allowing, as Dr. Buckland observes, two cubic feet of dust and bones for each individual animal, we shall have, in this single charnel-house, the remains of at least 2,500 bears; a number which may have been supplied in the space of 1,000 years, by a mortality from natural causes at the rate of two-and-a-half per annum. In the Cave at Gaylenreuth again, which also contains many hundreds of waggon-loads of bones and animal matter, Esper computes that a thousand individuals were entombed, of these 870 were bears, and only 25 hyænas!

In Britain, on the contrary, as I have already stated, the reverse of this occurs, the limestone caverns containing a majority of the latter animal, and but few of the former. When alluding to this circumstance, Professor Owen observes, "How far this difference may be taken as an indication of some geographical separation having existed at the remote

period of these beasts of prey, analogous to that which now divides us from the Continent, may be worthy of closer inquiry." That a continuity of land once existed between the coasts of Britain and France, there cannot remain a doubt; and that even a Geological union or close approximation of the west of Ireland with the north of Spain; as also that a great Miocene land (to use the language of Professor Edward Forbes), extended far into the Atlantic, past the Azores, is more than probable.

But allowing, for the sake of argument, that the first union alluded to existed at the period when the bears and hyænas were contemporary inhabitants of Europe, I cannot see in what way its subsequent separation explains the localization of the genera in question, or even suggest a cause why the bears were retained in greater numbers on the Continent, and the hyænas escaped to Britain, supposing they were ever tolerably equally distributed. But instead of this separation occurring during the precise time of their joint residence, there is evidence that the disruption took place at a much more remote epoch than the Pleistocene period! So that there still remains a predisposing cause for the peculiar localization just noticed, to be accounted for, more satisfactory, than has yet been adduced. The mere fact, however, of bears preponderating in the north of Europe and hyænas in Britain, might be considered by some persons as not very remarkable, the former being, generally speaking, more northern animals than the latter. But here again we have an apparent anomaly, inasmuch as no remains of the *Ursidæ* have ever been found in the extreme north of the British Isles, as Scotland; and even those which have occurred in Britain, do not extend further north than Yorkshire, and there only sparingly, while, on the contrary, their remains are most plentiful in the southern and south-western parts of England, as Devonshire and Somersetshire. So that during

the whole period of their residence in Britain, they do not appear to have extended to that portion which would have been more congenial to their habits, if the supposition of their northern origin was correct. This rather affords evidence in support of the conjecture that at early periods of the world a uniformity of climate prevailed over the whole of Europe, or at least, one more approaching that experienced in Sweden and Norway at the present day !

It is a remarkable fact, however, that certain caves in England contain the hyænas in excess, while others contain the bear in greatest numbers. For instance, in Kirkdale Cave, in this county, Dr. Buckland calculated, from the number of teeth alone he examined, that not less than from 200 to 300 hyænas had lived and died therein ; while only a few teeth and bones of bears were recognized. In Wokey Hole, in Somerset, Mr. Boyd Dawkins found 121 jaws, and 342 teeth of hyænas, and only 27 teeth and two jaws of bears. In Kent's Hole, near Torquay, on the contrary, bones of the bears occur in greatest number ; as also, at Oreston Cavern, near Plymouth. In Paviland Cave, in Glamorganshire, and in the Victoria Cave, near Settle, in this county, the bones of both the hyæna and bear were exhumed, but very sparingly. Now, as in all these instances both genera occurred, it is a circumstance which suggests two interesting questions for consideration, viz., as the bones are all found intermixed, and on the same level, were the habits of the extinct Carnivora different from those species now existing ? as we have here an indication of their having been contemporary occupants of the same abode. We know that at the present day bears and hyænas are neither of them social animals, even amongst their own kindred, or even live together in one common cave ! If, then, the habits of the former animals were not different from the present, by what means have the bones become associated ? Can the minority in each instance have been the food of the



majority? If such has been the case, the bears, at least, can only have been dragged into the caves when dead; for the great Cave Bear would have been too powerful an antagonist for an hyæna in single combat, unless when aged, or weakened by disease;—and such opportunities would be of only casual occurrence—and even then only portions could be carried home, as no single hyæna would be able to drag so ponderous a load as a dead Cave Bear. The same reasoning will also apply to the rhinoceros, mammoth, megaceros, horse, or ox, whose remains are frequently found in a fragmentary condition in such receptacles or primæval charnel-houses. The only reasonable inference, therefore, we can arrive at is this, that these extinct Carnivora were social as to species, and consequently that in each instance the majority have been for successive generations the dominant inhabitants of the cave, and the minority either subsequent tenants, or the food of the former, as many animals, especially the herbivorous, have evidently been from the knawed and broken state of their bones. These always bear a small proportion to those belonging to the supposed legitimate tenants of the cave.

While, however, the species of the genus *Ursus* appear to have been extensively distributed over Europe in early periods of the world, and to have occurred in various parts of England and Wales, bears were not supposed to have ever been indigenous in Ireland, principally from the circumstance that the earliest authorities or historians, had distinctly asserted that bears were unknown in Ireland! The Venerable Bede states the only ravenous animals of Ireland were the wolf and the fox. Giraldus makes no mention of the bear; and St. Donatus, who died in 840, says it was not a native. “*Ursorum rabies nulla est ibi.*” This erroneous idea has arisen, however, from their very early extinction on the one hand, and from the imperfect knowledge of com-

parative anatomy brought to bear on the fossil remains exhumed in former times, on the other. This question, however, is now clear of all further doubt, as several truly ursine crania have been discovered in Ireland within the last thirty or forty years. Archdeacon Maunsell, in his account to Lord Northland, of the exhumation of the bones of the *Megaceros*, or gigantic Irish Deer, in 1824, says, "I have also a skull of a dog of large kind, at least of a carnivorous animal, which I found lying close to some of the remains of the deer. Whether the above skull was that of a dog or bear—though most probably of the latter—cannot now be satisfactorily determined, as the specimen is lost. Another skull, however, undoubtedly ursine, was exhumed several years since, in deepening a river, near Parsonstown, by a gentleman named Cooke, which is now, I believe, in the British Museum. In 1846 and 1847, two remarkably fine crania of gigantic species of bears were discovered seven feet from the surface, in a deposit of marl, beneath peat, in cutting away a bog on the borders of Westmeath, between Moyvore and Ballymahon, by Mr. Edward Fermon, of Forgnay, County of Longford. These were purchased by a gentleman named Baker, who presented casts to the Royal Irish Academy, in 1849, through my late friend Dr. Ball, of Dublin, by whom the circumstances of their discovery were brought before that learned body, accompanied by Professor Owen's testimony as to their identity.\* Casts of the above skulls, as also of that from Parsonstown, had also been transmitted to the learned Professor, who stated it as his opinion, that they belonged to "a gigantic fen bear, closely allied to the Black Bear of Europe (*Ursus Arctos*), and that the largest of these were males, and the small, or Parsonstown example, with well-worn molar teeth, was a female." Finally these skulls passed into the hands of the late Mr. Glennon and Mr. J.

\* Proceedings of the Royal Irish Academy, vol. iv., p. 416.

Glennon, of Dublin, in whose possession they have been for several years. Upon the first discovery of these skulls, they were generally supposed to be those of the great Irish wolf-dog; and Richardson, in his work on dogs, states it as his opinion, "that they are the remains of an extinct animal allied to, but by no means identical with, the dog; and an animal with which we are now unacquainted, partaking somewhat of the characteristics of bears, perhaps also of the hyænas." Mr. Glennon, sen., always considered them as belonging to gigantic badgers, to which they were certainly more nearly allied than to the canidæ, the two families being readily identified by a careful inspection. For although considerable difference is observable in the skulls of bears at different ages, as also arising from sex, yet there is always a peculiarity of form and general contour which, under any circumstances, would distinguish the bear from the dog, however gigantic the latter: and still more so the hyæna, whose dentition alone, leaving out the great breadth and shortness of the zygomatic portion of the skull, would be sufficient to identify the species of that genus from any other carnivorous mammal.

The skull of a bear, similar to the Black Bear of the Pyrenees, was found a few years since, with swords and other weapons, by a Mr. Gray, in an excavation about four feet deep, made for the channel of the river Boyne, in the County of Kildare.

In March, 1859, the remains of two species of bears were found in a limestone quarry at Shandon, in Dungarvan, County of Wexford, with bones of the Mammoth, by Mr. Brenan. These have been described in a valuable communication to the Royal Dublin Society, by Dr. Carte, of Dublin, as belonging to the great Cave Bear, *Ursus spelæus*, and the brown or Fen Bear, *Ursus Arctos*.

In a recent exhumation of bones from Lough Gur, near Limerick, in August last, a right humerus, a left femur,

a right fibula, some ribs, and the atlas and axis vertebræ of a bear were found by Mr. William Hinchley. These bones have also been most carefully compared by Dr. Carte with bones of the *Ursus spelæus* and *maritimus*, and he is of opinion that they are identical with the bones of the last animal. As the acquisition of a new species is always an interesting circumstance, and more especially as the Polar bear has never hitherto occurred in Britain, or even in Europe, in a fossil state, it is the more to be regretted that a skull has not been found, as the diagnosis of the *maritimus* would have been more satisfactory and decisive in that portion of the skeleton than from the bones of the extremities alone. The removal of all semblance of doubt on the question is the more essential, as this species will prove one of the most important additions made to our Fossil Fauna for many years, and, with the Musk Ox, go far to prove that instead of this country having cooled down from that of a tropical climate, it has been gradually increasing in temperature since the Glacial Epoch, as we have now three decidedly boreal quadrupeds, the Rein Deer, Musk Ox, and Polar Bear; besides the Moose Deer, which is also a northern species.

During the autumn of last year, I was indebted to the kindness of Mr. J. Glennon for the loan of the two fine crania previously alluded to, and finding upon close examination that they presented a difference of conformation much greater than, I conceive, could be expected to result from age or sexual distinction merely, as both have evidently belonged to adult individuals, I propose to point out such characters as appear to me sufficient to mark them as belonging to two distinct species of bears. The most striking difference observable on looking down upon the two skulls in juxtaposition, is not only the disparity in size and the much greater entire length of one than the other, but



FIG. 1.



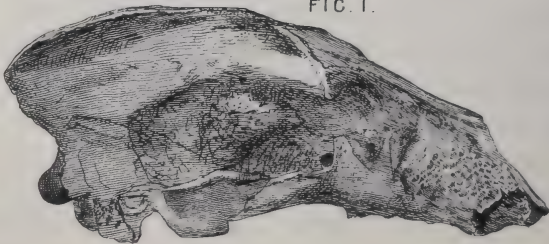
FIG. 2.



FIG. 2.



FIG. 1.



also the extent of the sagittal crest, the peculiar conformation of the sagittal expanse, the difference in formation of the forehead, the greater strength and width of the zygomata; and viewed from beneath there is a striking difference in the shape and size of the palatal margin of the nasal cavity, as also in the length from the margin of that orifice to the pterygoid process and to the occipital condyle, the former of which characters Professor Rolleston, of Oxford, informs me are not subject to variation.

Width of palatal margin in No. 1. . .	1½ in.,	do. in No. 2. . .	1¼ in.
Length of do. to pterygoid process . .	2	do. do. . .	1½
Length from palatal margin to occipital condyle . . . . .	6½	do. do. . .	5½
Palatal orifice to nasal cavity . . .	conical,	do. do. . .	cylindrical.

There are other less important characters (easier to recognize by reference to the figures of each, copied from accurate photographs, obligingly taken expressly for me by Mr. Hanson, of Leeds, than by a verbal description). The most essential peculiarities, however, will be apparent by a comparative measurement and enumeration of them in the two skulls, to which I shall refer as Nos. 1 and 2. (*See next page, and plate X., figs. 1 and 2.*)

From the characters just enumerated, I propose to assign the skulls to two different species of bears, in which opinion, I am happy to say, Professor Owen concurs, who says, in a letter to me (after seeing photographs of the skulls), "I do not regard No. I. as specifically the same with your No. II." The larger, which somewhat resembles in form the *Ursus maritimus*, but has belonged to an animal vastly superior in magnitude, and very nearly equal to *spelæus*, I propose to call *Ursus planafrons*, from the peculiar flat receding form of the anterior portion of the head. But it differs from the Polar Bear in the form of the orbital expanse, which in the latter is obliquely triangular, while in the former it is more

No. 1. PLANIFRONS.	Inch.	No. 2. ARCTOS.	Inch.	* STELEUS.	Inch.	* MARTIUS.	Inch.	FEROX.	Inch.
The antero-posterior extent is . . . . .	17	14½	19	14	13	15			
The length of the sagittal crest is . . . . .	8	4½	7	4½	4½	7			
Width of antero-superior orbital expanse . . . . .	6	5	5¾	4½	4½	5½			
Margin of do. very prominent, deeply emarginate.		Obtuse, gradually passing into the temporal bone.		Very prominent and distinctly emarginate, with a central depressed line.		Distinctly marked, but not elevated.		Distinctly marked and deeply emarginate posterior.	
Forehead comparatively flat and receding.		Forehead convex.		Abruptly convex with a sudden concavity anteriorly.		Low and receding towards the occiput.		Flat and receding.	
Transverse width of nasal orifices . . . . .	4½	Inch. 3½	Inch. 2½	Inch. 2½	Inch. 2	Inch. 2½			22 48
Length from nasal orifice to commencement of sagittal ridge . . . . .	7½	8½	8½	8½	7½	6			
Width of zygomatic arch . . . . .	9	9½	9½	9½	7½	9½			
One simple premolar on each side and nearest the canine.		Two simple premolars on each side, but much smaller than in No. 1.		No simple premolars.		Two simple premolars on each side, one near the canine, the other near the molar.			
Transverse cavity of last molar . . . . .	1½	Inch. 1½	Inch. 1¾	Inch. 1¾	Inch. 1	Inch. 1¼			
Transverse cavity of canine . . . . .	1¾	1¾	1½	1½	1	1½			
Width of occipital condyles . . . . .	3¾	2¾	2¾	2¾	2¾	3			

\* These two last are the other species which have been found in Ireland, and merely given for comparison.



lengthened and sagittiform; as also in the great difference in the length of the sagittal crest. In its size, the flattened form of the forehead, and the shape of the orbital expanse, there is a close resemblance to the skull of the Grisly Bear (*Ursus ferox*) of the Rocky Mountains, of which it may possibly have been the progenitor. It differs, however, in having only one permanent premolar on each side of the upper jaw, while *ferox* has two, which are also permanent—as I find from a noble adult skull of this species lately added to the Leeds Museum, which still retains its premolars. The smaller specimen I believe to be the Fen Bear (*Ursus Arctos*), though from its less protuberant forehead it resembles the *Ursus Priscus*. Hitherto I believe the *priscus* has only been found in caves, with spelæus, and, therefore, as a cave-hunting species, unlikely to be found submerged beneath a bog. The same objection, however, would apply to *Arctos*, which at the present day is found exclusively in forests in the north of Europe, and yet this species has been exhumed from a bog in Cambridgeshire, as well as from similar situations in Ireland.

The occurrence, however, of an individual or two in lacustrine formations, ought not to invalidate their identity, as an occasional straggler,—in the pursuit of the *Magaceros*, with which it was contemporary,—might either have become mired, or perished by the horns of that noble animal when at bay in a morass, in which situations the remains of this gigantic ruminant are almost invariably found. I am aware that some Palæontologists will object to my diagnosis of species, and consider the convex forehead as a character not constant to depend upon, but with due respect to such opinion, I may remark that if it is not constant, the absence of convexity is the exception to the rule in those species where it occurs. I have four skulls of the Polar Bear, of different ages, but not one exhibits a departure from the flat, low fore-

head so characteristic of this species. In fact, the general contour of the head of an animal prepares you for the form of the skull. In the Brown Bear a slight concave depression is observable between the orbits, and an apparent shortening of the nasal bones, which agrees with the semi-convex forehead in the skull of the fossil *Arctos* and *Priscus*. In these, also, the great width of the zygomatic region is perceptible: which character also agrees with the breadth of the head in the recent Brown Bear. In the Cave Bear (*Ursus spelæus*), the forehead is abruptly protuberant, with a sudden concavity towards the nasal bones, the lateral region of the skull is much compressed, and the superior maxillary bones protrude considerably beyond the nasal orifice, apparently indicating that this gigantic bear had a very flexible and extended nose; and I am not aware that skulls of this species are ever seen in which the great convexity of forehead is not a prominent character, and the other features just enumerated are not also constant. In the Bornean and Sloth bears, the heads are comparatively short and broad, and the skulls have a peculiar convexity, which almost approaches the segment of a sphere in longitudinal extent.

The number and position of the permanent premolars ought also to be considered a character of sufficient importance to depend upon for specific difference. Specimens may occur in which their number are not equal, an instance of which, R. W. Scott, Esq., informs me, is in the Royal Dublin Society's Museum. This skull is of *Ursus Arctos*, in which there are two premolars on one side of the upper jaw, and only one on the other. This, however, I do not consider as an exception to the rule, and venture to think that, upon close inspection, there will be discovered some slight indication of a premolar having been lost, and the space nearly obliterated by the natural absorption of the alveolar cavity; and, if there is not such indication, it is evidently a

monstrosity, and not to be considered as characteristic of uncertainty, as I cannot bring myself to believe that each species of animal has not a definite number of teeth assigned to it. I am aware that in some species of the genus *Ursus*, as *spelæus* for instance, there are in early life, small premolars, which become obliterated as the animal approaches maturity. In the Bornean Bear skull, which I possess, there are three minute premolars on each side, which are also temporary, as I presume from their extremely small size, which would render them comparatively useless in an adult. In the Irish skulls, however, under consideration, the individuals to which they belonged had evidently been mature, if not aged, and, therefore, the premolars were permanent and definite.

Another point connected with the premolars, is their position relative to the canine teeth, which it would be preposterous to suppose is uncertain. In all the other teeth the position is constant; and I am not aware of any instance which could be cited to prove that the same regularity does not prevail with the premolars also. In this peculiarity again, the two skulls differ considerably as to the space between the first premolar and the canine tooth, which is a circumstance not to be overlooked as an accidental occurrence merely, but on the contrary, may be considered as affording additional evidence of distinction.

Should my conjecture, therefore, prove correct as to the specific difference of the larger skull, it will be the means of adding another species of bear to the extinct Fauna of Ireland: \* a greater number of the genus than is now existing, or has previously existed (as far as we know), in any one locality on the globe. And as the Mammoth is now known to have been a former inhabitant of the primæval Irish forests, and the Hippopotamus of its swamps and marshes, it is not too much to expect that when the limestone caverns of

\* *Spelæus*, *Arctos*, *Maritimus*, and *Planafrons*.

that country have been as minutely explored as those of England, we may also find the Hyæna, Tiger, Rhinoceros, and other extinct mammalia of the Pleistocene period, and thus obtain evidence that the Fauna of the two countries has once been identical; by which fact the inferred probability of the continuity of land, by the union of the opposite coasts at a remote period, will be considerably strengthened, if not confirmed.

Now as we know the extinct bears were the contemporaries of the Megaceros, Rhinoceros, Mammoth, Hyæna, Aurochs, and other large mammals of that early period, it may be asked—have we yet any evidence of their having been coeval with man himself?—which is the most interesting, if not important, question of the present day. Until very recently, it was supposed that the great Cave Bear had disappeared at the commencement of the Post Pliocene period; but the labours of Dr. Falconer, Lartet, Pictet, Boyd Dawkins, and others, have brought forward such startling facts as to the undoubted association of human remains with those of extinct mammalia, that it is almost impossible to receive their statements, and yet refuse to reason with fairness on the evidence they supply, which appears the most conclusive as to the above point. Take that of Mons. Lartet alone. In the cave at Aurignac, in the South of France, he found flint implements, worked portions of Reindeer's horn, human bones in a high state of preservation, and bones of animals scratched and indented as though by implements, to remove the flesh and marrow, as is done by many modern tribes of savages. The human implements consisted of bone knives, flattened circular stones, supposed to have been used for sharpening flint knives, perforated sling stones, many arrow heads and spear heads, flint knives, a bodkin made of Roebuck's horn, and a tusk from the great Cave Bear (*Ursus spelæus*), one end of which had been rudely carved, and the tusk perforated lengthwise,

as if for suspension as an amulet or bead. Remains were also found of nine different species of Carnivora, such as the Cave Bear, Hyæna, Cat, Wolf, Fox ; and of twelve Herbivora, such as the Elephant, Rhinoceros, great extinct Stag, Bison, Horse, Reindeer, &c. : the most common were the Bison, Reindeer, and Fox. Now, the simple fact of the bear's tusk being perforated to string as a personal ornament by these primitive inhabitants of the Pyrenees, appears to me sufficient of itself to prove that they were obtained from animals still living in the neighbourhood. Perforated teeth of the wolf were found in the Craven caves ; and in the excavations connected with the examination of the Roman wall, near Newcastle, perforated teeth of the bear were discovered, with other antiquities ; and it is still a practice with the uncivilized tribes of Africa, to form necklaces of the canine teeth of the leopard and other feline animals, which is a singular coincidence of the similarity of tastes and usages in people of probably similar habits, at two such distant periods of time ;—and I confess it appears to me as fair to infer that these early people killed and eat the bear and other animals, and used their teeth and other reliquæ for domestic purposes or personal ornaments, as to suppose that they availed themselves of such bones and teeth of still earlier occupants of the caves as were spread over its floor, when they first took possession of such simple habitations. If the great *Bos primigenus* fell by the flint implement of the primitive inhabitants of this island, of which we have now incontrovertible evidence, why not its cotemporary mammals as the bear, &c.

In support of which view, the facts disclosed by the cave at Aurignac are of a nature which ought to remove every shadow of a doubt. In some caverns or fissures where the bones of extinct mammals and implements of human construction have been discovered in association, there has been no proof that man might not have been an occupant long

subsequent to the extinct animals, or that the remains of both had not been washed in simultaneously by the agency of some diluvial current. But here at Aurignac, we find a sepulchral chamber with the remains of seventeen human skeletons, various bone and flint implements, and, in juxtaposition, the bones of a nearly entire skeleton of the great Cave Bear—besides bones of various other animals;—and the aperture to this Charnel-house, closed by a large slab of stone, outside of which was an accumulation of soil, charcoal, and cinders upon a floor of stone, reddened as if by heat, but no human bones. The difference, however, in the condition of the osseous remains, was very remarkable. Those bones which occurred outside had been mostly split up to extract the marrow; some appeared streaked, as if the flesh had been scratched off by a flint instrument, the spongy parts had been knawed and eaten off by Carnivorous animals, probably hyænas, whose bones and coprolites were mixed in abundance with the overlying soil, and who had probably prowled about the spot after the funeral ceremonies were ended, to devour the remnants of the funeral repast. The bones in the interior, on the contrary, were all entire and uninjured, none broken, gnawed, half-eaten, scraped, or burnt, like those lying outside among the ashes, but appeared as if they had been deposited with the flesh on them! Here, then, as Sir C. Lyell eloquently observes,—“If the fossil memorials have been correctly interpreted; if we have here before us, at the base of the Pyrenees, a sepulchral vault with skeletons of human beings, consigned by friends and relatives to their last resting-place; if we have also at the portal of the tomb the relics of funeral feasts, and within it indications of viands destined for the use of the departed on their way to a land of spirits, while among the funeral gifts are weapons wherewith, in other fields, to chase the gigantic deer, the Cave Lion, the Cave Bear, and Woolly Rhinoceros, we have at last suc-

ceeded in tracing back the sacred rites of burial, and more interesting still, a belief in a future state, to times long anterior to those of history and tradition. Rude and superstitious as may have been the savage of that remote era, he still deserved, by cherishing hopes of a hereafter, the epithet of 'noble,' which Dryden gave to what he seems to have pictured to himself as the primitive condition of our race—

'As nature first made man,  
When wild in woods the noble savage ran.'

While thus endeavouring to extend the period of man's sojourn upon the earth to a more remote epoch than the one usually received; for which we have abundant collateral evidence, I am by no means advocating the supposition of a Pre-Adamite race, which is both unnecessary and unwise. The argument that the earliest historical documents and monumental remains attest a higher state of civilization than man could be supposed to have arrived at, so soon after his creation, carries no weight with it. In the first place we have no definite knowledge of what ages may have elapsed between man's advent and the erection of those stupendous edifices, whose remains have come down to us; and secondly, it presupposes that a low and more barbarous form of the human family were first called into being, who were in time replaced by the more highly organized and more amply endowed race of which we are the descendants; we are expressly told in the simple, but explicit language of Scripture, that man was the last created, and the most perfect in mental and physical powers, to have dominion over every living thing upon the earth, and as such it was only necessary for him to have an infancy or educational period to pass through before arriving at that state of civilization to which all seem to point for the first few generations. I would, therefore, venture to ask, is it not as rational to suppose that man commenced his

being perfect in all necessary knowledge from the hand of his Maker, and that by degrees after the fall some portions of the human family degenerated into a state of semi-barbarism as they spread into distant parts of the earth? Just as we know to take place in the human family at the present day, when left to the unrestrained indulgence of their passions, and removed from civilized life and the effects and influence of education. These early and degenerated races were probably the fabricators of the rude implements now exhumed, who had to combat with the Carnivora, huge Pachyderms and Herbivora of the same age, in the Darwinian struggle for life. But who will dare to define this remote period? which doubtless dates countless ages before the earliest written records, all of which are comparatively modern, and throw no rays of light upon these primæval people and their histories, which are alike veiled in the obscurity of the past. A modern writer ably illustrates this where he says:—"We turn to the Hebrew and the inspired records, but we soon discover that though containing a picture, unequalled for simplicity and dignity, of the earliest experiences of the present family of men, they are by no means a monument or relic of the most remote period, but belong to a comparatively modern date, and the question of time is not at all directly treated in them. We visit the region where poetry and myth, and tradition, have placed an ancient civilization—Egypt. We search its royal sepulchres, its manifold history written in funeral records, in kingly genealogies, in inscriptions, and in the thousand relics preserved of domestic life, whether in picture, sculpture, or the embalmed remains of the dead; and we find ourselves thrown back to a time far beyond any received date of history, and still we have before us a ripened civilization, an art which could not belong to the childhood of a race, a language which, as



far as we can judge, must have needed centuries for its development. The division of human races, whose formation from the original pair, our philosophy teaches us, must also have required an immense and unknown extent of time. We traverse the regions to which both the comparison of languages and the Biblical record assign the original birth-place of mankind,—the country of the Euphrates and the plateau of Eastern Asia. Buried kingdoms are revealed to us; the shadowy outlines of magnificent cities appear which flourished and fell before recorded human history, and of which Herodotus never heard. Art and science are unfolded, reaching far back into the past. The signs of luxury and splendour are uncovered from the ruins of ages, but, remote as is the date of those Turanian and Semitic Empires—almost equalling that of the flood in the ordinary system of chronology—they cannot be near the origin of things, and a long process of development must have passed ere they reached the maturity in which they are revealed to us. The Chinese records give us an antiquity and an acknowledged date before the time of Abraham, (if we follow the received chronology), and even then their language must have been as it is now, distinct and solidified, betraying to the scholar no certain affinity to any other family of languages. Indian history, so long boasted of for its immense antiquity, is without doubt the most modern of the ancient records, and offers no certain date beyond 1800 B. C. In Europe, the earliest evidences of man disclosed by our investigations are even more vague and shadowy. Probably, without antedating in time these historical records of Asia, they reach back to a more primitive and barbarous age. The earliest history of Europe is not studied from inscriptions or manuscript, or even monument. It is not like the Asiatic, a conscious work of the people leaving a memorial of itself to a future age. It is rather like

the geological history, an unconscious, gradual deposit left by the remains of extinct and unknown races in the soil of the fields or under the sediment of the waters. The earliest European barbarian, as he burned his canoe from a log or fabricated his necklace from a bone, or worked out his knife from a flint, was, in reality, writing a history of his race for distant days. We can follow him now in his wanderings through the rivers and lakes, and on the edges of the forest; we open his simple mounds of burial and study his barbarian tools and ornaments; we discover that he knew nothing of metals, and that bone and flint, and amber and coal were his materials; we trace out his remarkable defences, and huts built on piles in the various lakes of Europe where the simple savage could escape the few gigantic animals which then existed; and we find, also, that he fabricated some rude pottery. Of what race he was, or at what time he appeared amidst the forests of Northern Europe, no one can confidently say, but the Archæologists have denominated their period the "Stone Age of European Antiquity."

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Since this Paper was read, the skulls alluded to have been purchased and presented to the Museum of the Philosophical and Literary Society of Leeds, by J. G. Marshall, Esq., Arthur Marshall, Esq., Andrew Fairbairn, Esq., and James Hamilton Richardson, Esq.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE SIXTY-FIFTH MEETING, HELD IN THE  
GYMNASIUM HALL, HUDDERSFIELD, ON THURSDAY, JUNE 16TH, 1864,  
AT TWELVE O'CLOCK AT NOON.

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FREDERICK ROBERT JONES, Esq., in the Chair.

The Rev. G. Lloyd, of Thurstonland; John Freeman, Esq., Huddersfield; and Benjamin Crowther, Esq., Wakefield; were elected members.

The Chairman then called upon the Rev. W. C. LUKIS, F.S.A., to read a Paper

ON THE HISTORY OF LEEDS BEFORE THE NORMAN CONQUEST,  
BY THOMAS WRIGHT, ESQ., M.A., F.R.S., ETC., OF LONDON.

The science of history is perhaps the highest of all the sciences, inasmuch as its object is to make us acquainted with man in the exercise of his most divine faculties, whether for good or for evil, with the progress of his mental culture, in a word, with the development of his destiny; it prepares him for the future by the knowledge of the past. Moreover, man seems to have a natural tendency to the study of history, he seeks with eagerness to trace the revolutions of peoples and kingdoms which are known to him, he is anxious to become acquainted with the history of his own country, and,

to restrict still more the field of inquiry, who is there who is not curious to learn something of those who have inhabited in former times the place in which he was born, or in which he lives, and of the events in which they were engaged? It was for this reason that, when asked to read a paper before the Geological and Polytechnic Society, I chose for my subject the early history of Leeds and of the district surrounding it. Leeds has, during the whole known historic period, been a place of considerable importance. Beginning with the earthworks raised by a primitive people at some unknown date,—I will not venture to say whether Britons, or Romans, or Saxons,—which formerly crowned that part of the town now covered by houses and lanes between High Street and Charles Street; your town appears to have been the resort of Anglo-Saxon princes; it was intimately connected with the first introduction of Christianity into these northern parts of Anglo-Saxon Britain; it was occupied by a Norman castle of some importance; and it took its full share in all the great political movements in the history of our country, until it has now become one of the principal centres of its wealth and national resources.

It is evident that to take this full expanse of your history, would require a bulky volume, and that it would be absurd to attempt to bring it within the narrow limits of this paper. I will, therefore, venture to take for our subject this evening only the earliest and least known portion of the history of Leeds, which, nevertheless, contains much which is interesting in relation to primitive monuments still remaining among you, and much which is intimately connected with the early glories of our Anglo-Saxon race. In tracing back our national antiquities to their earliest date, we were always obliged to halt at an indefinite period which it was not thought safe to place long before the time at which our island was first visited by its Roman conquerors; but at the

present time new questions have arisen, as yet obscure and uncertain, but which we cannot avoid taking into some consideration when we treat of the antiquities of any part of our island. During the last few years, the antiquary has entered into alliance with the geologist, and out of this alliance new ideas have arisen, which are all embodied in the great question of the antiquity of man, whether he has existed on this earth only during the comparatively short period to which history seems to point, or whether he has inhabited it through a period stretching over a vast number of ages before time is known to history at all. It is a question of great importance, which is at present very far from decided. The supposed evidence of this great antiquity is found, 1st, in flint implements, rudely formed, but certainly by the hands of man, which have been discovered in the drift gravels in the valleys of the Somme and the Seine, in France, and in some of the river valleys in England, associated with bones of animals which must have been extinct in these countries at a very remote period; 2nd, caves, in which objects made by man, and remains of man himself, are found intermixed with the remains of animals which also must have become extinct at a very remote period, while the caves themselves are supposed to have been removed by some natural convulsion out of their original position since these deposits have been made; 3rd, remains of objects made by man, found at great depths in the ground; 4th, ancient shell-mounds, or heaps of refuse from the eating of shell-fish, found chiefly on the coasts of Denmark and Scotland; and 5th, the ancient lacustrine villages, or groups of huts raised upon piles, which have been discovered in the lakes of Switzerland, and which have been ascribed to a period hardly less remote than that of the bone-caves.

The stone implements found in the drift have all the appearance of being as old as the drift itself. As they possess no

peculiarities which point to any definite date, we can only suppose that they are contemporary with the drift, and wait for further means of ascertaining the period at which the latter was deposited. It does not appear that there is any reason for believing that these flint implements necessarily belonged to the same period at which the animals lived, bones of which are found in the same drift. The only implement made by man, as far as I know, which has hitherto been found in the shell-mounds in this island, is a rather rudely worked bronze pin, which is ascribed with little hesitation to the ninth century of our era. The objects found in the lacustrine villages, are very numerous and varied, and belong to different periods, but chiefly Roman, or presenting forms which fix no date, and therefore may be older than Roman, or they may be more recent. Other objects found in these pile-works, show that they must have been inhabited after the Roman period, for rather numerous examples of pottery which I have seen in the engravings accompanying the publications of the Swiss antiquaries are certainly Germanic, and belong, probably, to the fifth or sixth century. Now, I can understand that these Swiss lakes may have been inhabited during several centuries by a people, or peoples succeeding each other, who lived on them much in the same manner, but I consider it most improbable that such a continuance should have lasted thousands of years; and I think we may fairly put the question, whether those who advocate this extreme antiquity, instead of giving any good reasons for disturbing our previous archæological views, may not be building upon assumptions without any real foundations.

As none of these discoveries have occurred within the range of our present subject, I will enter into no further investigation of them; but the case is different with the two other classes of evidence. The caves are peculiar to the hilly

country a little beyond the north-western limits of the district formerly included under the name of Leeds,—in the wilder district of Craven; while the discovery of objects of ancient art at great depths under the present surface of the ground, under circumstances which would lead us to suspect that they had been deposited there at a very remote period, have occurred not unfrequently within the immediate neighbourhood of Leeds itself, and you have several examples of the objects thus found in your own museum. Some twelve years ago, in the course of excavations at Wortley, in the valley of the Aire, a deposit of bones of the very early extinct animals, among which were the hippopotamus and mammoth, was met with, and, as it is stated, in rather close association with them, an object of stone, which was judged to be a quern, or hand-mill for grinding corn, and two pieces of broken pottery. An account of these was given in the Report of the proceedings of your Geological and Polytechnic Society for 1856, by Mr. Teale, who expressed his conviction of the accuracy of his information that these objects lay at a depth of five feet in a six-foot bed of undisturbed clay. Of the two fragments of pottery, one has the well-known glaze which is considered to be not older than the Norman period, with an ornament which is characteristic, although rude, of the Anglo-Norman pottery of the twelfth century, to which period, at the earliest, I believe it belongs. This, therefore, could have no relationship with the fossil bones of the Pachyderms. The object in stone appears to me to have been formed from the frustrum of a small Roman column, which had perhaps been used afterwards for some other purpose.

Again, in the same Report of the Geological and Polytechnic Society, our excellent friend, Mr. Denny, has described an iron implement which he terms a “leister,”—in fact, an implement for spearing fish—which was found in

1851, in excavating for the terminus of the Leeds sewerage, on the south side of the Suspension Bridge, below Knostrop, at the depth of ten feet, in a bed of gravel, with some other articles which displayed man's handiwork, and he thought it might have belonged to some Scandinavian fisherman. Fortunately, your museum possesses this object also, and a glance at it will convince us that it is the work of a later period than that of Danish rule in the North of England. And, while speaking on this subject, I would earnestly impress, not only upon the members of the Philosophical Society, but on others also, how useful it is for the promotion of true knowledge that objects like those I have been describing should be collected together into one place, that they may thus be easily available for comparison and study, and how desirable it is that some means should be employed by which all such articles found in this part of the island should be brought to this museum as soon as discovered. It appears from Mr. Denny's account that other articles in metal were found with this leister, but they were afterwards dispersed, whereby we have probably lost the means of ascertaining more exactly the date of the deposit.

You have in your museum another object, in many respects of still greater interest, and which I believe you owe to the zeal of my friend, your late secretary, Mr. O'Callaghan—I mean the curious ancient boat, or canoe, formed out of the solid trunk of a tree. It was found, I understand, lying on the rock, under six feet of soft laminated clay, at a place called the Tarn, in the parish of Giggleswick, which is understood to have been the site of a lake, now drained. There is no mark about this boat to give us the slightest help in identifying its age, which may be very remote, and certainly cannot be very recent. Ancient boats of this general character have often been found at considerable depths in many parts of our island, but, as they are somewhat heavy, and



must have been lost in lakes or rivers, we may suppose that, falling upon mud and clay, which was soft from being under the water, they would gradually sink by their own weight, and thus add to the depth they would gain by the subsequent deposit from the water. I believe that such boats were in use in some parts of the country down to a comparative late date, and the interesting specimen to which I am alluding possesses peculiarities which seem to show that it is not a very early example.

Giggleswick, where this boat was found, is closely adjacent to Settle, where some of the most interesting of the Yorkshire caves are met with, and which must, in early times, have been a very wild and uncultured district. A good account of the caves examined in King's Scarr, near Settle, and of the various objects found in them, is given in the first volume of my friend Mr. Roach Smith's valuable *Collectanea Antiqua*. As caves of this description are now very well known, I will not occupy your time in describing them, but I will merely state that they contained bones of animals, including the hog and the bear, many of which appeared to have been gnawed; a great variety of objects of antiquity, most of them evidently of Roman work, and apparently late; and a good number of coins. These latter established, beyond a doubt, the lateness of the date at which these caves had been occupied by men. Some of them were Roman, chiefly of the Emperors of the Constantine family, which formed the mass of the monetary circulation in Britain at the close of the Roman period, but the greater proportion of them consisted of the rude imitations of the coinage of these Emperors which were made and circulated after the withdrawal of the Roman power, and which cannot, therefore, be older than the fifth century. Some of these caves, in Craven, have been more fully examined since the account printed by Mr. Roach Smith, in the *Collectanea Antiqua*; and the new discoveries

have been well described by Mr. Denny, in the Report of the proceedings of the Geological and Polytechnic Society for 1859. Objects of the same description were found, with the addition in one of the caves of bones of the wolf, the hyæna, and the cave tiger, but the remains of these animals, long extinct in our islands, were very few. It is curious that, in most of these caves yet explored, the objects found which come under the examination of the antiquary, of which the date can be given, belong to nearly the same age, although mixed to a small degree with works of ruder make, such as stone implements. Two years ago, a certain number of manufactured objects found in a similar cave at Heathery Burn, near Stanhope, in Durham, were exhibited before the Ethnological Society of London, and such of these fragments, for they were but fragments, as had preserved their original form, were easily recognised as Roman work, and as resembling those which are found among the remains of a late part of the Roman period. Similarly, the objects in bronze found in Kent's Hole, near Torquay (in Devonshire), were, I believe, all late Roman. And I have no doubt that other similar examples might be added. Now, from these facts—for they are facts—I conclude that the time when people resorted to these caves was that of the turbulence and confusion which marked the decline of the Roman power, and the equally turbulent period which immediately succeeded it. With our entire ignorance of the exact state of society during that period, it would be idle to attempt to give a reason for this resort, and, therefore, to assign a merely conjectural cause for their having been frequented at any particular period, is absurd. The passion for conjecturing, without sufficient knowledge, has been the bane of archaeological science during the past age. I must, however, urge that the circumstance of finding in these caves evidence of their having been resorted to at a late date entirely cuts

away the ground for assuming that the remains of man found in them must be coeval with the fossil bones or remains of extinct animals which occur in company with them.

Having thus referred, perhaps hardly briefly enough on this occasion, to the alleged monuments of a supposed extreme antiquity, I will beg your permission to make a few remarks on another of the new doctrines on early archæology, I mean that of periods marked by the use of particular materials, named the Stone period, the Bronze period, and the Iron period, and now further classed in sub-divisions of at least the two first. I have put on record my own protest against this system in a paper read before your Geological and Polytechnic Society and printed in its reports, and since reprinted in my two volumes of Archæological Essays, and I have only to add that the more I have considered and examined it, the more I am satisfied of its entire want of truth. The principles of this system seem to be, that there was first a period, supposed to be of very great duration, in which stone was the only material used, to the exclusion of all metals; that this was followed by a period in which bronze was the only metal used; and that then came a period in which the use of bronze was superseded by that of iron. And now, further, these periods are divided into 1st, 2nd, &c. Stone periods, or Bronze periods, in the belief that there is a distinction in the shape or make of the different objects which indicates different periods to which they belong. I will again state my objections to this system in as few words as I can.

First, with regard to the so-called Stone period, I do not dispute that there may have been, and, in fact, I believe that there was, a remote period in which the best known material for the manufacture of weapons, or implements for cutting or hammering, was stone. When metal was either unknown, or could be obtained only with difficulty, three materials were

accessible, wood, bone, or stone, of which the two former could not be worked to a sufficiently sharp cutting edge, and wanted the important quality of weight, so that stone, easily obtained, and not difficult to be shaped, was decidedly preferable to the others, and was the only material which could, for such purposes, be made of any real utility. But this system of periods rests upon a theory, if not openly avowed, at least implicated, that at any given times the whole population was in a uniform state of civilisation, possessed a uniform facility of obtaining whatever materials were attainable, and went through a uniform progress, in which I do not believe, except in regard to people who are in a very low state of savage life. Even in the very proudest time of Roman rule, there were many districts in our island where there must have been a very small supply of metals, and where, at intervals, they could not be procured at all, and then the people of such districts must have been obliged to have recourse to the more easily obtained material, stone. Moreover, there can be no doubt that during the Roman period metals cannot have been cheap, and were not to be thrown away, and people of the less civilised districts, who lived upon the produce of the chase, would make use of stone for the heads of arrows which were shot from bows, or of heavier weapons which were thrown by the hands or by slings, and which very probably they might not recover. This practice would of course prevail still more in districts which themselves produced no metal at all. These facts are remarkably illustrated in regard to the county in which we are now assembled. In the maritime district of eastern Yorkshire, in the centre of which the town of Bridlington stands, which evidently was in Roman times an isolated and uncultivated region, which produced no metals, and the inhabitants of which appear to have lived by hunting and fishing, and where we find but few traces of Roman settlements, flint implements,

especially arrow-heads, sling-stones, spear-heads, and what are supposed to be knives, are found scattered about in great abundance; while in the country of which Leeds is the centre, which produced iron plentifully, which was traversed by Roman roads in various directions, and in and around which were important Roman settlements, implements of stone are found more rarely. If these stone implements belong to a period anterior to the Romans, and before the metals were extracted from the ground, why are they not found as frequently in the neighbourhood of Leeds as in that of Bridlington? And so, when we leave the Leeds district, and enter the wilder country of Craven, we find, in the caves, for instance, which must have given shelter to a very unrefined class of people, objects formed of stone and the ruder materials, mixed with the materials in metals. So, again, if we look to Shropshire and the counties on the borders of Wales where the great Roman mining operations were carried on, which were covered with Roman towns, Roman roads, and Roman settlements of every description, and where the metals, therefore, must have been much less difficult to procure than in many other parts of the country, implements of stone are seldom found. And this, I think, will be found to be the case generally. There is, however, more substantial evidence that stone was used in this manner, not only during the age of the Romans, but at much later periods, and for the same reasons. Stone implements have been found in Pagan Anglo-Saxon graves; they were no doubt in use among the Christianized Anglo-Saxons. In the Latin-Saxon vocabularies, made for the purpose of teaching the former language to school-boys, compiled not earlier than the latter part of the tenth century, and preserved in manuscripts of the earlier part of the eleventh, we have in one the Latin word *bipennis*, explained by *stan-bill*, i.e. a stone-bill; and in another, under the head of axes and such im-

plements, we find the entry, "*Bipennis*, twibille, *vel* stan-æx," literally a twibill or stone-ax; while a third enumerates, under the head of agricultural implements, "*Bipennis*, stan-ex," a stone ax. It is quite clear from this that our ancestors, as late as the beginning of the eleventh century, were well acquainted with the use of stone axes and stone bills. Moreover, I think that a careful consideration of a great number of the earlier specimens of these stone implements will show that many of them must not only have been formed with tools made of metal, but that many of them are also evident imitations of the forms of metal implements. As I began by observing, I do not deny that there was a time when men had no better material to form their weapons and cutting or hammering tools than stone, but I deny altogether that the use of stone for such purposes was restricted to that period, or that you can judge by the form or character of any particular implement made of stone, to what particular period it belongs.

Second.—The period of bronze has to encounter still more serious objections. I deny that there is any authority, or any reason, for stating that the use of bronze preceded that of iron, especially in countries like ours, where iron is abundant and readily obtained. I have the printed authority of my friend Dr. Percy for stating that iron is the easiest of all metals to smelt into a malleable condition, while bronze requires the far more difficult and complicated process of smelting copper as well as that of smelting tin, and also the knowledge of moulding and casting. We have, moreover, to the contrary the assertion of a contemporary, who had every opportunity of ascertaining the truth of what he stated, and who was not in the habit of speaking loosely. In his final invasion of Britain in the year 55 before Christ, when he reduced the states with which he came in contact to at least temporary

subjection, Julius Cæsar evidently informed himself with care not only of the general condition of the island, but of the productions of value which might be derived from it, and he tells us distinctly that, in the first place, the natives used square pieces of bronze or iron, of fixed weights, for money, from which we are to understand that they had then no coinage. He then proceeds to state that "tin is produced in the interior of the island, and iron in the maritime districts; but the quantity of the latter is small; their bronze (*æs*) is imported." I can imagine no reason why we at the present time, on nothing better than assumptions of our own, should reject the deliberate statement of a man in the position of Cæsar, who obtained his information personally, who was interested in obtaining information that was correct, and who possessed an intelligence too high to be easily deceived. Cæsar does not tell us that the Britons were ignorant of bronze when he visited them rather unceremoniously, but he assures us that iron was the metal of the two with which they were best acquainted, and that bronze was a metal which they obtained from abroad, no doubt from Gaul. Why then should we think that they made their weapons and working tools of the newly introduced metal bronze, when they may have had the previous knowledge of the better metal, iron, which was produced in their own country? All probability, indeed, is in favour of Cæsar's statement, for why should we suppose that a people living in the midst of iron, should find and adopt a mixed metal like bronze, when they had a simple and much more useful metal before their eyes?

Before leaving the testimony of Julius Cæsar, I will venture another remark, which goes to corroborate the accuracy of his statement. He knew only of two metals which so late as his time were obtained in the island, iron and tin—the first found in the "maritime districts," by which no doubt he meant the great weald of Sussex and Kent, which

we must not forget was the territory of the new Belgian settlers, who no doubt carried on the iron mining. I think it no less certain that by the interior of the island Cæsar meant Cornwall, whence the tin was brought overland to the part of the island visited by the great Roman. The operations of mining for metals, I need hardly say, are processes which leave very apparent traces behind them, and if the Britons of the interior, those who preceded the maritime settlers, had been miners, we should hardly have failed to find some traces of their labours. Now I think I may venture to say that I have explored the remains of early mining in the interior of our island to a greater extent than any of our antiquaries, and it is my entire conviction that they were all commenced by the Romans themselves; that the Britons of the interior of the island, that is, in the great metallic districts, were not acquainted with the riches concealed in their hills and under the soil; and that Cæsar's statement is strictly true that when he wrote the iron of the weald and the tin of Cornwall were the only metals obtained from Britain. Lead was the first metal which the Romans procured in any quantity from Britain, and is first mentioned by Strabo as brought thence; and I judge, from a very careful survey of the great Roman lead-mines, that their whole plan shows that the Romans began them from the surface, and that when they first came to them they found the veins cropping out on the tops and sides of the hills, and previously untouched. So far from copper having been obtained before the arrival of the Romans, I believe from appearances that they were not acquainted with its existence here when they first came, but that they discovered it in their search for lead, the two metals occurring in the same localities, and that they never drew from Britain a very large supply. I believe, too, that we owe to the Romans the discovery of the rich iron-fields of the interior, such as that of the forest of Dean.



Thus the period at which the use of metals was comparatively unknown in Britain may have been at a much less remote date before the Roman period than some of our antiquaries seem to think.

The *supposed* bronze manufacture of the ancient Britons is represented chiefly by the leaf-shaped swords, the daggers which are in a manner cognate with them, and the implements of somewhat varied forms, which are commonly called *celts*. It is a name which means nothing, and would be better abandoned. I believe that all these objects belong generally to the Roman period, with the exception, perhaps, of the dagger, which has something more barbaric in its character, and may have been in use among the Britons of the Southern districts a short time before the Roman period. In the paper to which I have already alluded, and which will be found printed in the *Essays on Archæological Subjects*, I have explained in some measure the history of these bronze weapons and implements. No doubt, as I have before remarked, in the outskirts of the empire, commercial intercourse was slow and uncertain; so that individuals in outlying parts, who were of somewhat better quality than those who would be satisfied with stone, when they wanted implements of metal, would find great difficulty in obtaining them, if they were not supplied in a manner which was peculiar to the state of society in which they lived. We have certain evidence that there existed a class of travelling manufacturers, who made their courses through the distant provinces, and probably beyond their limits, to manufacture new weapons or implements, and who, in so doing, used up the metal of the old ones which had been worn out or broken. Bronze was the only metal available for this purpose, because it could be easily melted, and the implements required could be cast in moulds. The only luggage which these pedlars would have to carry about with them would be an earthen

vessel for melting in, a few moulds, and a certain quantity of metal; and it would be the less necessary to carry a great quantity of the latter, because those who looked for their visits would lay by in expectation their old metal to be used again. We find in various parts of England the remains of this traffic, and I have given a certain number of examples in the paper alluded to. Beginning with the county in which we are now assembled, a collection of sixty bronze chisels, &c., (the so-called celts), with a piece of a broken leaf-shaped sword of bronze, and a piece of bronze which appeared to be the residuum from melting, were found buried in an earthen vessel at Westow, about five miles from Old Malton, which is the undoubted site of a Roman station, and not far from the line of Roman road between that place and York. A similar collection of bronze celts, &c., whole and broken, was found, under similar circumstances, near the foot of the Wrekin, in Shropshire, between three and four miles from Wroxeter, the Uriconium of the Romans, and near the line of the great Roman road, the Watling Street. Another similar collection, with portions of a leaf-shaped sword, was found at Sittingbourne, in Kent, a town which there can be little doubt was a place of some importance under the Romans, and which lies on their road, the Watling Street. Another such collection, consisting of bronze punches, chisels, and other implements, with several pieces of unused metal, one of which appeared to be the residuum left in the melting-pot, was found at a village near Attleborough, in Norfolk, which, also, was no doubt an important place in Roman times, and lay on the Roman road between Thetford and Norwich. I might add other examples of such discoveries, but I will stop to remark, that the first thing which strikes us is the circumstance of their being all found in the neighbourhood of the Roman towns and Roman roads, which leads us at once to the conclusion that the dealers to whom they belonged had

travelled along the Roman roads, and had halted either at a temporary residence, or at their own homes. They had, moreover, followed the well-known Roman practice, which the middle ages derived from that people, of preserving their more valuable property by burying it in the ground. Discoveries exactly similar to those just described, and under similar circumstances, have been made in Germany, Switzerland, and France, which show evidently that all this traffic came from a common centre, the Roman empire, where such implements appear to have been designed more especially for the peoples of the distant provinces throughout Europe. The identity of form especially observed in the bronze leaf-shaped sword, whether found among the Celtic population of the British islands, among the Scandinavians of the North, among the Germans, and among the various Slavonic tribes, races which had nothing in common, points distinctly to this centre ; and two discoveries are recorded which prove clearly that these leaf-shaped swords of bronze did belong to the Roman period, and that they were in use until a late date in that period. One of these swords was found at Heilly, in the department of the Somme, in France, with other articles, among which were four brass coins of the Emperor Caracalla, so that these articles could not have been deposited there before the beginning of the third century ; and in another locality in that country, one of these swords was found with skeletons and coins, some of the latter of which were of the Emperor Maxentius, so that they must have belonged to the fourth century. The bronze "celts" have been found not unfrequently in the galleries of the Roman mining works in our island under circumstances which would lead us to conclude that they were left there at no very early date. From these facts, and others, I conclude that what has been called a bronze age, in the sense which antiquaries give to that term, never existed.

Third.—Of the Iron Period I need say nothing—we all know that, from the time when the use of iron was first discovered, this metal has never ceased to be employed.

Through the discussion of these questions, which I fear some will think almost irrelevant to our subject, we approach the period when history begins to dawn upon us, and we begin to have a clearer notion of the condition of the country around us. The geographer Ptolemy informs us, and his statement is confirmed by other contemporary writers, that the greater part of the interior of Britain was occupied by the extensive tribe of the Brigantes, probably the oldest of the British tribes then existing. All that I can say more of the Brigantes approaching to anything like certainty is, that they are considered as one of the branches of the great Celtic race in the West. In Ptolemy's time there was a tribe of the same name in Ireland so situated as to render it almost certain that one was merely a division from the other, but which was the original I will not venture to decide, though it appears more probable that the Brigantes of Britain had emigrated into Ireland, than the contrary. This would lead us to suppose that the original population of the interior of Britain, before the Romans took possession of it, may possibly have been Gaels.

With regard to the country around Leeds, all we know is that it lay in the heart of the territory of the Brigantes. Its pleasant valleys were probably covered with thick woods, and thinly inhabited. But the face of this country was soon changed when the Roman invaders came to take possession of the land, and under their enterprising activity the primeval forests yielded place to excellent roads and flourishing towns. Within a short distance from Leeds, at the place now called Castleford, on the river Aire, stood the Roman town of Legiolium, on one branch of their great Northern road, and it was no doubt a town of some importance from

the number of roads which branch off from it. One of these is said to have run direct to the Roman station of Cambodunum, the site of which has been identified, with apparent correctness, with the hamlet of Slack, between Huddersfield and Halifax, and proceeded thence to Mancunium, or Manchester. But the more important road to Cambodunum started from the Roman Calcaria, now Tadcaster, and passed near Barwick-in-Elmet, and probably through or near Leeds. Another road of some importance seems to have run from Legiolium (Castleford), over the moor to Whitkirk and Hawcaster Rigg, where there was a station, by Cookridge, where the remains of it were very distinct in Thoresby's time, through Adel, where we find the remains of a Roman town of some importance, and so on to the Roman town of Olicana, at Ilkley, from whence it proceeded over the mountains, which the Romans are said to have called the Pennine Alps, to Ribchester, in Lancashire, long supposed to be the Roman Coccium, but which recent discoveries appear to identify with Bremetenracum. There are traces of other cross roads within the district which is the immediate subject of my paper. Early in the last century the remains of a Roman villa were discovered at Cleckheaton, by Dr. Richardson; and Roman remains of one kind or other have been found in several localities. Your district had thus, within itself or immediately beyond its limits, no less than five Roman towns or stations of importance, Calcaria (Tadcaster), on the North-east, Legiolium (Castleford), on the South-east, Cambodunum (Slack), on the South-west, Olicana (Ilkley), on the North-west, and the unknown town at Adel nearly in its centre.

There is a suspicious name of a place in the parish of Adel in the Domesday survey, Burhedurum, which has led some antiquaries to suppose that the name of the Roman town may have been Burgodurum, or Burgodunum. Whatever it

name, however, it was of some extent, and possessed temples, for altars and votive inscriptions have been found there, some of which are now safely deposited in the museum of our Philosophical Society. One of the most interesting of these monuments is an altar dedicated to the goddess Brigantia. The same name occurs on an altar at Birrens, a Roman station in Scotland; and another, found at Chester, is dedicated to a *deæ nymphæ Brig.* It is not, however, necessary to suppose that this refers to a goddess of the Brigantes, for these altars were more commonly dedicated by settlers—soldiers usually—from some other part of the Roman empire, to the nymphs, or goddesses who were the protectors of the place of their birth, and who, as they imagined, still watched over them in their distant settlements. There are three places which might thus have given the name, Brigantium, in Switzerland, now called Bregentz; Brigantium, in France, now Briançon; and Brigantia, in Portugal, now Braganza. Of these I should be inclined to prefer the first.

The only other place in this district which has left us Roman inscriptions is Olicana, and at Ilkley, its modern representative, has been found an altar, dedicated to the Goddess Verbeia (*Verbeie sacrum*), which is of especial interest if the supposition of some antiquaries be correct, that Verbeia was the Goddess of the Wharf.

The activity and importance of this district under the Romans no doubt arose from two causes—first, it lay in the direct line of communication between one of the most important districts of Roman Britain, that which formed afterwards the kingdom of Northumbria, and the South-west, as well as between Lancashire and the Eastern parts of the island; and, secondly, its mineral riches were soon discovered by the Romans, and turned to advantage. That they obtained iron here extensively there can be no doubt. I am told that extensive beds of the scorix from which the metal had been

extracted, and other remains connected with Roman mining, have been found at Horsforth, at Adel, at Oakenshaw, at Scarcroft, and also in Leeds. When, about twelve years ago, they were carrying the sewerage down Kirkgate, in this town, the workmen came upon a great quantity of scoriæ, &c., at so considerable a depth as to leave little doubt that smelting had been carried on there by the Romans. In the time of Thoresby, great heaps of these ancient cinders were found at Allerton Gledhow, from which circumstance that antiquary supposed the name to be derived, for *gled*, in Anglo-Saxon, means a cinder. The lead mines of the Romans lay towards Craven, and appear to have been worked at a very early period, for some of the pigs of lead, prepared for transportation, have been found, bearing the name of Domitian—IMP. CAES DOMITIANO AVG COS VII—which carries us back to the first century of our era. Lead appears to have been considered at that time in the light of a very valuable metal, and that which came from Britain was especially esteemed, which was no doubt the reason why the emperors kept the mines in their own hands; but they seem afterwards to have let or granted them to others, for we find no pigs of lead bearing the Emperor's name after the second century.

Among other branches of the industry of the Roman population of our island, remains of potteries may be mentioned, which have been discovered at Hawcaster Rigg, above-mentioned as a place situated on a line of Roman road. Traces of another manufacture of a less creditable character have been found in some abundance at a place called Lingwell Gate, in the parish of Rothwell, near Wakefield. You possess an example of this manufacture in your own museum, which I have the satisfaction of exhibiting to you. It is part of a mould for casting Roman coins, objects which have been found in several localities in Roman Britain. The

imperial government, and its agents, appear to have adopted an ingenious practice for debasing the coinage, and at the same time saving their own credit. They made these clay impresses of the money of former emperors, and then poured in the debased metal, and when this was sent into circulation, which it was no doubt largely, it passed for good money, until now and then it would be discovered, and some imperial officer of a former reign would be considered to have been the forger.

The position of Leeds in the heart of this district, and near the junction of so many roads, would lead us to suppose that it must have been a place of some importance during the Roman period; and that this was the case is placed beyond any doubt by a statement made by the historian Bede, from which we gather that, at the close of the Roman period, some petty chieftain, either of native blood or of foreign descent, perhaps the latter, had established himself in a little kingdom (*regiuncula*), in the territory of which this town was looked upon as the capital, and that it was called Loidis, which was simply the ancient form of its present name. His successors maintained their independence amid the turbulence of the Anglian invasions and the formation of the Northumbrian kingdom, until the year 616, when the kingdom of Loidis was conquered by King Edwin and incorporated into his territory, apparently in revenge for the murder of his nephew, Hereric. The last of these kings of Loidis is generally supposed to have been a Briton by blood, and indeed his name, written by Bede Cereticus, might be supposed to represent Caractacus, or Caradoc, but it is unsafe to argue from mere names in such cases, and it might equally well represent the Teutonic name Cerdic. Mr. John James, your Yorkshire antiquary, in a very excellent paper, read here before the British Archæological Association last year, and since printed in the journal of that learned body, has traced the limits of this territory

Bede quotes *Nennius* or *Gildas*, and  
is an authority - There was no *kingdom Loidis*



in, I think, a very satisfactory manner. It appears to have extended in different directions to Tadcaster, Shirburn, Halifax, Bingley, and the borders of Craven, including the whole or greater part of the valleys of the Aire, the Calder, and the Wharfe, and to have remained with the same limits through the Saxon period still dependent upon Leeds, which had become a royal town; but the Saxons called this territory Elmete. This name is said to have been given to it on account of the number of elm trees which grew in its woods, but this is a derivation which appears to me hardly satisfactory, and that of the name Leeds is still more obscure.

The territory of Loidis, or Elmete, had other claims upon the consideration of King Edwin, in its pleasant valleys, the extensive woods with which they were covered, no doubt filled with game, and perhaps the political importance of its geographical position and of its roads, and he built for himself at, or not far from Leeds, a mansion, or palace, which continued long to be a favourite residence of the Northumbrian kings. The site of this palace has been generally supposed to be Osmundthorpe, where in Thoresby's time extensive and bold entrenchments were still to be seen, and where antiquities of various kinds have been at different times dug up. Among these was a gold coin of the Emperor Justinian, found in the year 1774, an object which points to a date not earlier than the seventh century, when that emperor lived, and which hardly can have been possessed in this district by any one of less than princely rank. The remarkable earthworks of what is supposed also to have been a residence of Edwin of Northumbria, are found at Barwick-in-Elmete.

These earthworks belong to a class which is, I think, not very uncommon in the North of England. They consist of one larger inclosure, of an oblong form, which no doubt con-

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Elmete was Ella's meat, or  
Ella's pigs kept in the city of Barwick.

tained the buildings in which the chieftain and his household lived, and of a smaller enclosure, nearly circular, which is occupied by a great mound, the space round the latter being small. The object of this mound is a question of some interest. It could hardly be intended for defence, because it was cut off by strong entrenchments from the larger inclosure, which was sufficiently strong in itself. It has not the appearance of having ever supported buildings. It was not wanted as a place for watching the approach of enemies, for the position of this stronghold is so bold that you overlook the country as well from the entrenchments below as from the top of the mound. An excellent and learned friend, Sir Emerson Tennent, who has found similar earthworks in the districts held by the Danes in Ireland, believes this mound to be the *thing* of the Northern nations (and of the Anglo-Saxons also), the hill on which the king or the shire held the assembly for administering justice. From what I know of Sir Emerson's researches, I look forward to a very important essay on this subject from his pen. The entrenchments at Barwick-in-Elmete are so unlike anything Roman, or anything which has been supposed to be older than Roman times, that I think we are quite justified in considering them to be an early Anglo-Saxon work. I may add that I have visited them personally to-day, and I did that which it is always well to do on such occasions. There are, within the large enclosure, houses and cottages with gardens. I inquired of one of the cottagers if he never dug up objects of antiquity in his garden, and he immediately produced two or three coins and some pottery, which were mostly of the sixteenth century, and are easily accounted for by the circumstance that an old manor-house occupied this part of the site, as early, I believe, as the fifteenth century. Two coins only were older than the sixteenth century, and these, which I now exhibit to you, are Roman,—small coins of the emperors of the Constantine.

family, and very much worn, as though they had been long in circulation. These do not prove that the earthworks within which they were found are Roman, because the Roman coinage, and especially this money of the Constantine family, appears to have remained long in circulation among the Anglo-Saxons. These coins are of no intrinsic value, but they are worthy of being preserved in your museum on account of the locality in which they were found.

The conquest of Elmete was one of the earliest acts of Edwin's reign; he was then a pagan, but a few years afterwards he was converted to Christianity through the exertions of Paulinus. Every reader of English history will remember the romantic and beautiful story of the conversion of Edwin, as told by Bede, which took place afar from our district, at Godmanham (Godmundingaham), and, probably, at Londesborough, where the Northumbrian King appears to have possessed another residence. It may be well to explain that, in the division of land among the Teutonic conquerors and settlers, a considerable share was allotted to the chieftain who led the invasion, and who became king. This was the case in all the conquests, and the chieftain's share consisting in manors scattered over his dominions, which formed his whole private property, he built on them houses of more or less strength and importance, where he went with his court from time to time to reside and consume the produce of the land—which, in fact, was the only way of consuming it. It was thus that the habitual life of a king, through the greater part of the middle ages, consisted in wandering about from one manor to another—in moving from house to house, or from castle to castle—in the course of which he naturally remained longest on the estates which were most productive, or which he liked best.

From this period Leeds and its neighbourhood are found intimately connected with King Edwin's history. Paulinus

Phere Oake of <sup>II</sup>Wahon Lake at Edwin's  
tree, and his Borough. Ley attached.

Edwin  
settled  
at  
Londesborough  
and kept  
his court  
there  
before  
Edwin  
was born.

built a church within the precincts of the King's residence near Leeds, which seems to have been known at that time by the name of Dona's field. In 633, Penda, the pagan King of Mercia, and Cadwalla, King of the Welsh of North Wales, joined in an invasion of Northumbria, defeated and slew Edwin in the sanguinary and decisive battle of Heathfeld, and, after the battle, the conquerors ravaged the territory of ~~Elmete~~, and destroyed with fire the palace of King Edwin and the church built by Paulinus. Bede tells us that the altar, being made of stone, alone survived the fire which destroyed the church, the latter being probably built of wood, and, he adds, "it is still preserved in the monastery of the most revered abbot and priest Thridwulf, which is in ~~Elmete~~ wood." The Rev. Daniel H. Haigh, in a paper read before the Geological and Polytechnic Society, has I think advanced very weighty reasons for believing that the monastery mentioned by Bede stood at Leeds, and this gives us the exact position of what was especially called the ~~wood of Elmete~~. In 1838, a number of fragments of sculptured stones were found in making repairs in the old Parish Church at Leeds, which, when examined, proved to be portions of crosses of very remote antiquity. I think Mr. Haigh has shown almost to conviction that these crosses had come from the cemetery of Thridwulf's monastery. It was at this monastery that Eanbald, Archbishop of York, died in 796, and two of the historians who record that event, Simeon of Durham and Roger de Hoveden, call the place, æt Læta, which is evidently the mere Anglo-Saxon phrase "at Leeds." This is all we know of Thridwulf's foundation, for I think the manner in which Bede speaks of it implies that he was the founder; and I totally disagree with Mr. Haigh's arguments, although ingenious, by which he would have us believe that this monastery was founded by a brother of the Welsh St. David.

Some months passed over, during which Northumbria was

torn by foreign invasion, or governed by usurpers, who held it as two separate kingdoms. Osric, a prince who held that division in which Elmete was situated, rebuilt the royal palace near Leeds. Oswald, a king celebrated for his great piety, as well as for his bravery, soon afterwards succeeded to the throne. He was attacked first by Cadwalla and the Welsh, but in the battle of Heavenfield the Welsh king was defeated and slain. Oswald now in his turn marched upon North Wales, but he also was defeated and slain at Oswestry, in Shropshire. Between 642 and 650, this part of the Northumbrian kingdom was ruled by the saintly King Oswin, who became an object of hatred to Oswy, the other Northumbrian king. The latter invaded his dominions in the year 650, and a battle was on the eve of taking place at a locality called by Bede, Wilfaresdun, when Oswin, considering his great inferiority in forces, and wishing to save the lives of his countrymen, disbanded his army, and sought safety in flight. He attempted to hide himself at a place called in Gætlingum, the residence of an earl named Hunwald, who had received great favours from him, and in whom he placed entire trust; but Hunwald betrayed him, and Oswy sent a party of his warriors who put Oswin to death. Mr. Haigh, in his paper just alluded to, holds that Wilfaresdun is the modern Wilbarston, in Northamptonshire, and that the modern village of Collingham, a few miles from Leeds, occupies the site of the in Gætlingum of Bede. Oswin appears to have fled to the wooded district of Elmete; and it is curious that among the early Saxon crosses still preserved at Collingham, Mr. Haigh found one with a mutilated inscription in Anglo-Saxon runes, which appears to commemorate the martyred King Oswin, and to have been erected by his aunt, probably a nun.

Oswy now seized upon the crown of Deira, and united the two divisions of Northumbria. Enmity, however, sprung

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Oswald's Cross.*

up between him and the Mercian Penda, and Oswy also had to enter upon a terrible struggle for his crown. Penda, though now far advanced in years, raised the army of the Mercians, marched fiercely into Northumbria, and encountered the forces of Oswy near the river Winwæd, where he was defeated and slain. In the early annals of Cambria, which are quoted in Mr. Haigh's paper, some circumstances relating to this event are recorded which are not mentioned by Bede, from which, if they are truthful and of any value, we learn that before the battle Oswy's head-quarters were established at a place named Ludeu, and the battle is said to have taken place on the field of Gais, or, as appears to be the correct reading, Giti. The first of these names seems evidently to be meant for Leeds. We are also there informed that Penda's army was then encamped at Manu, which Mr. Haigh identifies with Meanwood, while he supposes that Giti, which would be only another form of Witi, is the modern Weetwood. Mr. Haigh further supposes that Penda having been compelled to retreat, fell back on Weetwood, was there arrested by the Aire, and obliged to fight the decisive battle in which he was slain. The nearest point to Weetwood on this river, he says, is the neighbourhood of Kirkstall, where there was at the west end of the ancient bridge a piece of land called in an old charter, Winnet, and this spot he conjectures with some appearance of probability to have been the Winwæd of Bede. Your antiquary, Mr. James, whose opinions on such a subject are worthy of all consideration, thinks that there are considerable difficulties in the way of Mr. Haigh's solution of this question of locality.

We have no further notices of the history of Leeds during the Anglo-Saxon period. Its neighbourhood evidently continued to be the residence of the Northumbrian princes, even of the Danish dynasty; and one of the fragments of crosses discovered in repairing the Parish Church presented some

runic characters, containing the name of Anlaf, king of Northumbria, the last of the Danish kings, who was a Christian at the close of his life, and who would appear from this inscription to have died and been buried here, soon after the middle of the tenth century, probably in 952. I will only add that Mr. Haigh, who is an experienced numismatist, especially in the history of the Northumbrians, appears to have found traces of a mint at Leeds.

At the time of the Norman Conquest, the people of Leeds and its neighbourhood probably distinguished themselves by their resistance to the invaders, and thus merited their full share of the vengeance of the conqueror, for much of the country around is set down in Domesday as then *waste*.

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Mr. Denny read the next Paper:—

ON AN ANCIENT BARROW OR TUMULUS, AND FLINT IMPLEMENTS, FOUND IN THE NEIGHBOURHOOD OF BRIDLINGTON, BY MR. EDWARD TINDALL, OF BRIDLINGTON.

At a Meeting of the Geological and Polytechnic Society, held at Barnsley, on the 16th January, 1857, a paper by Mr. Thomas Wright, F.S.A., was read "On some Ancient Barrows opened by me in East Yorkshire." In this paper the particular locality of five Barrows was pointed out and their contents enumerated; as a supplement to that communication, it is my object on the present occasion to describe another barrow or tumulus I have since had the privilege to examine, which presented some peculiarities I have never before observed, and which I believe have not been noticed by any previous writer on these ancient receptacles of the dead. I trust, therefore, a brief description of the above will not prove devoid of interest to the members of this Society, from the increasing importance of placing on record every isolated fact which may serve to illustrate

*Poor Denny, very creditable!*

the manners, customs, and funeral rites of the primitive inhabitants of this part of Britain.

Having previously made arrangements for opening this sixth tumulus, Captain George Collinson and myself commenced our operations on the 13th of October, 1857, in a field adjoining that in which was situated the last tumulus recorded in a former communication, and from which it is one hundred and fifty yards distant, that is to say, about three miles north of Bridlington, to the right of the old coach road from the latter place to Scarborough, where two conical hills in close proximity are still to be seen. The one on the extreme east is that to which I have now to call attention and with which my operations were connected. From the elevated position of this mound, an extensive view is obtained of Bridlington Bay and Holderness to the south-west, and on the north-east, a more extensive view of the German Ocean, Flambro' Head, Buckton and Speeton cliffs. It is about 100 yards in circumference and about nine feet in depth. After removing the surface earth, and by means of a trench about five feet wide and six feet deep, we approached the centre of the tumulus. A quantity of flint chippings were here discovered, the fractures of which were remarkably fresh in appearance, looking in fact as if they had been broken the same day, the edges were so sharp, but they were all bright, and, therefore, unlike recently broken flints, which are invariably dull on the fractured surfaces. Amongst these, occurred one very fine example of flint implement, and a second not unlike a leaf-shaped arrow-head. On resuming our labours on the second day, the 14th, we came down to a human skeleton, and upon carefully removing the surrounding soil to prevent any derangement of the bones, and especially the skull, a fine flint spear head of the leaf-shape pattern, well made and remarkably sharp at the edges, was observed in an



oblique direction between the jaws. This weapon appeared to have entered the neck of the individual immediately under the left ear and passed up into the interior of the mouth, in the right corner of which, within the teeth, the point of the spear was lodged. The skeleton was laid upon its back and deposited in a trench dug in the chalk rock, about two feet wide, eighteen inches deep, and rather more than five-and-a-half feet in length. The legs were crossed and the head lay to the south-east. On the natural surface of the chalk surrounding the space containing the skeleton, were *twelve circular holes* about nine inches in diameter and twelve inches deep, in which were deposited calcined bones and earth with particles of charcoal. These holes in the solid chalk rock were a peculiar feature, which in all my experience I had never observed before, and for what precise purpose they may have been made it is difficult to conjecture, though from the contents just enumerated it is not improbable they might have been to receive the ashes of some relatives, or those of sacrifice or food offerings, which the friends of the deceased wished to deposit in his last resting-place, a custom by no means uncommon in primæval sepulture; but, in such instances, the materials for this purpose are generally deposited in earthen vessels made expressly for that purpose, and which frequently occur in early British and Roman graves. An urn of this description was also found with the skeleton. It was, however, broken, but had contained ashes, charcoal, and a small quantity of burned earth. The materials of which the urn was made appeared to be a mixture of clay, oxide of iron, mica, and pounded quartz. It had evidently been turned on a wheel, and afterwards, while moist, rudely finished by hand. In shape it resembled in many respects the larger British urn, figured in Philips's Mountains, Rivers, and Sea Coast of Yorkshire. (Plate, 33.) In the Journal of the Archæological Institute,

however, I have since seen an instance recorded of the occurrence of two hundred primitive graves on the Isle of Portland, discovered while removing materials for the formation of the Portland breakwater, at a spot three hundred feet above the sea. The graves appeared to be of Romano-British times. Near to many of them, deep holes had been made and filled up with pieces of stone mixed with bones of animals and birds, conjectured to have been the remains of sacrifice, or the relics of the funeral feast.\* The similarity of some of these interments with that I have already described, affords strong evidence that one and the same object was sought to be obtained in each instance by the persons whose office it was to perform the last ceremonies for the dead.

Upon examining, with some degree of minuteness, the numerous flint implements found by me in tumuli or in the gravel during twenty years explorations, I have invariably observed that those from the interior of Tumuli are of a much more modern form and elaborate workmanship than those discovered deeper in the soil overlying the chalk, which are of a rude and primitive character, and so closely resembling the celebrated flint implements from Amiens and Abbeville, as to be undistinguishable from them by an ordinary observer. This will be evident from an inspection of a series of sixteen specimens herewith sent, consisting of examples from the Valley of the Somme and the neighbourhood of Bridlington. The latter of which I may remark, as a general rule, occur at from four to six feet in depth from the surface, unless they are in the drift deposits, when they exceed the above depth, the rudest in manufacture being the lowest, and those of more careful make nearest the surface.

\* Journal of the Archæological Institute, vol. X., p. 61.

The specimen numbered in the series 16, and much stained with oxide of iron, has been ground at one end to a fine edge, and chipped at the other, in order to produce the required form. This was found in deepening a drain from ten to twelve feet, in a bed of drift gravel, beneath layers of Lacustrine deposit, brick earth, and alluvium.

In this particular instance, however, I do not consider the depth at which it occurred as indicative of extreme antiquity, but, on the contrary, that it may be more modern than any of those numbered from one to nine, and yet more ancient than the flint implements generally found in tumuli. In fact, from all that I have observed during my long experience, I feel convinced that, however conclusive the evidence may appear to be on the Continent, that there have been two long divided or distant epochs, during both of which the manufacture of stone implements was carried on by primitive races of men—the first being distinguished by their rude, and the second by their skilful finish—no such indications occur in Yorkshire, though there is sufficient collateral evidence that man has been a dweller on the earth “that now is” during periods long anterior to the usually received one, and, therefore, that he was coeval with the larger extinct *Pachyderms* and *Herbivora*, whose periods of active life have been supposed to date ages prior to man’s advent.

Of the great antiquity of man, however, we have now the united testimony of the most eminent philosophers of modern times, both at home and abroad, whose convictions have been arrived at by a careful and patient consideration of all the various and well-authenticated instances in which man and his works have occurred with the remains of extinct animals.

That the human race were contemporaneous with the Irish Elk I think no one can doubt who has read Mr. Denny’s

paper on that subject in the proceedings of this Society; and if with that animal, why not with other extinct species? Whether, however, they have lived down to a later date, or man existed at an earlier than is generally ascribed to the "Beginning," it matters not, as either case may have been the fact, and equally refers to a remote antiquity. But, as yet, we have not in Yorkshire, or any county that I am aware of, positive evidence that there was a very ancient time when man lived and made rude implements of flint, and that, subsequently, this race was either swept away, or emigrated on icebergs to another country, and then, after thousands of years, another perfectly distinct race sprang up, and manufactured more artistic implements of flint found in the same locality where formerly resided the ruder manufacturers of the same material.

The evidence, however, which our Yorkshire and the foreign flint implements alike adduce to me is, that since the first flints were chipped into shape by the human race, up to the present moment, there has never been any interruptions to their occupancy of this, or any other, country whatever. For, as Hugh Miller justly observes, "The geologist in the tablets of stone, which form his records, finds no examples of dynasties, once passed away, *again returning*. There has been no repetition of the dynasty of the fish, of the reptile, of the mammal." That is to say, of the peculiar dynasties of each class which characterized different and distant formations. The classes have been continued through countless ages, but the species have changed or been replaced by widely differing forms. As, for instance, the Cephalaspi, Coccostei, and Pterichthi, of the old red sandstone, made way for the Ganiods of the Carboniferous era, which in like manner disappeared, and were represented by other Ganiods, Placoids, and Lepidotes of the lias, wealden, and chalk. In the same way, the small saurian reptiles of the sandstones of

Scotland, and coal formation of Germany, were but the progenitors of the huge Dinosaurian and Enaliosaurian reptiles of the lias, Oxford clay, and wealden, which have passed away for ever, but are now represented by the gavials, and crocodiles, and alligators of the present day. The mammals of the tertiary system were only the precursors of the modern forms; in many instances the genera being the same, but the species perfectly distinct, as in Rhinoceros, Hippopotamus, Elephant, Horse, Giraffe, Bear, Hyæna, Tiger, Ox, Deer; and in numerous cases both genera and species are both alike extinct, as Dinotherium, Megatherium, Mylodon, Mastodon, Palæotherium, Anaplotherium, Diproctodon, Hyracotherium, Trogontherium, Coryphodon, Megaceros.

In man, however, but one genus and one species has been created, which has continued to exist from the beginning, and only varied in character by circumstances, the result of climatal changes, or the varied conditions which savage or civilized life may have brought to bear on him. Islands may have been submerged or continents upheaved, but they have all been tenanted in succession by one and the same human family which was first called into being. Races of men, like kingdoms and dynasties, may have had their rise and passed away, but the one species has never become extinct. Consequently, though the last created, man is the oldest inhabitant of our planet, and whose dynasty has never been replaced by a succession of higher forms, each better fitted for the changing scenes surrounding him or the destiny which awaited him, but perfectly organized in the beginning for all the changes of time and eternity.

Upon the termination of this paper, the Rev. W. C. Lukis stated that with regard to the circular holes around the trench, where the skeleton was deposited as mentioned by Mr. Tindall, though he had had a great deal of experience, he had never found a similar arrangement.

ON THE EFFECTS OF CERTAIN GEOLOGICAL ARRANGEMENTS ON  
THE WORKING OF COAL. BY MR. PHILIP COOPER, OF  
HOLMES COLLIERY, ROTHERHAM.

There are reasons for believing that all stratified rocks, including coal-beds, were originally deposited in a nearly horizontal position, from which their inclination now varies in some instances to almost vertical. By far the greatest area of the explored coal-fields of this country exist at an inclination varying from 1 in 9 to horizontal. Such is the case, generally, in the counties of Durham, Northumberland, and Yorkshire. In Durham, from the sea on the east, to the outcrop of the Coal Measures at Hownes Gill on the west, the average inclination is only 1 in 41, and from Shireoaks Colliery in Nottinghamshire to Barnsley, it is only 1 in 100. The effect of this general upward inclination towards the outcrop of the coal-fields, is to bring each coal-bed in succession to the surface, where they have been opened out and worked by levels from the banks of rivers, &c., during the earlier periods of coal-mining. As coal-measures are found many hundreds of feet thicker on the deep side of faults than they are on the opposite, it may be presumed denudation to the extent of the difference has taken place since the deposit of the coal-beds. At the deepest pit in Durham, the first workable bed is found at a depth of 1,593 feet, and at the deepest pit in Nottinghamshire, at 1,286 feet. In both cases, the beds referred to are now found at moderate depths over extensive areas of each district. But for this arrangement of the coal-measures, subsequent to their original deposition followed by extensive denudation, the beds of coal now found so generally accessible at moderate depths, could only have been worked by deep sinkings. Their generally moderate inclination also facilitates the underground conveyance of the coal by inclined planes, and also, by allowing the water

yielded in prosecuting the workings to gravitate to fixed points, it renders its extraction much less costly.

#### FAULTS IN COAL-BEDS.

It has already been stated, there can be no doubt the original position of our coal-beds was horizontal, and that extensive denudation has subsequently taken place. This is proved by circumstances connected with faults; these faults or slips are very common, scarcely a square mile of any coal-field being free from them. They have completely severed the strata, and caused the same beds of coal to be placed at very different levels. The same bed of coal being found on opposite sides of some of these faults at from 500 to 3,000 feet separate.

During the deposition of the whole of the Carboniferous rocks, it is believed that none of these faults were formed, as hitherto no single fault has been found in the coal-measures, which did not reach the upper portion of the coal-measures. Immediately after the deposition of the Carboniferous system, the whole of its area seems to have been affected by some violent and almost universal agency, shivering and displacing the rocks 3,000 feet in thickness, dividing the coal-area into isolated tracts, situated at various relative levels and presenting every possible inclination, and locally augmenting the difficulty and expense of extracting the coal. Fortunately, this is to a great extent compensated for by certain advantages.

The coal-measures consist of alternations of shale, coal, and sandstone, and are frequently in the deeper portions overlaid by limestone, the two latter very *gullety* and porous, and, consequently, they pass water very freely and to great distances.

Had the entire extent of any given coal-field been simply inclined, without these fractures, slips, or faults, these porous

strata would have conveyed the water from the whole area, situated to the rise of any coal-field to such shaft, and rendered the sinking not only much more costly, but even almost impossible. As it is, however, with the water-channels broken up and intersected, this otherwise almost insurmountable difficulty is obviated, and much expense avoided. In sinking the celebrated Murton Winning, in the county of Durham, the quantity of water met with was most enormous, upwards of 9,000 gallons per minute had to be raised from a depth of 540 feet, and the aggregate machinery employed being equal to a power of 1,584 horses, boilers 39, the consumption of coal for which was nearly 200 tons per day.

Fortunately, such cases are not of frequent occurrence; the widely extended flow of water is intercepted by these faults, more properly named, perhaps, if called nature's dams. This is not mere theory. The celebrated Gosforth Colliery, in Northumberland, was purposely sunk, not on the depressed side of the Tynedale fault, but on the contrary; and, after being sunk to the required depth, access was gained to the bed of coal by an horizontal gallery 700 yards in extent. By such arrangement the sur-charged water-bearing strata was entirely avoided, which was indeed the object sought to be attained in the arrangement. The intercepting character of faults is fully proved by this and similar instances, and the effects in deep coal-mining is very beneficial. And, in fact, we find in deep sinkings that, in practice, water in large quantities is only found within a limited distance of the surface. These surface waters having been most effectually shut off by encasing the shafts with metal tubbing, a modern application, it has been found that deep mining is little troubled by water. Indeed, this is true to such an extent that, whilst in many mines of a depth less than 200 yards the quantity or weight of water



daily raised is equal to two or three, or even ten times the weight of coals daily raised, in deep mines, such as Monkwearmouth, 1,590 feet deep, Ryhope and Seaham, in the county of Durham, Shireoaks and Hucknall Toskard, in Nottinghamshire, and the Holmes Colliery, the deepest in Yorkshire, the water requiring to be raised from depths of 350 to 600 yards, is not one-tenth the weight of coal daily raised. At Shireoaks it is said to be only 3,000 gallons per day, or 2 gallons per minute.

In some of these shafts the upper strata when passed through, and which are now effectually tubbed off, yielded water at the rate of 224 gallons per ton, 30 tons per minute, 1,800 tons per hour, or 43,200 tons per day. I need scarcely add that, had such quantities been met with in the lower strata, coal mining, under the circumstances, would have been an impossibility.

We thus see that by the Geological arrangement of faults, the miner meets only with the water belonging to an isolated section, instead of having to contend with feeders due to a whole coal-field.

Even under such circumstances, the difficulty and expense are, in some cases, all but insurmountable; what, then, would they have been without such Geological arrangement of the strata?

It has been found that in beds of coal lying near the surface, the most insidious and dangerous enemy to mining, inflammable gas, is never, or very rarely, met with; but in penetrating deeper and deeper, it is found that the evolution of this gas constantly increases, at least to a certain depth. No doubt this is in a great degree due to the intercepting agency of faults, on the one hand, preventing the downward flow of water, and on the other, the upward flow of gas. Hence, as a general rule, it may be said that downward, to a certain point, water is met with in abundance, and little or

no inflammable gas; whilst beyond this depth, little water is met with, but a greatly increased quantity of gas. This will materially affect the future deep coal-mining of this country.

#### BANDS IN COAL-BEDS.

Coal-mining is materially affected by the intercalation in the coal-beds of earthy matter, technically named bands. These are not co-extensive with the bed of coal, but begin by a mere smooth parting or division of the bed, gradually increasing, I believe, generally, in a given direction in all the beds of coal in any coal-field, until the bed becomes divided into two distinct beds, many feet apart. Undoubtedly, some coal-seams are very persistent, extending over many square miles; but even these are frequently found to be divided. Beginning from the north, the Silkstone and Barnsley beds are frequently thus divided in passing southward through Derbyshire. In the north of England scarcely a bed is known but is thus affected.

The High Main, or original Wallsend Seam, is divided by the Heworth Band, gradually thickening to the south, and ultimately forming two distinct beds. The gray seam of Cramlington is similarly divided as it passes southward; and the far-famed and unequalled Hutton Seam is also divided more than once as it follows in the same direction, forming distinct beds. There is scarcely any bed of coal that is not similarly affected. The Ten Yard Seam of South Staffordshire is divided into nine distinct seams; in North Staffordshire by 420 feet of sandstone and shales, the whole change taking place in 4 or 5 miles. In the Warwickshire coal-field, five distinct coal-seams become united by the thinning out of 120 feet of sandstone and shales, forming at Wyken, near Coventry, one bed 26 feet in thickness.

The fact that it is frequently, if not universally, found that the lower portion of a coal-bed thus divided by a band

of dirt, continues to be further and further separated from the upper portion by a continued increase in the thickness of the band, but that it also continues to decrease in the same direction, is worthy of note. The cause of this intercalation of dirt beds, together with their progressive thickening in a given direction, has been explained by Sir C. Lyell to have been a slow settling of a part of the area of the coal-bed, after the lower portion had been deposited, together with the subsequent deposition of the shales, &c., of which they are formed.

Taking this to be the true explanation of their formation, and supposing it to have been proved that their commencement, thickening, and extension in any given coal-field is uniformly in one direction, that direction being towards the deeper parts of the particular coal-field as it now exists, we should probably arrive at the conclusion that their present conformation has arisen from a frequently recurring, but intermittent settling in one uniform direction, and also that as a consequence in that direction many of our lower coal-beds either exist in a divided form of thin beds or have completely thinned out in the deeper parts of the coal-field. And the deepest boring in the northern coal-field, viz., Backworth, seems to confirm this surmise; for we do not find a single bed below the Low Main, or Hutton Seam, of workable thickness: I, therefore, advance it not as an opinion, but as a probability, that the lower coal-beds, developed in workable condition on the outcrop of extensive coal-fields, may now be found to underlie the upper beds already found to exist in the deeper portions of such fields.

#### DIFFERENT QUALITIES OF COAL-BEDS.

One peculiar feature in coal-beds is, their consisting of different layers of coal of totally different quality, and which can only be used for distinct purposes, part of the

bed being a highly bituminous house-coal, and the remainder a white ash steam-coal. In no coal-field in this country is this so common as in the Midland Counties, the effect being to considerably increase the cost of production in separating the two qualities.

Besides, notwithstanding the season of greatest demand of one quality is the season of least demand of the other, it is imperative to work the two together.

In the coal-field of Northumberland and Durham, this state of things is very rare; but at least two of the most valuable beds, in passing from south to north, gradually and completely change from first-class house to first-class steam-coal. As, for instance, in the Hutton Seam, in the county of Durham, which at once yields the best house and gas-coal, but at different collieries; whilst in the county of Northumberland, it supplies the large bend of the well-known Hartley Steam Coals.

In South Wales, the same bed is found in one place bituminous; in another, semi-bituminous; and in another, anthracitic. The almost universal anthracite character of the American coal-beds is found to change in a given direction to that of bituminous.

The duration of the coal-fields of this country is a subject of curious interest, and has been variously estimated; probably the data have not yet been obtained for arriving at a satisfactory conclusion.

The quantity of coal exhausted during the last twenty years has been more than doubled; probably the future increase will not be in anything like the same proportion.

The extent of unopened coal-field, required for such extension, has not yet been proved to exist. In all the older worked coal-fields, scarcely any coal area remains to be occupied. Much of the very best portions are already exhausted; and where they are known to exist, as along the

eastern part of this county and the counties of Derby and Nottingham, the depth and consequent cost of winning is such that very large capital will be required.

The quantity of coal annually worked in this country is upwards of eighty millions of tons, which requires annually the complete exhaustion of 16,000 acres, or 25 square miles of a bed of coal 50 inches in thickness. It must, therefore, be plain enough that the entire exhaustion of our coal-beds is but a question of time; this depending on the quantity annually raised, the area of the coal containing strata, and the depth and thickness of the beds which can be worked to profit. Long before the beds are entirely exhausted, the thickest, most accessible, and most valuable beds now known will have ceased to exist for ever, and our future supply will be dependent on thinner and deeper beds.

In this country, coal-beds vary from less than an inch in thickness, to upwards of 30 feet. Much the greatest proportion of our present supply is from beds of from 3 to 6 feet in thickness. After all such beds are exhausted, as much or more coal will remain in thinner beds as is found in what are now deemed beds of a workable thickness.

A careful examination of the strata passed through in sinkings in different parts of England proves that upwards of 60 per cent. of the coal contained in the coal-measures exists in beds under 3 feet in thickness.

One of the greatest physical difficulties in deep mines is their high temperature. In mines 2,000 feet deep the temperature is frequently 90 degrees; and it does not vary much between winter and summer, except at a very limited distance from the shafts. The temperature of the strata increases one degree for every 60 feet; and if a depth of 4,000 feet were reached, that being supposed to be possible, the temperature of the interior of the mine would be from 100 to 120 degrees: the constitution of man, however, could

not bear severe labour in such a temperature, and science, the mind of the age, must then make some arrangement by which this difficulty might be obviated. I have found by a series of experiments, extending over several years, that in the cold days of winter when the air on the surface was fifteen or twenty degrees, with a current of 100,000 cubic feet of air passing into the pit in a minute, ice was not seen at the bottom of a shaft 1,000 feet deep, and seldom in one 600 feet deep. When the surface temperature was thirty-two degrees, the temperature at the foot of the shaft was forty-two degrees; and at 800 yards from the foot of the shaft, the intake current was sixty degrees, which I found to be uniform during the winter and summer months, or nearly so; for, with the same quantity of air passing in, and a surface temperature of seventy degrees, the temperature at that point was sixty-one degrees.

At the conclusion of the Meeting, the Assistant Secretary read the annexed financial Report of the Society for the past year :—

#### STATEMENT OF RECEIPTS AND EXPENDITURE

OF THE GEOLOGICAL AND POLYTECHNIC SOCIETY OF THE WEST RIDING OF YORKSHIRE.

From May, 1863, to May, 1864.

DR.	£. s. d.	CR.	£. s. d.
By Subscriptions—		Messrs. Baines, on account for	
From 9 Members for 1862..	5 17 0	Printing .....	22 10 6
„ 67 „	1863.. 43 11 0	Philosophical Society for Rent	
„ 10 „	1864.. 6 10 0	of Museum Room .....	15 0 0
		Collecting Subscriptions .....	0 15 6
		Postages and Postage Stamps ..	1 7 6
		Expenses of Meetings .....	1 9 6
		Assistant Secretary on account	12 0 0
		Carriage of Parcels and Sundry	
		Expenses .....	0 14 8
		Balance in hand .....	2 0 4
	<u>£55 18 0</u>		<u>£55 18 0</u>

The following noblemen and gentlemen were declared as elected the Officers and Council for the ensuing year:—

President.

THE EARL DE GREY AND RIPON.

Vice-Presidents.

THE DUKE OF LEEDS.  
THE EARL OF EFFINGHAM.  
THE EARL OF DARTMOUTH.  
EARL FITZWILLIAM.  
LORD WHARNCLIFFE.  
LORD LONDESBOROUGH.  
VISCOUNT GALWAY.  
VISCOUNT MILTON.  
RT. HON. SIR C. WOOD, BART., M.P.

EDWARD AKROYD, ESQ.  
JOHN WATERHOUSE, ESQ., F.R.S.  
W. B. BEAUMONT, ESQ., M.P.  
E. B. DENISON, ESQ.  
LORD HOUGHTON.  
J. SPENCER STANHOPE, ESQ.  
G. WENTWORTH, ESQ.  
J. G. MARSHALL, ESQ., F.G.S.  
THOMAS WILSON, ESQ., M.A.

Council.

HENRY BRIGGS, ESQ.  
DR. WM. ALEXANDER.  
H. C. SORBY, ESQ., F.R.S.  
HENRY HOLT, ESQ.  
BENTLEY SHAW, ESQ.  
T. P. TEALE, ESQ., F.L.S.

R. CARTER, ESQ., C.E.  
T. W. EMBLETON, ESQ.  
REV. DR. BURNET.  
DR. SCHOLEFIELD.  
WM. CHADWICK, ESQ.  
SAMUEL BAINES, ESQ.

Secretary.

WM. SYKES WARD, ESQ., F.C.S.

Honorary Curators.

J. G. MARSHALL, ESQ., F.G.S. | T. W. EMBLETON, ESQ.

Local Secretaries.

H. C. SORBY, ESQ., Sheffield.  
HY. BRIGGS, ESQ., Wakefield.  
DR. ALEXANDER, Halifax.  
DR. SCHOLEFIELD, Doncaster.

BENTLEY SHAW, ESQ., Huddersfield.  
RICHARD CARTER, ESQ., Barnsley.  
THE REV. DR. BURNET, Bradford.  
DR. PALEY, Ripon.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West Riding of Yorkshire,

AT THE SIXTY-SIXTH MEETING, HELD IN THE  
CUTLERS' HALL, SHEFFIELD, ON THURSDAY, MARCH 9TH, 1865,  
AT TWELVE O'CLOCK AT NOON.

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DR. AVELING in the Chair.

The Right Hon. the Earl of Harewood having been unanimously elected a member,

The Chairman addressed the Society, and thanked the meeting for the honour that had been done to the Philosophical and Literary Society of Sheffield by requesting him, their President, to preside on the occasion; and then called upon

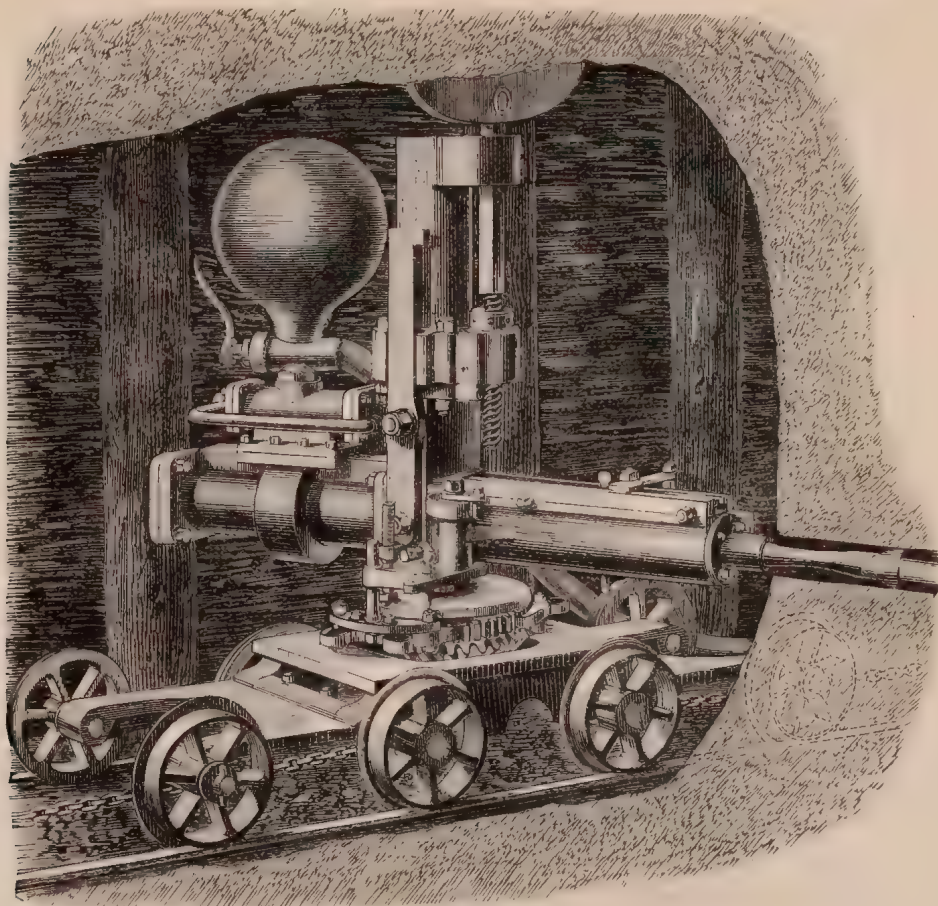
T. W. EMBLETON, Esq., of Middleton Colliery, near Leeds, to read the first Paper—

ON THE HYDRAULIC COAL-CUTTING MACHINE.

After stating the important aid which machinery had furnished in lessening manual labour, Mr. Embleton entered into a clear and practical explanation of the machine manufactured by Messrs. Carrett, Marshall, & Co., of Leeds, now in operation at the colliery of Messrs. Locke and Warrington, at Kippax. The paper was illustrated by diagrams and sections



# PATENT HYDRAULIC COAL CUTTING MACHINE.



This Machine undercuts, holes, or kirves four feet into the coal or mineral at once going over, at the rate of 13 yards per hour, and at any height from floor or rails, being suitable for either "dip" or "rise" workings, and is capable of working the thinnest seams.

This apparatus is actuated by the pressure of water, which can be obtained either from the stand pipes in the pit, or from pumps attached to any existing engine, or from an engine and pumps specially made for the purpose. The quantity of water necessary is only what is sufficient to fill the circuit of the pipes, using it over again when desirable.

Where Engine and Pumps are required to make the water pressure, their cost, to supply two Machines, is under £300, exclusive of 2-inch bore wrought-iron pipes, to stand 500 lbs. pressure, at 3s. 6d. per yard. These pipes are screwed together in the ordinary manner, and adapt themselves readily to the irregularities of the floor of mine. An India-rubber pipe of 1 1/2-inch bore, suitable for the same pressure, allows the Machine to traverse.

Ordinary gas pipes, 2 inches bore, serve for the exit water.

This Self-Acting Coal-Cutting Machine is simple in all its parts, is not liable to get out of order, is easily managed by an ordinary miner, and transported from place to place on the ordinary rails about the mine.

The mechanism employed consists of an Hydraulic Reciprocating Engine, adjustable to any height and angle, having a self-acting valve-motion. The cylinder is lined with brass, and the piston made tight with ordinary hydraulic leathers, easily renewable. The piston-rod is of steel, within which is attached the cutter-bar, also of steel, carrying the tools or cutters. These can be varied in number, to suit the depth to be holed at one operation.

The cutting tools are easily made, are very strong, and can be removed and replaced in a few moments; they are readily sharpened on an ordinary grindstone. The cutter-bar is also removable when transporting the Machine from place to place, for which purpose the main cylinder is, for the time being, slewed longitudinal with the rails.

The Machine in operation fixes itself dead fast upon the rails during the cutting stroke, and releases itself at the back or return stroke, and traverses forwards the requisite amount for the next cut without any manual labour. Should the tools be prevented making the full stroke at one cut, they will continue to make more strokes at the same place until the maximum depth is attained, when, "only," the Machine will traverse itself forward the required amount for the next cut.

Thus, at one operation, a uniform straight depth is attained parallel with the rails, inducing an even fracture when the coals are brought down, and thereby a straight line for the new coal face.

There is no percussive action, either against the roof or into the coal, but simply a concentrated pressure, producing a steady reciprocating motion at 25 strokes per minute.

There is, consequently, no dust, and little noise and wear and tear.

For the same reason, when cutting pyrites, the tools throw out no sparks, and the workman can hear any movement in the coal or roof. There is no limit to the pressure of water that may be used, nor the distance it may be forced without loss of power, beyond that due to its friction along the pipes. The same water pressure is also applicable to water pumps and rotative engines for hauling, &c., and other requirements in the mine.

In the working of Coal Mines the safety of the workman is of great importance, which this invention goes far to accomplish. Thus by this self-acting Machine the most laborious and costly part of the work is done at a comparatively trifling cost.

The size of the coal is improved, the amount of slack being considerably reduced thereby; a single seam will yield more by 1,000 tons of coal per acre than when worked by hand labour in the usual manner.



of the machinery, from which the author explained that the machine was actuated by water pressure, produced by an engine placed at the bottom of the shaft. The water is conveyed in malleable iron pipes to the machine, a distance of about 600 yards, the pressure employed varying from 150 to 300 lbs. per square inch. The cylinder is  $4\frac{1}{2}$  inches in diameter, and 18 inches stroke, making 25 strokes per minute, and using in that time 40 gallons of water. The cutting bar is furnished with three cutters, thus effecting, at one stroke, a depth of three feet three inches. As much as 39 feet in length, on the face of the coal, has been cut in the above depth in an hour. At the conclusion of the paper, an animated discussion ensued between Mr. Philip Cooper, of the Holmes and Masbro' Colliery; Mr. Jeffcock, senior; Mr. Warrington, and Mr. Embleton, when the latter explained that the cost per ton on the coal obtained, including interest of capital and all labour, varies from  $3\frac{1}{5}d.$  to  $5\frac{1}{2}d.$ ; while hand-labour cost  $8d.$  per ton. The produce of slack is 8 per cent. by the machine, and all the coal is sent up to the surface. By hand-labour the average slack is 18·3 per cent., besides 18·75 per cent. left below, the latter proportion of which is altogether lost. Thus showing that, independent of the saving of time and labour, much less coal is destroyed and reduced to slack by the machine. Without entering into details to reduce this difference of production to money, the result is a saving of rather more than  $10\frac{1}{2}d.$  per ton upon the produce. (*See Plate and further information.*)

The Chairman then called upon JOHN JAMES, Esq., F.S.A., of Brincliffe Edge, to read the second Paper—

#### ON THE EARLY HISTORY OF SHEFFIELD.

There exists in the human heart a universal and predominant passion, which powerfully induces all intelligent classes to seek eagerly for information respecting the former

state of the district they inhabit, or transactions in which men who lived on the same local stage as themselves played a part.

To use the words of an old author, "We are curiously listening after the memory of our ancestors." We delight to hear the voice of the past describing the objects of natural scenery, or the affairs of our own locality in ancient times, and generations of old.

For these considerations I have chosen for the subject of this paper, "The Early History of Sheffield," as I apprehend it will be of peculiar interest to many here assembled. I propose tracing the history of this district to the time of Doomsday Survey, under three divisions—the British, the Roman, and the Saxon. Should any of the views entertained by me excite discussion, I hope it will be approached in a candid and unbiassed spirit, and with a desire only of ascertaining the truth.

After much consideration, I have arrived at the conclusion that the Don formed the boundary between two of the British tribes, the Brigantes and the Coritani; between the Roman provinces, Maxima Cæsariensis and Flavia Cæsariensis; and between two of the great Saxon kingdoms of the Heptarchy, Northumbria and Mercia. In the ensuing narrative I shall adduce several reasons in support of these conclusions, which I have formed with some reluctance, and offer with all deference to the authority of the late Mr. Hunter, the able and learned historian of Hallamshire, who was of a contrary opinion.

#### *British Period.*

The Roman historians inform us that when their countrymen landed on our shores, they found the country divided among many independent tribes, somewhat resembling the septs or clans of Ireland and the Highlands of Scotland in the middle ages, and ruled by chiefs or petty kings.

The most powerful of these tribes, the Brigantes, inhabited nearly the whole of the territory now forming the counties of York, Lancaster, Westmoreland, Cumberland, Durham, and Northumberland. The neighbours of the Brigantes on the south and east—namely, the Coritani, or Coritavi—were also a large and powerful tribe, inhabiting, among other districts, what now constitutes the counties of Derby, Nottingham, and Lincoln. The great natural boundary in one part, between these two tribes, is, by all antiquaries, admitted to have been the Humber; and, in *my opinion*, the Don in another part, and the Pennine Mountains in another. That the present artificial boundaries now dividing Yorkshire from the counties of Derby, Nottingham, and Lincoln, could not be the line of demarcation between those tribes, appears evident; for—in addition to the reasons hereafter adduced regarding the boundaries of the above-mentioned Roman provinces—it must be remembered that the British tribes carried on a continual war with each other; were, like the Red Indians, exceedingly jealous of encroachments on their hunting-grounds, and, in fact, of the smallest invasion of their territory by neighbouring tribes.

We have historical evidence that, to secure these objects, the British tribes were separated from each other by estuaries, great rivers, lakes, and high mountains. What, then, more probable than that the Don constituted one of the great natural boundaries between the Coritani and the Brigantes?

Unlike the Britons of the southern parts of the island, the tribes above-mentioned were purely a pastoral and hunting people. They neither sowed nor reaped, and were altogether a more primitive and rude race, who apparently had been thrown back by the successive waves of continental emigration.

In the days of these ancient inhabitants of this district, vast forests covered the whole face of the country with an

almost impenetrable shade. A remnant of these forests still exists in the woodlands of Wharnccliffe, in whose high groves it is probable the Druids practised the barbarous rites of their creed. Here in this thick Hercynian forest, which covered the slopes and valleys of Hallamshire, roamed the wolf—which was a denizen of Yorkshire even so late as the days of Edward II.; the fierce wood boar, which afterwards afforded so much sport to the lords of Sheffield Castle; the wild cat, then a formidable beast; the wild ox, of which the type may yet be seen at Chillingham Castle, and other wild animals, now extinct in England.

We do not possess many British remains in this locality. Most likely the traces of castramentation existing on Wincobank are vestiges of British work. The camp has been of circular form. A mighty earthwork still shows its bold front, and stretches from Wincobank for miles to the north, under the names of Roman Rig, Danes Bank, and Scotch *Balk*. It was probably raised to defend the frontier of the Don against the incursions of an enemy. Several vestiges of British occupation are mentioned by Mr. Hunter as existing in remote parts of Hallamshire: for instance, a Carnedde, or British tumulus, called the Apron-full-of-Stones, near Broomhead; a trench, called Bardike, in the same locality, is also noticed by him as a British remain; likewise, a circular encampment which lately existed at Castle Dyke, in Ecclesall.

#### *Roman Period.*

We now come to the Roman period. When the Romans had subdued Britain they divided it into several provinces, for the purpose of better local government. There is strong proof that the boundary between two of these provinces—Maxima Cæsariensis and Flavia Cæsariensis—was, in these parts, the Don. The Brigantian kingdom was included in the first of these provinces, and the Coritani in the latter.

In the eighteenth iter of Roman Roads in Britain, compiled or transcribed by Richard of Cirencester, we find, in a station named Ad Fines (eighteen Roman miles from *Legeonium*, Castleford), a singular reflex of the word Rother, which the celebrated glossarist, Baxter, defines as a British word, signifying *boundary*; and this, to my mind, furnishes important evidence that the neighbourhood of Rotherham constituted the boundary of the Brigantes, and also of the above-named Roman provinces.

The Roman station, Ad Fines, is, by all antiquaries, believed to have been in the neighbourhood of Rotherham—Whitaker, the acute historian, of Manchester, placing it at Greasborough, and Mr. Hunter at Templeborough, where a Roman camp has been. But there is even stronger evidence than this. In the fourth iter of Richard of Cirencester, it is stated that at Danum (Doncaster) the road entered the province of Maxima Cæsariensis—that is, as I take it, on crossing the Don—clearly enough proving, at all events, that the large tract of country east of the Don, now included in Yorkshire, did not form part of the province of Maxima Cæsariensis.

Scattered throughout Hallamshire many Roman coins have been discovered. A hoard of about twenty of the coins of Hadrian, some years ago was found at Crookes. But a more important discovery of Roman remains was made in 1761, when, at the Lawns, or rather Launds, near Stannington, two manumission tablets of copper were ploughed up. They are now in the Museum of the Society of Antiquaries, and, being partly defaced, are not easily deciphered. Their purport, however, can be gathered. They are decrees of the Emperor Trajan, conferring upon Roman Legionaries, as marks of honour and reward, the rights of Roman citizenship. Such grants were inscribed on plates of copper or brass, and, after being registered at Rome, were, it appears, sent to where

these new citizens resided. These Roman colonists were often placed on border lands to check the inroads of the unsubdued natives who inhabited the mountains and difficult portions of the kingdom. Perhaps some of these colonists were placed on the banks of the Rivelin to keep in awe the Britons of the Peak, and here, probably, stood a Roman town. There is a tradition that, in these parts, a city was destroyed by fire, and this may have been a Roman town devastated by the Saxon or the Norman. It must, however, be noted that, on this spot—the Lawns—no other Roman remains have been found.\*

#### *The Saxon Period.*

Many reasons may be advanced to show that this district belonged to the kingdom of Mercia in the days of the Heptarchy. In the first place, it is altogether improbable that the two great kingdoms of Northumbria and Mercia were divided by a mere rivulet, such as separates, on the south, the parish of Sheffield from Derbyshire. These nations, it is known, were almost perpetually at war with each other. Their border lands, a very Flanders, formed the battle-fields for centuries of these turbulent neighbours. Some proof has been given that the Don formed the boundary of the Brigantian kingdom and of two Roman provinces. What so likely as that it also constituted the boundary of Northumbria and Mercia? There are abundant traces in the names of places and the dialect of the inhabitants of the parish of Sheffield, of the Mercian tongue.

We may safely conclude that when Yorkshire, in the time of King Alfred, became a county, it was carved out of the three great Saxon kingdoms of Northumbria, Mercia, and Cumbria. He must, indeed, be credulous who believes that

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\* Since this was written, I have been informed that Mr. Samuel Mitchell has discovered some Roman tumuli hereabouts.



the rivulets which separate Yorkshire from Derbyshire on the one side, and Westmoreland on another, were ancient divisions between great and rival kingdoms. We have, in the Saxon Chronicle, a succinct but very clear account of the manner in which counties, and their subdivisions, wapentakes and hundreds, were formed, and it is sufficiently evident that the boundaries were mostly artificial, and determined by the limits of the lands of the great Saxon thanes, or the community of interest which prevailed between neighbouring districts. Mr. Hunter acknowledges that the boundary line of Yorkshire has, on the east, been different in former ages from the present one. As an instance, part of the county of York, near Rossington, is, in an ecclesiastical point of view, within Nottinghamshire.

We now pass into the light of the written records of the kingdom. Domesday Survey informs us that, at the Conquest, the great Earl Waltheof, Earl of Northumberland, Huntingdon, and Northampton, had the Manor of Hallun or Hallum, with its sixteen Berewicks, which, unfortunately, are not named. These Berewicks were hamlets dependent upon, and parcel of, the Manor. It contained 29 carucates of arable land—about 3,000 acres—and there were twenty ploughs. There were there, also, thirty-three villains, who, at that period, were a superior kind of landowners. Earl Waltheof married the Countess Judith, that wicked Jezebel, as she is called in the Saxon Chronicle, the niece of the Conqueror, and was allowed to hold his land in Hallam. He, however, afterwards rebelled against the Norman king, and was put to death; the Manor remaining at Domesday Survey in the hands of a grantor of his widow. Owing to the devastations of the Conqueror, the Manor of Hallam, which, in the days of Edward the Confessor, was taxed at 8 marks of silver, is returned in the Survey as rated only at 40s. Any one conversant with the modes of life of the Anglo-

Saxons will know that these 3,000 acres of arable land would afford support to a large population. In the Manor of Hallam there must have been a population of at least 1,200 persons. Were we to compare the population of the Manor of Hallam with that of the whole kingdom at this period, as estimated by the late Sharon Turner, we should find it great in proportion to that of the rest of the kingdom. In the whole of the Manor of Hallam there were only eight acres of meadow land: clearly enough showing that they did not keep much live stock in winter. There was a woody pasture which extended nearly over half the wide manor.

Sheffield was a distinct manor. It is spelled two ways in Domesday Book, first as Escafeld, and then as Scafeld. I apprehend the latter spelling gives a clue to the etymology of the name. Mr. Hunter thinks the first syllable of the name is derived from a Saxon word signifying water, and that Sheffield means the field on the water. The word Scau, in Anglo-Saxon, means a woody slope; and, I think, the spelling of the name in Domesday Survey favours this meaning.

It is mentioned that Sheffield and Attercliffe were separate manors from Hallam, and each contained three carucates of land, and were held by a Saxon thane of the name of Sweyn. It is also stated that these manors were "inland of Hallam," whatever that may mean. I think its signification is that they were surrounded by the Manor of Hallam.

At the time of Domesday Survey the Manor of Hallam was held of the Countess Judith by a wealthy Norman, Roger de Busli; yielding, therefore, every year, as it seems, two white greyhounds. Two dogs a year would now represent very poorly the rental of Sheffield! In Hallam, Earl Waltheof had a hall or mansion, which, no doubt, was on a scale equal to his position as a mighty thane. Where this stood cannot now be ascertained, though Mr. Hunter gave

much attention to the subject. Many years after the publication of the History of Hallamshire, he confessed that his mind inclined to the conjecture that it stood on the spot where Sheffield Castle afterwards reared its head.

Soon after the Conquest, on the triangular plot of ground formed by the junction of the Sheaf with the Don, and now partly occupied by the Royal Hotel, a castle sprung up at Sheffield, and around it gathered, for protection, the nucleus of the present town. For nearly 800 years there have been, through the Lovetots, the Furnivals, the Talbots, and the Howards, a succession, by inheritance, of noble lords, unbroken by forfeiture: a circumstance which, so far as I remember, is unparalleled in the history of any other town in the kingdom. Indeed, during the whole of this long period the history of the town is filled with curious and romantic incidents.

In the mind's eye we picture its ancient lords, the flower of chivalry, emerging with their knightly retinue from the spacious portals of their many-turreted castle, to enjoy the chase, or wave their proud standard on the battle-field.

We look back to a glorious past of exciting associations. We see in the present a large, important, and prosperous town, filled with an intelligent, industrious, and thriving population. We cast our eye forward, and discern in the vista of the future a great and noble sphere for the good old town. May she faithfully fulfil the great destiny which awaits her, and take that high position in literature, science, and the useful and ornamental arts, which she so well deserves!

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FURTHER EXPLORATION IN THE DOWKERBOTTOM CAVES, IN  
 CRAVEN. BY JAMES FARRER, ESQ., M.P., OF INGLEBOROUGH  
 HOUSE; WITH REMARKS BY HENRY DENNY, A.L.S., &c.

Being desirous of making some further explorations in the Dowkerbottom Cave, or rather Caves—for, in its present state, it is divided into two chambers, one being to the east and the other to the west—I caused fresh excavations to be made in these two compartments during the month of October, 1863; and as the results of these explorations were productive of some objects of more than ordinary interest, I shall briefly enumerate the specimens so obtained, as also the superposition of the deposits passed through. On the surface of the western chamber was a deposit of 14 inches of rubbish, composed of broken stones, earth, and charcoal, in which were found fragments of two kinds of pottery—one, of a coarse black earth, and very rude manufacture; the other, an apparently inferior Samian ware, and a bone needle, about 3 inches in length. Below this deposit was a bed of pure clay, 18 inches in thickness, at the bottom of which, and upon a stratum of very soft stalagmite 3 feet 2 inches thick, were the antlers and bones of the red deer, portions of skulls and bones of the short-horned ox, roebuck, wild boar, primitive dog, fox, &c.: this layer of soft stalagmite rested upon a bed of excessively hard stalagmite 8 inches in thickness, upon which lay the nearly perfect skeleton of a very fine specimen of the gigantic red deer, with antlers of great beauty. An excavation was next made to the depth of 6 feet, passing through clay mixed with stones, gravel, and sand, and subsequently penetrating, by a boring-rod, to a further depth of 6 feet of soft unmixed clay, without reaching any bottom.

The floor of the east chamber was next examined, and the deposit of 18 inches of rubbish yielded a large brass coin of





Antoninus Pius.—[J. F.]\* This coin, singularly enough, is one of the rare types commemorating the conquest of Britain, and minted during the fourth consulate of the Emperor, of which the following is a description:—*Obverse*, “ANTONINVS . PIVS . AVG . P . P . T . R . P . COS . III . (*Antoninus . pivs . Avgvstvs . pater . patriæ . tribvntia . poteste . consvl . tertiem.*)” A radiated head of the Emperor to the right. *Reverse*, “BRITANNIA . COS . IIII . (*Britannia consvl quartum*):” a female figure seated on a rock in an attitude of dejection, before her a large oval shield and a military standard.—[H. D.] (*See Plate.*)

This type is of considerable interest on two points. First, That while Antoninus struck several coins commemorating different periods of the subjugation of Britain, this is thought, from the desponding attitude of the emblematical female figure, to denote that the conquest was *then ended*. Secondly, As the only other coins found on previous explorations are of Trajan, A.D. 98, they may point to a probable period when the Dowkerbottom Caves were first inhabited; while that of Antoninus, A.D. 131, to the last occupancy, which was, perhaps, during the second century, unless we suppose that the coins of the latter continued in circulation among the Brigantine or Romano-British inhabitants of the Yorkshire hills during the many changing and turbulent years which succeeded.—[H. D.]

There was also a fragment of an iron hook and ring, obviously of comparatively modern date, which had probably fallen in accidentally; but no pottery occurred. The hard stalagmite was then dug through down to the rock, four yards and a half thick! At about 18 inches below the surface, a small broken flint implement was found, which had not only been used, as evidenced by its edge, but also broken at a remote period. The flint was stained or discoloured with what a numismatist

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\* The letters “J. F.” distinguish Mr. Farrer’s communication: “H. D.,” Mr. Denny’s.

would call on a coin *patina*, and had all the appearance of extreme age. Here were also bones and fragments of horns of the red deer, and a portion of the second tyne of the left antler of the gigantic Irish deer—which is the second instance of the remains of this noble ruminant that has occurred in Yorkshire.

The nature and superposition of the deposits just enumerated deserve attention, as also the situation of the deer's skeleton, which appears to suggest the idea that the animal must have entered the cave by some other inlet than the one known, and before the fissure or break which now forms the entrance had been caused, and in consequence of which the cave is divided into two compartments. From the size of the animal it could not have got in alive by the present entrance, neither could it have been washed in when dead and entire; as, if this had been the case, there would have been clay, earth, and rubbish associated with it, carried in at the same time. The skeleton lay on hard stalagmite, which would seem to have been deposited under different circumstances from those connected with the deposition of soft stalagmite. It appears certain that there must have been periods when great changes, and various in character, took place. At the present level of the cave, the presence of such a vast body of clay, stones, and gravel cannot be easily accounted for. Can it be attributed to the action of glaciers, and that by such agency the valley beneath has been scooped out; or to some great river or submarine current in remote times?

In the absence of any better solution of the causes which may have operated, I venture to suggest the following as what may possibly, at least, have occurred; though so many difficulties arise that I feel very diffident as to the soundness of my inferences, which, however, I venture to throw out in the hope that they may be the means of eliciting some more satisfactory explanation:—Originally, I conceive, this cavern



was merely a large hollow in the solid limestone rock; floods and glaciers forced in, through small apertures, pure unmixed clay or loam, and afterwards, as the apertures became enlarged, stones and gravel, mixed with clay. A period of quiet would then seem to have intervened, during which the 8 inches of stalagmite, now so firmly consolidated, were deposited. The formation of stalagmite was then arrested, and the deer crawled in to die. At this period the cave was probably very high, the softer stalagmite, which now blocks up many parts of the cavern, not having begun to form.

We can hardly calculate how long the deer reclined on its hard bed before the stalagmite again began to ooze through the roof, and gradually covered up the skeleton. But this time it was much softer, and possibly more rapid in its formation than the hard 8-inch stratum. We have no data, however, from which to estimate the period during which this stalagmite was accumulating to the depth of 3 feet 2 inches.\* But again there was a change, and the stalagmite having ceased to form, wolves, deer, and other animals appear to have inhabited the cave. I draw this inference from the fact that all the bones were immediately above the

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\* The late Mr. Farrer, of Ingleborough House, commenced a series of experiments to ascertain the rate of deposition of calcareous matter in Ingleborough Cave. A boss of stalagmite, known as the Jockey Cap, is fed by one line of drops. It measures about 10 feet in circumference at the base, and the height is about 2 feet. It appears to contain about 8 cubic feet, or 9,450,000 grains of carbonate of lime. The drops were collected by Mr. Farrer on the 9th of October, 1851, after a rather wet period, and it required  $14\frac{1}{2}$  minutes to fill 1 pint, say 100 pints in a day. In this pint was found only one grain of calcareous earth, or 100 grains a day. If the water were supposed to yield up all its contained salt of lime, the number of pints of water consumed in producing this boss of stalagmite was = 9,450,000, and the years which elapsed in its formation =  $\frac{9,450,000}{100 \times 365} = 259$ ; from other experiments Mr. Farrer ascertained that, in 6 years, the stalagmitic crust had been increased in height about 3 inches, or about one-tenth of the whole, and in diameter 2 inches, or about one-twentieth of the whole. (*Philip's Rivers, Mountains, and Sea-Coast of Yorkshire*, p. 34.) Supposing, therefore, that the deposition of 3 feet 2 inches of stalagmite above alluded to in the Dowkerbottom Cave did not proceed more rapidly than that at Ingleborough, 76 years would elapse before the deer was finally covered up, and the wolves and dogs, &c., inhabited the cave. But probably it was more rapid.

—[H. D.]

stalagmite, and at the bottom of 18 inches of pure clay, and not mixed with the clay. There is, again, another change at hand, and 18 inches of pure clay covers all the animal remains. Another period of quiet ensues, the roof of the cave falls in where it approaches near the surface of the ground, the cavern is divided, the entrances being partially blocked up by the fallen *débris*, and the two caves, thus formed, are discovered and inhabited by human beings whose ornaments, implements, and coins are found in the most recent deposit of 14 inches of clay, earth, charcoal, and rubbish, which lies immediately upon the unmixed clay. In the east chamber the deposit of rubbish, charcoal, &c., was 18 inches thick, and, resting on stalagmite, was consequently drier; and this part of the cave may have been inhabited for a longer period of time than those parts where clay formed the basement, which would naturally attract more moisture.—[J. F.]

In an account of an exploration of the Craven Caves read at a former meeting of this Society, I hazarded a conjectural period when they were occupied by human beings, which was derived from the relics found therein, and it is a remarkable coincidence that a series of specimens, almost identical in kind, were exhumed from a Pict's house at Kettleburn, in the county of Caithness, by Mr. Rhind; from which circumstance, probably, a nearer approximation as to date may be arrived at, as it is utterly impossible that two localities, so far distant, would contain articles so precisely similar for domestic or ornamental purposes, or so similar an assemblage of animal remains, if not occupied at one and the same period. Of the specimens found in both Kettleburn and Craven, I particularly allude to the following:—

The bone comb of that peculiar hand-shaped form and rude workmanship.

Whetstone; perforated disks of sandstone.

Pieces of bone, with an oblong hole drilled through the

end, as if to receive some small implement, of which it was to be the haft.

Fragments of coarse pottery.

The upper ends of the tibia and humerus, and parietal bones of the human subject.

Bones and teeth of the horse.

Horns and bones of a noble species of deer, ox, goat, sheep, roebuck.

Skulls and tusks of wild boar.

Remains of dogs—some of large size, and others of small size. The large examples in Craven are, undoubtedly, wolves; the smaller, a primæval dog.

Now, as the Craven Caves, in addition to all the above primitive specimens, contain also coins, fibula, and other relics of unmistakable Roman construction, the question arises, Have these caves been inhabited by two successive races of men—the original settlers and the Romano-British; or are they relics of one race only, who, while still retaining many of their primitive implements, had also obtained some decorative ornaments, money, and other more civilized articles from the conquering Roman legions which spread over the north of England, and who would, doubtless, during their sojourn have occasional intercourse with the now fugitive, though primæval, colonists of Britain? This latter supposition will probably apply to the objects occurring in the superficial deposit of charcoal and rubbish; but whether it will equally apply to the few scattered human bones which have occurred deeper down, mixed with those of quadrupeds, in both Kettleburn and Dowkerbottom, is doubtful, as these imply an earlier interment, and would rather refer to the first supposition, but will not, even then, account for the fractured condition of the bones, which, however, is supposed, by some writers, to indicate that they belonged to a barbarous race, who were cannibals, and that these bones are the refuse of their orgies, as Diodorus Siculus, Strabo, and

St. Jerome describe many of the Celtic nations, in the first century, as being anthropophagi. Be this, however, as it may, from the depth at which the various fractured bones have been found—in one instance even upon the limestone floor of the cave—their interment must date much earlier than those just beneath the deposit of charcoal and rubbish on the surface, which clearly indicate a residence of considerable duration long subsequent to the former, and consequently point, if not to two distinct races of men, at least to two separate and distant periods of occupancy. Still a proof may appear wanting that the bones at the greatest depth indicate residence at all, but may have been washed down to the lowest part of the cave. The subsequent deposition, however, of hard and soft stalagmite and clay is, in my opinion, of itself sufficient evidence of the improbability of the above supposition; and I have this morning (February 18th, 1864) received the results of another exploration, carried on during the present week, which is of the most important and conclusive character, and supplies incontrovertible evidence of the correctness of the supposition as to distinct and distant residence. In an exploration in the west chamber, about four yards from the spot where the skeleton of the red deer was discovered on the former occasion, and on the same level, a slight hollow or grave was disclosed, which had been dug in the bed of hard stalagmite, measuring 1 foot long, 8 inches in width, and  $1\frac{1}{2}$  inches in depth, in which were the remains of the skeleton of a child of probably  $2\frac{1}{2}$  years of age. It was in a very imperfect and fragile condition, arising, doubtless, from the immature condition of the bones; the teeth are good, but the elementary portions of the skull were all disunited, and, from the adhesive nature of the bones when applied to the tongue, the animal matter has been nearly all destroyed. The human bones were covered by a deposit of softer stalagmite, 2 feet 6 inches in thickness, in which occurred several shells of the *helix nemoralis*, in a perfect

condition, but much faded in colour; after which again occurred jaws of the primitive dog and fox; teeth of the ox and deer; clay, and fragments of pottery and charcoal. But as a doubt might still be attached to the most important part of the discovery—that of the human remains—as it might be inferred that their position was not conclusive of an earlier residence, but might have been interred at that depth for security, by its Romano-British parents, when occupying the upper and last deposit, I made particular inquiry of Mr. Hodgson, of Settle (an experienced and intelligent explorer of the caves, and who superintended Mr. Farrer's excavations), as to whether there was any indication whatever of a mixture of deposits or materials at this precise spot, which must have occurred if the grave had been sunk through the upper beds of clay, rubbish, and charcoal, and he distinctly says, "The softer stalagmite had never been stirred or moved since its formation,"—a point upon which a mistake could not easily be made, as the colour of the stalagmite, I know from experience, is uniform and pale.

Finally, the occurrence of a small portion only of one of the horns of the megaceros in the west chamber of the cave is somewhat strange, for if the animal had been washed in, or carried there as food, some of the bones would have been preserved also, they being more durable than the antlers; yet the former have never been found in the north of England, which may perhaps be accounted for from the fact that this fine ruminant does not appear to have ever occurred in any number in this portion of Britain, the only other indication of its former residence in Yorkshire being that of the horns found at Cowthorpe, near Wetherby, in 1744: I therefore think it probable that a straggler may have died from some cause in the neighbourhood, and that a portion of one of its antlers had been torn off and carried into the cave by some of the carnivorous inhabitants of the district to devour at leisure, which we know at particular seasons would be comparatively

easy to fracture and masticate; while, on the other hand, if it is conjectured to have been a *shed horn* its hardness under such circumstances would render it a very difficult operation for either wolf or dog to accomplish.

Connected with the above occurrence of this animal, there is another point of some interest, which is, that in Ireland, the great centre for this species of deer, their osseous remains are invariably found either in peat bogs or in crannoges, where in the one case they have probably been submerged, and in the other are the refuse of the lake dwellers; while in other localities, both in England and on the Continent, their bones have in almost every instance been found in caves, as at Kirkdale, Kent's Hole, Brixham, &c. How then are we to account for the entire absence of any remains of the megaceros in the limestone caverns of Ireland, into which we might equally suppose some of the individuals would have retired, or been washed by any sudden and local catastrophe, or been carried piecemeal by the large carnivorous animals which are known to have inhabited Ireland at the same period?

The two chambers of this cave extend conjointly 390 feet in length, and as the entrance to another fresh cave has been recently discovered, additional interesting and important results may be expected, it being Mr. Farrer's intention to make an examination of the new cave. (*See Ground Plan and Section prepared for and contributed by Mr. Farrer.*)

The whole of the bones, &c., disinterred during these excavations have been presented to the Museum of the Leeds Philosophical and Literary Society by Mr. Farrer.—[H. D.]

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SIXTY-SEVENTH MEETING, HELD IN THE  
COUNCIL-CHAMBER OF THE GUILDHALL, DONCASTER, ON WEDNESDAY,  
NOVEMBER 22ND, 1865, AT TWELVE O'CLOCK AT NOON.

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The Right Hon. LORD HOUGHTON, D.C.L., in the chair.

The Chairman having read a letter of apology from Dr. Vaughan, Vicar of Doncaster, who was to have presided, announced Charles Bartholomew, Esq., of Broxholme, as elected a member of the Society.

The Chairman called upon JOHN EVANS, Esq., F.R.S., F.G.S., F.S.A., &c., of London, to read the first Paper, of which the following is an abstract.

ON THE COINS OF THE ANCIENT BRITONS, AND MORE PARTICULARLY THOSE FOUND IN YORKSHIRE.

In bringing before you a brief notice of the Coins of the Early Britons, I may state at the outset that considerable diversity of opinion has existed amongst antiquaries as to whether the Britons really had a coinage of their own; and if so, as to the period of the first introduction of a coinage into Britain. Leland, our earliest historian of any note, says that in all his travels through England he could never meet with one British coin; and he accounted for their

absence by the assertion of Gildas, that the Romans would not allow any metal to be struck in the country unless with the image of Cæsar. Subsequently, however, coins and various relics were discovered in different parts of England; and, as the attention of the learned of those days was gradually given to these objects, it was then found that Early British Coins did exist, and Camden, in 1586, was the first to publish figures of fourteen undoubtedly British coins.

The popular opinion that before the invasion of Julius Cæsar the ancient Britons had no coinage, but used rings of iron and brass, rests on a disputed passage in Cæsar's own writings; one reading of which mentions the use of golden coins instead of rings, which would seem, from subsequent discovery, to be more in accordance with fact. When Cæsar landed he found the country inhabited by various tribes who were not natives of the country, but chiefly immigrants from the continent of Gaul, who had driven the original inhabitants into the interior. This immigration led to a constant intercourse between the various tribes of the two countries. When we come to consider the character of the early commerce of this country with other nations, and the connection which, long before the days of Julius Cæsar, existed between the people of Britain and those of Gaul, the supposed unacquaintance of the former with the use of money is quite incredible. There seems to have been a trade in tin, as early as 445 B.C., carried on between Britain and Gaul, and thence by land through the continent of Gaul. It was therefore probable that the Britons would gain a knowledge of coinage not very long after the Gauls acquired that knowledge themselves. In the year 600 B.C., a Greek colony was founded at Massilia (Marseilles), in Gaul, the civilization of which gradually spread into the districts around. It was here the original of all our coinage was introduced about 330 B.C., the ancient and beautiful Philippus, a diagram of which coin is



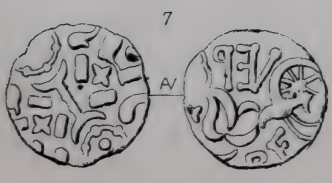
exhibited. On the obverse of this is a bold figure of the head of Apollo encircled with a laurel wreath, or, as some writers suppose, the head of young Hercules; and on the reverse a chariot drawn by two horses, and underneath the name of Philip. These coins were very soon extensively imitated by the native inhabitants of Gaul, and in course of time these imitations came over to Britain and were again imitated in this country. Thus the gold Greek Philippus was the origin of the coinage in Gaul; and the Gaulish imitations of it, there is no doubt, formed the first coins from which the Ancient Britons took their copy. The variety of the figures upon them, and the changes which mark them, enable us to form a pretty accurate opinion as to the time when they were issued; as the greater the divergence from the prototype, the later probably will be the coin.

If, on the contrary, the art of coining was unknown in Britain until the time of Cæsar, the coins must either have been struck on the Roman model or on that of the later Gaulish coinage, in which nearly all resemblance of the original Macedonian types had been lost, and which shows also unmistakable signs of Roman influence. Again, we should have a coinage of the metals then in use—gold, silver, and bronze—and not one of gold only, as it would have been had it originated at an early period of the Gaulish coinage. Now let us see what evidence the coins themselves afford upon this point. We find coins of gold of a type which never occurs on the inferior metals, and which, though occasionally found in France, are of much more frequent occurrence in England, and are therefore, in all probability, of British origin, and on which the laureate head and the charioteer in the biga can at once be identified, though they are both considerably modified, and these are, without doubt, the earliest of the British series. Now as regards their date. The death of Philip II. took place B.C. 336, and we may

safely infer his coins began to be copied or imitated in Gaul as early as B.C. 300. But as these imitations would be merely servile copies retaining the name of Philip on the coins, while those of the Britons exhibit various innovations, such for instance as the addition of drapery, or a gorget to the neck of the laureate head, and a bandlet around it, the giving wings to the charioteer, and the union of the two horses of the biga; it appears probable that some considerable time must have elapsed between the period when first the Philippi were imitated in the south of France and that when their As their weight is considerably less, it is evident they could modified copies were in circulation on the northern coast. never have been in circulation with the true Philippus, which is about 133 grains, while the heaviest British are only 120 grains. It is a well-known fact that among all nations, whether civilized or uncivilized, there is a strong tendency, for the sake of some small gain to the governing power, to reduce the weight of the coins, so that the earlier coins are almost invariably heavier than those of a later date, even though of the same denomination and current value.

Our Silver Penny, for example, of the present day weighs but  $7\frac{1}{4}$  grains, though its original weight was 24 grains, as evidenced in our pennyweight; and the ancient Roman Solidus, of 70 grains of gold, is represented by the English Shilling and by the French Sou. Again, as I have already stated, while the proper weight of the Macedonian Stater or Philippus was 133 grains, it was in the later times of the British coinage reduced to 84 grains. There is also a strong desire not only to reduce but to adulterate the gold coins with less valuable metals, so that some of the later gold coins are often found with a strong coating of verdigris upon them.

Coincident with this diminution in weight, there is also a remarkable change in the types of the coins, each successive imitation becoming more and more remote from the original.





Among barbarous nations the laws which regulate the types of a coinage, consisting of successive copies of a given original, are very similar to those which, according to some of our best naturalists, govern the succession of types in the organic kingdoms of nature. As with plants or animals of any group or family, there are two tendencies to be traced in these successive copies—the one to retain the character of their ancestors, the other to vary from it. Again, there is a third principle or tendency of more importance, as far as results are concerned—that of the perpetuation of varieties when they are in any way advantageous. In nature those varieties appear to have become more or less persistent, which, in the “struggle for life,” have presented advantages over the parent forms in their relation to external conditions. In the succession of types of British coins, the requirements which new types had to fulfil in order to become to a certain extent persistent, were, firstly, to present facility of imitation, and, secondly, symmetry of form. The great desire in all uncivilized people appears to be the selection of simple yet symmetrical forms of ornament, as also the saving of trouble.

From the diagrams placed on the walls it will be easy to see the divergence of successive types from the original Philippus; all the alterations, however, are in accordance with the principles I have just laid down. Compare No. 1 (the prototype) with Nos. 2, 3, 4, 5, in the plate, and we see the face, it is true, preserved, but the rest of the head has become conventionalized, or reduced to a system; the front hair has become converted into three open crescents; the hair at the back is represented by two parallel rows of nearly similar locks; the wreath is reduced into a double row of leaves, all of one size, extending across the coin; while the head is crossed at its centre by a straight band ending in a hook, where originally was the ear; and the neck has an ornamental covering of beaded and plain straight lines. On the reverse a greater

transformation has taken place; the horses of the chariot are distorted into something which undoubtedly was meant to be a horse, but which I feel great diffidence in presenting to a Yorkshire audience as a specimen of that noble animal. Some of the horses have the most fantastic shapes; that there were originally two is indicated by a double set of legs to one body: again, we see the head, legs, and tail all disjointed, and so distorted as to be only recognized as such by tracing them through a series of types. The same occurs with the head of Apollo. On some coins all recollection that a head was being represented appears to have been entirely absent; on others the face has completely disappeared, and a central rounded projection where it should be is all that remains. In others we see the head beginning to assume a cruciform appearance: further on it has been reduced to a regular cruciform pattern or flower, but with crescents in the angles of the cross to represent the locks of the front hair, and eventually no part of the head remains. On some coins the obverse is perfectly smooth and even.

There are two series of British coins,—one the inscribed and the other the uninscribed series; and although it is difficult to state the particular tribes to which they may have belonged, it is not difficult to see that the uninscribed series are, as a rule, of earlier date than those inscribed with the names of princes which belong to a more civilized era. By means of the conventionalized pattern previously referred to, the inscribed coins can be traced to their prototype, as for instance those of Tasciovanus, Eppillus, Dubnovellaunus, and Tinc (ommius), which are all evidently descendants from the same original, though widely differing in type. Now as we have the means of assigning a date to all these four princes, it will afford a clue to the probable date of the earlier coins. Tinc (ommius) and Eppillus appear to have been the sons of Commius, the Atrebatian mentioned by Cæsar in his *Com-*

*mentaries*; Dubnovellaunus is most probably the Damno Bellaunus of the Inscription of Augustus at Ancyra; and Tasciovanus was the father of Cunobeline, the Cymbeline of Shakspeare, and, therefore, a contemporary of Augustus. Speaking generally, therefore, the date of the British coins just enumerated may be taken as from 10 to 20 years before the Christian era; and if we consider what period would be necessary to allow of such a transformation of type from their prototype to their debased and degenerate state, both in execution and weight, from 120 grains to 84 grains, it is very evident some considerable period must have elapsed, as it is only fair to suppose that each successive type was struck in imitation of one already in circulation; and as there was also a debasement of the metal accompanying the diminution in weight of 30 per cent., I think that from 100 to 150 years is but a reasonable allowance for so complete a change of type and weight. We may, therefore, regard it as highly probable that there was a native coinage in some parts of Britain as early as B.C. 150, if not earlier.

The classification of British coins which I have adopted is that of assigning the different types, as far as practicable, to particular parts of the country in which they were probably struck. I have already assigned the date of about B.C. 150 for the commencement of the British coinage; but it is difficult to fix, with any degree of certainty, in what part of the country it actually commenced, though there is high probability that the knowledge of coining was first communicated to some parts of the south-eastern coast, as Kent, and gradually spread from thence, as a centre, and was adopted in different districts of Britain at different periods, varying in time in proportion to the distance of each from the centre, while the coinage of each district derived its character in a great degree from the peculiar modification of the prototype which was first introduced—the uninscribed series, in every

instance, being, doubtless, the earliest. One thing, however, is certain, that the currency of the British coins was for a time limited to the southern and eastern parts of Britain, though it afterwards extended as far northwards, along the eastern coast, as Yorkshire; and this is quite in accordance with the statements of our early historians. In Cæsar's time the coast of Britain, opposite to Gaul, had long been occupied by Belgic tribes; and the tribes of the interior are described as far more barbarous, and unacquainted with agriculture, though possessing flocks and herds. The Silures of South Wales, are expressly cited by Solinus\* as refusing money and employing simply barter. Mela† also relates that the further the tribes were from the Continent the more ignorant were they of other riches than flocks and territory.

The immigrants from the Continent, who had driven back the earlier inhabitants into the interior, were no doubt considerably in advance of them in civilization, and were the first to introduce the art of coining. From the south-eastern parts of Kent the use of coins appears to have extended westward and northward, though we have no precise means of ascertaining the exact course it followed, or of the time it took to reach the more distant parts of the country. Following it westward along the coast, the counties of Sussex and Hants first claim our attention, and have some types peculiar to themselves. The silver coinage of Surrey and Sussex appears to have commenced long after the gold, and was formed upon a different model, probably also of Gaulish origin; but no uninscribed types in copper or brass can be assigned to these counties. Proceeding westward, we find that the prototype with the laureate head, after passing through various phases, took root in Dorsetshire, Wilts, and part of Hants; but whether the coins were struck by the Belgæ

\* Cap. xxxi., sec. alios xxii.

† Lib. iii., c. 6.



or Durotriges it is difficult to determine, though I think it must have been by the last tribe. The type had now arrived at that state of degradation which rendered it so easy to copy that there was no inducement for variation, and it therefore became persistent. It is remarkable that in this district both silver and brass coins were struck of the same module and of the same type as the gold, while in all the other parts of Britain coins made of the inferior metals are, as a rule, of smaller size and of different types. There is also another peculiarity attaching to this district, viz.—that it never had an inscribed coinage, though a little to the north, in Somersetshire, Gloucestershire, and part of Wilts, an inscribed currency was adopted, but at a later period, and derived from a different modification of the prototype, and comprising silver coins of a totally different module and character. Following the extension of the British coinage westward, beyond the territory of the Durotriges, it appears very doubtful whether the Damnonii, who occupied Devonshire and Cornwall, though not wholly unacquainted with the use of money, ever had a coinage of their own, as no purely British coins, as far as I am aware, have ever been found in Devonshire; and the only discovery of British coins in Cornwall, with which I am acquainted, is that of *Karn Brê*, which were of classes more commonly found in the southern counties to the east of Devonshire. In Buckinghamshire and Oxfordshire, the district occupied by the *Catyeuchlani*, various early types have been found, and the same has been the case in Herts, Beds, and Essex, the country of the *Trinobantes*. It is somewhat remarkable that no types can at present be assigned with certainty to the Midland counties, though it is most probable that some of the modifications of the original prototype were struck there, which connected the coinage of those counties with the barbarous descendants of the *Philippus*

in Norfolk and Yorkshire—the money of the Iceni and the Brigantes.

Having now arrived at the coins of this latter county, I may remark that the dominions of the Brigantes appear to have comprised Yorkshire, Lancashire, and other northern counties, and are described by Ptolemy as extending from sea to sea. Their most populous towns, whose sites can now be ascertained with any degree of certainty, are Caturac-tonium (Catterick Bridge), Isurium (Aldborough), Olicana (Ilkley), and Eboracum (York). Being situated so far north we find no mention of the Brigantes or their rulers in Roman history until A.D. 50 or 51. Coins belonging to Yorkshire have been discovered at Pickering, Almondbury, and Light-cliffe, near Halifax. Most of the coins of the Brigantes have been found in the southern parts of Yorkshire and in Lincolnshire, and have generally occurred to the number of three or four together, and sometimes associated with Roman coins.

From the localities where these coins have been found, there is little doubt of their having been struck by the Brigantes, though the fragmentary legends upon them afford no clue which will connect them with either the name of the tribe or of any of its cities or princes. The principal of these legends are the following:—VOLISIOS-DVMNO-CO-VEROS; DVMN-TIGIP-SENO(?); HSVP(?)-SV; and VEP-CORE. With reference to the date of the Yorkshire coins there is, however, a certain amount of evidence to guide us. Their type is perhaps the rudest of all the copies from the prototype, and so barbarous an imitation of the Philippus as to place them amongst the latest of the British coins. The metal is also much deteriorated, pointing to a late date. In most instances also they have been found associated with Roman coins. In 1829, sixteen or eighteen were found at Almondbury (the Cambodunum of Leland), with 200 Roman family coins, some of which were in tolerable preservation, while the British coins

were sharp and unworn, from which it might be inferred they had not been in extensive circulation.

In 1827, a workman digging for gravel in the immediate vicinity of the old Roman road at Lightcliffe, near Halifax, came upon a fictile vase, apparently of Roman manufacture, which contained a number of coins, principally Roman denarii and family coins, but among them were four ancient British coins; three were of the well-known Yorkshire type, with the inscription, . VOLISIOS . in two lines across a wreath on the obverse, and the rudely-formed horse and DVMNO-CO-VEROS on the reverse. (*See Plate Nos. 6, 7.*) The fourth was a new variety, but evidently a direct descendant of the Macedonian Philippus, though only the wreath and the horse survive to prove its relationship, and the wheel-like form of the tail of the horse is all that is left to remind us of the chariot which was attached to the more artistic animals on the original. The imperial coins above alluded to included one of Caligula and Agrippina I., struck probably about A.D. 40. The hoard, therefore, could not have been deposited until after that period, and as we know that in the western parts of Britain the native coinage continued in circulation until after the accession of Claudius, it is very probable that the same occurred in the northern parts also; and as I am not aware of any Roman coins found with British of a later date than A.D. 40, it is very probable the coinage of the Brigantes ceased before A.D. 50. The date of its introduction, as I have already stated, cannot be determined; but from the similarity of the type occurring among them, it is evident the period over which they extended could not be long.

As far as I know, the ancient British coins are confined to the south-eastern portion of the territory of the Brigantes, and have not yet been found in Lancashire or the counties north of Yorkshire, and it is very probable that some of the uninscribed coins are the connecting links between the proper

coins of the Brigantes and those of the southern parts of Britain. They certainly do not appear to have derived their coinage from the Iceni. The type of their gold coins is quite different, and a silver currency, except of Roman coins, was apparently unknown, though the native coins of the Iceni, inhabiting the eastern district of Britain, are most abundant in that metal. I should therefore infer that the Brigantes derived their knowledge of the art of coining through the Coritani (or Coritavi), of whose coinage we know little or nothing at present. The gold coins of the Brigantes are rude in execution, debased as to metal, so as scarcely to deserve the name of gold, and in shape much dished or concave. The use of money at so early a period in this country may appear almost incredible to those who have been accustomed to regard the ancient Britons as in the lowest state of barbarism; but such persons, I suspect, have formed their estimate of the character of the Britons from the descriptions handed down to them of the tribes located in the interior rather than of those living along the seaboard of the island, who were mainly of Belgic origin, and to whom, for a long period, the use of money was confined, until it gradually spread into the neighbouring districts more inland. It is, however, an undoubted fact that the Britons were not only acquainted with the use of money, but were also accomplished workers in metals, and understood not only the art of coining, but also that of counterfeiting coins, which is a branch of the art indicative of a high state of civilization. I may observe, however, that the contemporary forgeries best known are of the inscribed series of gold coins of Addedomaros, Dubnovellaunus, and Cunobeline, and of silver coins of Tasciovanus. The forgeries of the uninscribed and most ancient coins are rare. The false gold coins are of copper and bronze, and covered all over with a thin plating of gold, and the silver coins have been fabricated by plating with

silver in the same manner. As to the method by which the coins were struck we have no certain means of judging, but I think it very probable that the dies in use amongst the Ancient Britons were similar to a very curious die lately discovered at Avranches, in Switzerland, and which had been intended for striking the obverse side of one of the Helvetian degenerate imitations of the Philippos. This die consists of a disc of bronze inlaid in a cylindrical block of iron, with a concave surface to produce the convexity of surface so common among the coins of this class, and also probably to prevent the rolling of the spherical pieces of heated metal from which the coins were struck. The execution of the devices upon the dies appears to me to have usually been produced by punches rather than with the graver, though it is probable both were used for the purpose on some occasions.

The influence of the intercourse with Rome upon the character of the coinage of the Britons is very perceptible, not only in the great improvement in the execution of thoroughly British types, but also in the introduction of purely classical devices by Roman artists, or probably native artists, who had had the benefit of Roman instruction, and who were first employed in the British mints about the period when the inscribed coins of Tinc (ommius) commenced, probably B.C. 54; and I have little doubt that in nearly every part of Britain where an inscribed coinage was current, one that was uninscribed had preceded it, and also that in most instances the use of this uninscribed currency preceded the Roman invasion. Finally, I may say, we have now evidence of a coinage belonging to the Ancient Britons extending over a period of two hundred years; and though much has of late been accomplished in arranging this important series, yet no doubt many types still remain undescribed, which the researches of those living in different parts of the country will, it is hoped, eventually supply.

ON THE OCCURRENCE OF A LEAD CELT IN LINCOLNSHIRE;  
WITH REMARKS ON CELTS GENERALLY. BY HENRY  
DENNY, A.L.S., ETC.

Of the various implements which have come down to us belonging to people of remote ages, none are so extensively distributed as those known under the general name of *Celts*, and perhaps none possess greater interest from the obscurity which exists as to their original use or uses; for, though all are denominated celts, they are not all precisely alike. It is also a fact, not a little remarkable, that the rude stone implements of all uncivilized nations have a nearly uniform type or pattern, and are made of such materials as were most probably the nearest at hand; hence we find the most primitive made of serpentine, jade, basalt, sienite, coarse grit, clay-slate, granular porphyry, andernach trap, red iron-stone, horn-stone, and flint. As the nations became more advanced in civilization, we find implements made for the same purpose of metals, and almost invariably of copper and bronze; many of these exhibit great proficiency, not only in the art of casting, but also of design and finish.

The latter, however, I believe, have never been found except in the various countries of Europe, though Worsaae tells us that the ancient Egyptians and Mexicans possessed battle-axes of bronze and copper. But who these early people in Europe were, or what the probable date of their original introduction, is still a subject of controversy. For, as Mr. Syer Cuming has well remarked, the term celt, used as it is in such an indefinite way for nearly all bronze and stone implements, has no relation whatever to the people bearing that name, but is derived from an old Latin word, *celtis*, supposed to mean a graving-tool\* or chisel; and it is remarkable, at all events, that the word is thus used in

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\* See Forcellini's *Lexicon* under the word *Celtis*.

the Vulgate translation of Job xix. 24—*Celte sculptantur in silice*, and translated in our version, “Graven with an iron pen in the rock;” and it is very probable that implements of flint or stone were used in the very earliest ages for various purposes, as we find Joshua made knives of stone to circumcise the children of Israel (Joshua v. 2). There is, however, a presumption that the period of the manufacture of bronze implements in Europe is at least a thousand years before the Christian era, as Worsaae says that there are geological reasons for believing that the bronze period must have prevailed in Denmark five or six hundred years before the birth of Christ; and as he supposes that the bronze was obtained from England, it is fair to infer they were of higher antiquity in Britain than in the north of Europe. For, although the stone and bronze periods may have been coeval in different and distant countries, the first attempt at the construction of such objects in each would, doubtless, be to form them of stone, and even when the use of metal was partially discovered, the operation at first would be slow, and, like that of the Indian of the present day, by beating out a lump of copper or other metal; which mode would continue for a long period before the art of casting or ornamentation was arrived at, and probably centuries would elapse unless the above manufacture was introduced by a more advanced or civilized people.

That they have been native manufactures in most instances is, I think, evident; for not only have large numbers been found together in one spot, but also the moulds from which they were cast. Now, as copper or bronze are the materials or metals of which they are usually made, a question has been raised—From whence have all these early people obtained their metal? I have already given Worsaae’s opinion that it was Britain; and it is most probable that Cornwall has been the locality, as we know that a very extensive

trade was carried on by the Phœnicians with the Cassiterides, or Tin-islands, centuries before the Christian era. While, however, the former metals were in general use for various objects, lead, also a Cornish metal, does not appear to have been in request for the manufacture of celts, as I am not aware of any record of a celt having been found composed of that metal alone, which from its softness certainly does not appear well adapted for the purposes to which such implements are generally supposed to have been applied.

A specimen, however, of the ordinary socketed celt, with a loop, and made of lead, has been for many years in the Museum of the Leeds Philosophical and Literary Society, obtained from Anwick, near New Sleaford, in Lincolnshire. It measures four inches in length, and nearly a quarter of an inch in thickness at the base, and weighs a little exceeding three-quarters of a pound. The lead appears much altered in colour; the surface, acted upon by age, has what a numismatist would call a coating of patina upon it. Placed as this specimen had so long been with several other celts of the usual material, it had not attracted particular attention until recently, when, upon showing it to the Rev. William Greenwell, of Durham, that gentleman immediately recognized the novelty of the metal for implements of that description, and expressed a desire to know something of its history. As there was every indication of age and genuineness in the specimen, it became important to inquire what were the precise circumstances connected with its discovery. Much must depend not only upon the locality in which it occurred, but also the character of the parties from whom it was originally obtained, which alone could remove any suspicion which might be entertained of its being a mere modern fabrication, like some of the flint implements from Bridlington and Scarborough, the handiwork of the notorious Flint Jack. I therefore applied to the gentleman by whom it was presented



to the Museum for such information as he could still communicate, and received the following reply:—

“33, SAINT JAMES’S STREET,  
“Leeds, 18th June, 1865.

“DEAR SIR,—The lead celt referred to in your letter was given to me by Mr. Faulkner, of Anwick, near Sleaford, in Lincolnshire, farmer, about 22 years ago. I first saw it lying on his chimney-piece, when I asked him for it and its history. He informed me that one of his labourers found it while hoeing in a field on the farm;—that he had previously carted away a hillock in the field and spread it over the land, and he supposed this thing had been carted out of the hillock on to the land, and afterwards found by the labourer, who struck it with the hoe while hoeing, I think he said, turnips. When I obtained it it was so thickly incrustated that the metal could not be seen, but my domestics cleaned and spoiled it. What Mr. Faulkner meant by ‘carting away a hillock,’ was the removal of a hill in the field and spreading the earth thereof on the field to level it for cultivation.

“I placed considerable value upon the celt, as I had not any doubt of its being a genuine celt, and it seemed to me to upset the theory that celts were used as weapons or axes, and would ultimately lead to an inquiry as to whether celts were not insignia only amongst the persons who held them.

“Anwick is in a very ancient district, on the high ground at the edge or brink of the Fens or ancient sea of Lincolnshire, just in the place where you might expect to find things of the highest antiquity.

“Kynie, the adjoining parish, has produced many antiquities.

“Sleaford and the surrounding country is exceedingly rich in geological remains. You have in the Museum some elephant’s teeth found there in the gravel; the bones of the same animal were lying in the same spot as the teeth, some of the bones being so large that their diameter was almost as much as the width of the workman’s spade when he cut them.

“I am, dear Sir, yours faithfully,

“JNO. GREENE, Solicitor.

“Henry Denny, Esq.,

“Curator, Philosophical Hall, Leeds.”

With reference to this letter, I will only remark that the hillock to which Mr. Faulkner alludes as having been levelled in his field, may have been a barrow, and, if so, the occurrence of the celt is at once accounted for; as Mr. Bateman, in his ten years’ diggings, records three instances in which

bronze spear heads and celts were found in barrows, and, I believe, in Derbyshire. In the 10th volume of the *Archæological Institute*, p. 691, occurs a notice by Mr. Fowler, of Winteringham, in Lincolnshire, that on the 17th December, 1852, a ploughman turned up in a field near Winteringham seventeen bronze celts, with three other metallic fragments, and that his attention was drawn to them by the ploughshare sticking amongst the celts, which were all candied together. The seams left by the mould in casting were imperfectly trimmed—a circumstance which, connected with the discovery of metallic fragments with the celts, might suggest that this place of deposit was the site where a foundry for such objects had formerly been situated; and he also states that a chain of barrows extends from the Humber into the interior of the country.

The last fact partially corroborates my supposition of the hillock in Mr. Faulkner's field having been a barrow; and the probability of a foundry having been formerly in the neighbourhood has also a bearing with the celt under consideration, to which I shall presently allude. The great interest, however, of the example centres in the material of which it is made; from which circumstance Mr. Syer Cuming (no mean authority) says, as far as he knows, it may be pronounced *unique*. This fact has induced me to bring before the Geological and Polytechnic Society a short notice of so singularly rare a specimen, accidentally rescued from destruction. Affording, as it does, another instance that from the *débris* of a British or Saxon barrow—the solitary grave of a Red Indian—the mounds of Nineveh—or the buried cities of Mexico—relics may be obtained which tell us, in a language not to be misunderstood, the great progress these early people had made in different branches of art; as also the interesting fact, that the same rude wants were provided for by the same simple means in the construction of

implements of one common type by widely-separate races of men, and appear to furnish indirect evidence of the common origin of mankind. Dr. O'Callaghan, in a paper read before this Society at Bradford, arrived at a similar conclusion, from the consideration of the universal practice of forming the cromlech as a place of sepulture by uncivilized people in every part of the world, and in all ages.

Finally, in reply to the generally received opinion that celts, in the ordinary acceptation of the term, have been used as weapons of defence, I venture to remark that it is very probable, as we find them of different forms. The common socketed celt or pot celt, the same with the loop, the palstave, the lance head, &c.\* Their uses may have been as different as their forms. That while some have undoubtedly been for spear heads, or offensive and defensive weapons, others appear as ill adapted for that purpose.

Mr. Syer Cuming, who has given much attention to these objects, believes that the socketed specimens have been used as butts or ferrules for the shafts of spears or lances, by which they might be fixed in the ground, or even used at times for offensive weapons; just as the Romans used the *spiculi* of their *hastæ*. As evidence of this connected use, Mr. Cuming cites their frequent discovery along with spear heads; that of a stone found in the Isle of Anglesea, upon which were cut moulds for casting both the spear blade and the celt; and also that iron ferrules, of analogous shape and structure, are frequently seen upon the spear shafts of warriors of both Eastern and Western Africa.

The occurrence of celts in burial mounds, or simple graves, is quite in accordance with their character, either as weapons of defence or insignia of office, as we find it a universal practice among uncivilized nations to inter with their dead

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\* See Wilde's Catalogue of the Antiquities of the Royal Irish Academy.

warlike implements and other objects, whether of ornament or for domestic purposes, which have been valued by the deceased, or presumed to be required in the world of spirits by their original or former owners. Hence we find necklaces, amulets, fibula, caskets, drinking cups, needles, celts, spears, knives, bosses of shields, horse harness, portions of war chariots, fragments of the funeral repast, trophies of the chase, and various other relics of unknown use.

A most remarkable instance of this kind has been discovered in New Zealand during the past year. A man in the employ of Mr. Davidson Fyffe, of Kai Koras, near Wellington, while digging for the foundation of a house on the side of a small mound, suddenly came upon a human skeleton, doubtless that of a Maori, which appears to have been buried in a sitting posture, with the arms extended towards the mouth, near which was the entire egg of a Moa, and between the legs numerous tools made of jade—including a spear, an axe, and several other implements. Here, as is most probable, the egg was intended as food for the deceased, as it is barely possible an empty shell would have been so deposited, unless in some way transformed into a drinking vessel or personal ornament, which in this instance did not appear to have been the case. Under the former supposition it affords indubitable evidence that the Maori and Moa were contemporary inhabitants of New Zealand, and that the latter had probably been used as food by the former.

Again, we know that even among people so highly civilized as the ancient Egyptians, they commonly interred with the dead small emblematical representations of the different divinities who were supposed to have influence over the eternal destinies of the deceased; and various other objects, even dolls, personal ornaments, corn, bulbous roots, &c.

Supposing, however, that evidence, apparently the most conclusive, may eventually be adduced of their having all been

intended for weapons of warfare, but that the specimen before us, from its material, appears still to refute such a supposition, this refutation may be more imaginary than real; as my friend, Dr. O'Callaghan, of Leamington, has suggested a probable reason for the use of so unusual a metal, which is, that it may have been a *trial celt of lead* run into the matrix before the more valuable metal bronze was hazarded for the final operation of casting. To which I may add the singular coincidence, that the Rev. W. C. Lucas, F.S.A., well known for his extensive explorations of barrows in Great Britain and the Channel Islands, suggested precisely the same solution of this difficult problem, without being aware that a similar opinion had been already expressed. And it is somewhat remarkable, and may probably bear on this subject, that in draining some land at Winterton, specimens of Roman pottery were discovered, in one of which vessels thirteen rudely-formed disks of lead were found, the use of which was unknown. Might they not have been samples of lead preserved for casting celts or objects of a similar kind?

Whatever diversity of opinion, however, may exist as to the uses of metal celts, that as regards those of stone is now as clearly established, by collateral evidence, as could be required, by one of the most important Anthropologico-Archæological discoveries of modern times. In the month of January, 1863, a magnificent skull of the *Bos primigenius* was found beneath four feet of peat, near the village of Reche, in Burwell Fen, Cambridgeshire, with the frontal bone on the upper margin of the orbits broken in, and the remains of a flint celt in the orifice. The celt had penetrated the skull to a depth of  $2\frac{3}{4}$  inches, and broken off against the inner surface of the base of the skull, the fragment measuring three inches in length. Professor C. Babington, of Cambridge, to whom I am indebted for a printed notice of this interesting discovery, says "that probably the celt was

fixed in a heavy handle so as to increase the weight of the blow, and so placed as to resemble an adze rather than axe;" the fracture in the skull being just that which we see in those of oxen slaughtered with a pole-axe at the present day. The discovery of the skull with the celt *in situ* is a most remarkable corroboration of the origin of similar fractures in skulls of the megaceros, ox, and swine, which were found several years since in Lough Gur, near Limerick,\* and created no little diversity of opinion at the period. Had a solitary specimen only occurred, it might have afforded a plausible reason for conjecture as to its being merely the result of accident. But when several examples were discovered, with precisely the same fracture in the frontal bone, it appeared to me that but one cause ought to have been assigned, and the one most natural to suggest itself was that the animals had been slaughtered or received their death-blow from the hands of man.

This specimen, therefore, not only illustrates one use of the stone implements of that character most conclusively, but also a still more important fact, hitherto considered very doubtful by some of the most eminent geologists of the day. It proves that man has most certainly been coeval with this gigantic ruminant, which was itself a contemporary of the mammoth, rhinoceros, and other extinct mammalia of the post pliocene period; and therefore, in all probability, man has also coexisted with the extinct pachydermata, which consequently carries the advent of the human family back to an almost incalculably remote antiquity, and, to use the words of a modern writer—"The conclusion of such discoveries is that ages ago, in the period of the extinct mam-

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\* Skulls of the ox and swine, with the fractured frontal bone, from the above locality, have been many years in the Museum of the Leeds Philosophical and Literary Society; as also the skull of an ox with a similar fracture, found with other bones in a Roman well near Gilsland.

moth and fossil bear, perhaps before the channel separated France from England, a race of barbarous human beings lived upon the soil of Europe, capable of fabricating rude implements of flint. The mind is lost in astonishment in looking back at such a vast antiquity of human beings, a tribe of men in existence thousands of years before any received dates of creation; savages who hunted with their flint-headed arrows the gigantic elk of Ireland and the buffalo of Germany, or who fled from the savage tiger of France, or who trapped the clumsy mammoth of Northern Europe. Who were they? we ask ourselves in wonder. Was there with man, as with other forms of animal life, a long and gradual progression from the lowest condition to a higher, till at length the world was made ready for a more developed human being, and the Creator placed the first of the present family of man upon the earth? Were those European barbarians of the drift period a primæval race destroyed before the creation of our own race; and lower and more barbarian than the lowest of the present inhabitants of the world? Or, as seems more probable, were these mysterious beings, the hunters of the mammoth and the aurochs, the earliest progenitors of our own family, the childish fathers of the human race?"

At the conclusion of the Paper, Mr. EVANS, F.R.S., humorously alluded to the difference between celt, the implement, and Celt, the race known by that name. The two names being similar, produced, he argued, a confusion of ideas, and as the Saxons pronounced the "C" hard, he suggested that it would be better to vary the pronunciation by pronouncing the implement kelt, and the race Celt. Without vouching for the accuracy of what he was about to propound, he thought it was worthy the consideration of a Society like this to ascertain whether celts

found in the various places might, after all, not be actual implements, but placed on the grave, as swords and implements of war were in former times in Germany and other countries placed on the graves of many persons. Instead of burying the actual arms used by the persons so buried, it had been the custom to place with the corpse imitations of the kind of weapon used, and thus there were miniature swords and other arms; and it was a matter for consideration whether the unique celt, to which their attention had been drawn, might not be an imitation after all, though genuine as to its antiquity.

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The Rev. SCOTT F. SURTEES, Rector of Sprotburgh, was the contributor of the next Paper, which, in that gentleman's absence, was kindly read by Dr. SCHOLFIELD, Honorary Local Secretary. It was as follows:—

ON LOCAL NOMENCLATURE, AS DERIVED FROM SAXON SETTLEMENTS IN SOUTH YORKSHIRE.

A local meeting of this sort expects some local information. There are few parts of England, we believe, where subjects of greater interest could be found. These eastern coasts of ours were of easy access to the northern races, who yearly sailed from their fiords in search of adventure and plunder. The Humber and its tributaries, up which their narrow ships could run far into the inland country, we find were constantly visited, and *Dune-muth*, or mouth of the Don or Dun, is often mentioned as their resort; it certainly was in the later years of the Heptarchy. Are there any traces of earlier visits to these parts? Was there, or was there not, a Saxon settlement north of the Humber when the Saxons first settled on these shores? The names of places in this neighbourhood answer the question for us. We



have a collection of names clearly indicating a location of a Saxon or Scandinavian race—names not selected at random, but those familiar to every student of Norse history—household words in their Sagas and songs.

First, we have a residence marked out of a Saxon king amongst us, and near by of the blood royal, and also the site of the district court established by the older and first Saxon settlers; secondly, we find traces of the newer or later Northmen, who fought and harried, and then settled in these districts in the later centuries before the Conquest.

Now, as to the first point, that here was a royal residence: Coninges-burh—Coning, *king-es of burh*, borough, or “King’s borough,”—“Conisbro” still retaining its ancient orthography, although the ferry has it altered into *King’s ferry*. Then we have the town of the “Blood Royal”—Edling-ton—ðeling, or *Etheling*, being Saxon for royal or noble (Ð in the Saxon alphabet, bear in mind, standing for *th*).

We would here mention how invariably the Saxon race shortened their words and elided the middle syllable. Two examples will be familiar to you all—*Woden-es-day*, or *the day of Woden*, into “Wednesday;” *St. Botolph’s town* into “Boston.”

Now, note the name “Mexbrough”—*Mearcs-brough*, how it tells of the ancient race and their customs. The Anglo-Saxon settlers called all lands held in common “Mearc” or “March.” Kemble says, “Mearcs-burgh was the mount or hill where they held their courts, and they themselves, *i.e.*, the freemen, were called Mearcs-men.” (How the old title “Lords of the Marches,” in our history of border warfare, perpetuates the name!) Mexbrough, no doubt, was one of such sites, or places of assembly, held in common by the mearc-men or march-men of this district.

But, again, other bands of Northmen enslaved, if they did

not trample out, the Anglo-Saxon settlements in this part of England. So complete was the conquest that they changed the very laws of the land, and we find in that interesting book—Laing's *Chronicles of the Kings of Norway*, "That for three hundred years from about 787 A.D., the laws and customs of the Northmen superseded in large districts, such as East Anglia, Mercia, and Northumbria, the ancient laws of this realm." In our ignorance we choose to call them all by the name of Danes, but in reality these districts were possessed by different peoples. Now it was a Dane—then a Norwegian, or, it may be, a "Viking" from Sweden, who, sometimes acting in alliance and sometimes as foes, occupied and ruled in turn these lands.

It is strange that students of English history have so missed this point. Two quotations I will make to prove this from the old *Chronicles of Norway*—"Athelstan sent a message to Eric (Hakon's brother), who went out on an expedition plundering all the north part, that he should hold North Humber-land as a fief from him, and defend it against *Danes* and other Vikings. Eric resided at York, where it was said Lodbrook's son had formerly been, and Danes and Northmen had often plundered."

Again—"The Danes had spread themselves so widely over England that Ethelred had gone south to Valland. In the autumn King Olaf came to England. Ethelred came back to England and sent an invitation to all who would to enter into his pay; amongst others King Olaf, with a great troop of Northmen, came." King Olaf attacks the *Danes* in London at *Sudrivick*—Southwark. The old Norwegian Saga has as follows:—

" Brave Olaf will his throne defend,  
 King Ethelred has found a friend ;  
     In bloody fight  
 Maintain his right,  
 Win back his land  
 With blood-red hand."

In 1016, "King Olaf was still in England and came into these parts, as we read Ethelred's sons came to Olaf and promised him North Humber-land (that is, the land north of the Humber) if they drove the Danes out of England. Olaf comes to North Humber-land to Furo-vald, and in a battle with the townspeople and merchants gains great booty and victory."

In short, as the Saga informs us, thus corroborating the Chronicles, "he appears to have sailed about defeating the Danes and plundering the people—

"Money, if money could be got;  
Goods, cattle, household gear, if not."

Now these later Northmen called their court or place of assembly "Thing," or *Møre Thing*, and themselves not *Mearcs-men* but "Thing-men." Now note how satisfactorily we trace their occupation of this district. Laughton-le-Morthen, law town, where they met to make their laws. *Møre Thing*, the place of meeting. The Normans, into whose hands these districts passed, in giving the name of *Law-toun*, added the *le*, and gave also the word *Mor-Thing*, used by the Northmen to describe their place of assemblage in their own country, and so we arrive at the name of Laughton-en-le-Morthen, and also almost to a certainty of the rule and location of a race different from the older Saxon occupants of these lands.\*

Now the principal places where "Things" were held in Norway, were one at Moere or *Møre*, and one at Lade, in Drontheim district, where they transacted the business of the people. At Upsal also there is a mound called the "Thing's Mound," flat at the top and steep slopes for the people to sit upon. The "Lagman" or "Lawman" presided at these

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\* In Inq. 13 Ed. 1st, by John Kirkby, Treasurer of Fees in county of York. the name of Laughton is correctly spelt; under the head of "Morething,"—"John de Morething holds of John Count Warren."—See *Dodsworth MSS.*

meetings. The mound at Laughton-en-le-Morthen still exists, similar to the one at Møre in Norway and Upsal in Sweden. (See Laing's *Chronicles of Norway*.)

There are other names, not fanciful or far-fetched, bearing witness to the earlier settlement of the Saxons here. Some of them we have given in a work called *Waifs and Strays of North Humber History*. There is for instance—

*Cudeby*—Keadby; and Ceadbad is a descendant of Woden.

There is *Hunger-hill*, and Hunger is a chieftain noted in the ancient Sagas.

There is *Cusworth*, or *Gewisworth*; and Gewis is a contemporary and relative of Hengest.

There is at Sprotburgh, *Hengest-rein*, and adjoining it *King's-grave Field*, witnessing in a most striking manner to the spot where the great chieftain met his death, which we are told by all the old historians was near Conisbrough, on the banks of the Dun.

There is *Beorn-brough*, or *Barnbrough*; Beorn being a son of Bældeg, son of Woden.

There is *Harlington*, a hamlet near Barnbrough; Harling being another famous worthy mentioned in the *Traveller's Song*.

There is the name of the residence of Billing—*Billingham*, or *Bilham*; Billing being the noble founder of the royal race of Saxons.

There is the town of *Icel*—*Hickel-ton*. Icel, a descendant of Woden and Wœrmund.

There is *Wœurmunds-worth*—Warmsworth, or the land of Wœurmund, he, too, being a descendant of Woden and contemporary of Hengest.

There is *Hengest-thorpe*, or Hexthorpe—as contracted *thorp* or *dorp* being Saxon for village.

There is *Wada-worth*, or Wadworth; Wada being the

father of Weland, "the smith;" the ancestor in nomenclature of the numerous progeny of Smiths who are not unknown in this our England of the present day.

There is *Branton*, or the town of Brand; he being another son of Bældeg, and grandson of Woden.

Surely all these different names of Saxon chieftains and heroes, in so many ways connected with Hengest, point out to us not only that it was here that that great conqueror of Britain fought his last fight and fell, but that here himself and followers had their location and their home, and that *Thun-castle*, or *Dun-castle* (*th = Þ*) which all historians mention as the name of Vortigern's grant, was situate in this district, on the banks of this old Dun.

There are many other points of interest which might be mentioned, but it would only encumber our subject. We have finished; and we trust that we may have interested some of you in the traditions and localities of your own immediate neighbourhood, and that others may be led to make further researches in that earliest of all districts mentioned in ancient English story, the old *Campodunum*, or *Dona-felda*, or *Plain of the Don*, which has witnessed such changing scenes, and been alike the home and battle-field of so many and such various people and nations, and which has known as masters the Briton and the Roman, the Pict and the Saxon, the Dane and the Norseman, and, finally, the Norman, conquerors of them all.

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Mr. DENNY, in the absence of the writer, JOHN JAMES, Esq., of Sheffield, read the following Paper on—

THE LITTLE BRITISH KINGDOM OF ELMET.

When the Roman legions had been withdrawn from our shores, and nearly the whole country lay at the mercy of the Anglo-Saxons, there existed in the heart of the West-Riding of Yorkshire a little state called Elmet, which maintained for nearly two hundred years its independence. It was probably enclosed on all sides by the kingdom of Deira, which included the whole of the other parts of Yorkshire.

This *Regiuncula* of Elmet, as it has been called, possesses for many reasons great interest both to the antiquary and general inquirer.

1st. Because it probably remained, in regard to inhabitants, religion, and manners, much the same from the time when the Romans quitted this country until the year 616.

2nd. Because in this interval it stood like an oasis hemmed in by the desert of Saxon paganism. From the time that Christianity was introduced into Yorkshire, probably in the latter part of the second century, its pure light, it may be believed, never afterwards became extinguished, nor the literature, arts, and civilization of Rome quite lost in this territory of Elmet, though the gross darkness of heathenism pervaded for a long period the Saxon rule in England.

3rd. Because Leeds, now the capital of the West-Riding, was most likely also the capital of the kingdom of Elmet.

The history of this interesting little state is involved in deep obscurity, for very few ancient notices have descended to us respecting it.

Lappenberg, in his *History of England under the Saxon Kings* (translated by Mr. Thorpe), states that Herevic, grandson of Ælla, King of Northumbria, was poisoned in Elmet

some time before the year 616, and that about the same year his uncle Edwin, also King of Northumbria (which included the province of Deira), as one of his earliest deeds on ascending the throne, conquered about the year 616 the little British territory of Elmet, which had existed as an independent state. We are also informed that at this time Cereticus held the sovereignty of Elmet. Within a few years after this conquest, Edwin was converted to the Christian faith by Paulinus, who afterwards preached at Dewsbury and throughout these parts.

The country of Loidis, which by Thoresby was assumed to be the same as the district of Elmet, is mentioned by the venerable Bede, and also the "Wood of Elmet," as hereafter more fully stated.

But the most curious notice of Elmet is contained in the fragment of an ancient MS. inserted in Camden's *Britannia*, and containing a list of the Saxon divisions of England during the time of the Heptarchy, when England was not divided into counties, but only into several partitions with their number of hides. In this list the number of hides possessed in Elmet is set down, but it is far from certain whether these were all that were included in the former district of Elmet, or merely represented a later "partition" carved out of it. At this point the inquiry naturally arises—What, then, were the extent and bounds of the ancient kingdom of Elmet? The subjoined remarks are offered as aids in answering this inquiry:—As to its extent, from the ancient MS. inserted in Camden's *Britannia*, we find that Elmed Setna (that is, the inhabitants of Elmet) possessed or occupied 600 hides of land, and Wight-Gora (which it is presumed stands for the Isle of Wight) is also set down in the same MS. as consisting of the like number of hides; so that, taking the hides to contain the same measure of land in both places, we obtained from the known area of the Isle of

Wight 86,800 acres, or about 136 square miles. But it is very probable that the district of Elmet contained much more.

Bishop Kennet, in his *Parochial Antiquities*, observes that the word "hide" was originally taken for a house, and what Bede calls *familias*—that is, as much land as would maintain a family; for his Saxon interpreter, King Alfred, calls the owner a Hydeler. The quantity of a hide was never expressly determined—sometimes it contained 100 acres, sometimes eight virgates (192 acres). The truth seems to be, hide, knights' fee, and yardland differed in different places.

Now it is quite certain that in the Saxon times the hide contained more land in the sterile or uncultivated lands of the north of England than in the more fruitful districts of the south. For instance, it appears from Domesday Survey for some parts of Lancashire, six carucates or 600 acres made a hide of land, but in other counties the hide and carucate were mostly the same. The district of Elmet, it is supposed, took its name from abounding in elm trees. As will hereafter appear, it is conjectured that it included within its bounds at least the valleys of the Wharfe and Aire, and probably also that of the Calder. Every one traversing these valleys cannot but be struck with the large remnants of the forests which completely covered their slopes in the days of our Saxon forefathers. In Otley manor, there were at the time of the Domesday Survey—Coppice Wood, nine miles in length and nine miles in breadth; the Great Wood of Farnley, near Leeds; the Bishop's Wood, near Sherburn, and numerous others, are vestiges of the immense forests which spread over the face of Elmet, and gave security and independence to its inhabitants. It is evident, therefore, from the existence of these immense forests, and the vast tracts of moorland between the valleys, that a very extensive



tract of country would be required to support 600 families, supposed to constitute the population of Elmet: for a family in Saxon times had often a large number of dependents. From all these considerations it will perhaps be a moderate estimate to allot to the kingdom of Elmet about 400 square miles, or say 25 miles long and 16 miles broad. In corroboration of this surmise Bede states that the island of Ely (which is 24 miles in length and 14 miles in breadth) contained in his time 600 families, hides or households, and it was unquestionably then a more fertile spot than the country around Leeds.

As to its bounds, Thoresby, in his *Ducatus*, observes: "The territory about Leeds called Elmet, or the *Regio Loidis*, which seems in those ages [Saxon] to have been of equal extent." Undoubtedly, the *Sylva Elmetica* of Bede, and adds that he durst not venture upon defining the boundaries of this *Regiuncula* of Elmet. What Thoresby durst not venture upon it may appear rash to attempt. The following hints are, however, with all diffidence, offered towards solving this difficulty. Thoresby himself, in the *Ducatus* (page 245, second edition), remarks:—"I take Shireburn to be the utmost limits, at least in this topography, of the ancient *Elmed Setna*, or the inhabitants of Elmet, as I take the word to signify." Here, then, we have the authority of Thoresby for assuming Sherburn to be on the eastern boundary of Elmet; but there are also other reasons for this opinion.

In many ancient writings Sherburn is described as "Sherburn in Elmet;" and Old Lambarde, in his Dictionary, published in 1577, says the "Territory or Hundredth about Shyrburne, in York, is called Elmete." Again, the very title—"Shireburn"—denotes the boundary of a shire or district. Towards the north it is not unlikely that the river Wharfe formed the boundary. Nowhere can the monastery

of the most Reverend Abbot and Priest, Thrydwulf, mentioned by Bede to stand in the "Wood of Elmet," be placed more appropriately than at Tadcaster, for there or thereabouts a monastery existed in the Saxon times, the only one in that part of the country which can be considered as included in the territory of Elmet. That this territory could not extend to the north further at the most than Tadcaster, may be concluded from the circumstance of York being the capital of Deira from the time of its subjugation by the Saxons, and that the district between the Wharfe and the city incontestably belonged to it. It is clear that the country contiguous to Tadcaster on the south belonged to Elmet, because Berwick-in-Elmet lies in that quarter. And here, most likely, from the remains still seen, stood the royal villa or residence of the later Kings of Northumbria, mentioned by Bede as lying in "the country of *Loidis*." As to the boundaries of Elmet on the west, there seems but little material to form even a probable opinion.

Lappenberg thinks that the district called *Cumbria* extended into the later kingdom of Northumbria, and that "the little state of Elmet" belonged to it. This conjecture, for it is only one, does not seem very plausible, for the voice of history is plain that Elmet was an independent state under its own king. Besides, Lappenberg's theory would require Craven to have been included in *Cumbria*, and the evidence is strong that it belonged to Deira. It is, however, not improbable that the state of Elmet extended on the west to the confines of the Deanery of Craven (about 25 miles from Sherburn), where there seems to have existed from a remote period a strong line of demarcation. On the south there are no means of forming a judgment as to the situation of the boundary line.

Dr. Whitaker, by including the parish of Halifax under the title of his great work, apparently thought that it formed

part of the southern boundary of the district, to which he gave the name of *Loidis et Elmete*. Indeed, his work includes very much the same country as that ascribed in this Paper to Elmet. Taking Sherburn as the east point, Bingley as the west, the breadth required (16 miles) would include the lower portions of the valleys of the Wharfe, Aire, and Calder. The town of Leeds either gave the name to the *country of Loidis*, mentioned by Bede, or took its name from it as its capital.

Let us now consider for a few moments the question of the state of Leeds prior to the Conquest. Thoresby believes that *Caer Loid Coit*, one of the twenty-eight British cities enumerated by Nennius, was Leeds, *not Lincoln*, as many have supposed, and adduced, among other good reasons, the great authority of Dean Gale for this opinion. Dr. Whitaker, that prince of topographers, in a note to the passage in Thoresby, says:—"On a cooler consideration than our author's partiality to the subject would allow him to bestow on it, I cannot but think that Leeds has a fairer claim to be the *Caer Loid Coit* of Nennius than any other place." That Leeds was a very important place in the Saxon times is satisfactorily proved by Domesday Survey; for seven Thanes held it of King Edward the Confessor for seven manors, valued at the large sum of £6. Besides, there were there a church, a priest, and a mill, several classes of occupiers representing a considerable population for the age, and many other indications of a place of importance; in fact, the chief town of the district. Singularly enough, the Conqueror, though he devastated the neighbourhood, spared Leeds, and hence its rapid growth soon after, whereby it eventually obtained a great charter from the Paganel, its lords, and became large and prosperous.

The concluding Paper, contributed by HENRY CLIFTON SORBY, Esq., F.R.S., of Sheffield, was

ON IMPRESSED LIMESTONE PEBBLES, AS ILLUSTRATING A NEW PRINCIPLE IN CHEMICAL GEOLOGY.

In certain conglomerates, consisting chiefly of pebbles of limestone, met with in various places on the Continent, and notably in the so-called *Nogelflue* in Switzerland, a very curious and interesting phenomenon has been observed: one pebble penetrates into another, sometimes to such an extent that it nearly passes through it, without there being any apparent fracture. Usually, however, the impressions vary in depth, up to half-an-inch or more, and into them another pebble accurately fits; and when it is removed a hollow is left, as if it had been pressed into soft clay. Much attention has been paid to this phenomenon in Germany and France, and various theories have been propounded, none of which in my opinion are satisfactory; but it has attracted so little attention in our own country, that I have met with very few of my countrymen who ever heard of the subject. On studying the German and French literature related to this question, references to which may be found in a Paper of mine published in Germany,\* I soon became convinced that the facts could not be explained in a satisfactory manner on any known chemical or mechanical principles, and I therefore was induced to investigate the question with the view to ascertain whether it would lead to some new physical principle. One thing led to another, until I was led into a wide and almost unexplored branch of research, which in the course of time enabled me to establish the direct correlation of mechanical and chemical forces; † in other terms, I

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\* *Neues Jahrbuch für Mineralogie*, 1863, 801.

† See Bakerian Lecture. *Proceedings of Royal Society*, vol. xii., p. 538.

proved that in the same manner that we may obtain mechanical force by means of chemical changes, so we may modify or produce chemical changes by mechanical pressure.

All previous writers had attempted to explain the impressions in the pebbles either by mere mechanical or simple chemical action, localized by mechanical conditions. The facts point so strongly to both agencies, that it is easy to understand why the opinions ever varied between the two extremes; and it now appears to me astonishing that no one was led at an earlier period to suggest a correlated action of both. At the same time we must admit that a large part of those who have studied the question, did so before the doctrines of the correlation and conservation of force were generally admitted or understood. It is mainly as an illustration of the applicability of such principles to geology that I have been led to draw attention to the impressed pebbles.

In my Paper already cited, I showed that in the case of the majority of substances mechanical pressure increases their solubility. For example, if a crystal of common salt is placed in a perfectly concentrated solution, so that no more would be dissolved under the ordinary pressure, on applying to the solution a pressure of, for example, a thousand pounds to the square inch, and maintaining it for a sufficiently long time, more salt is dissolved, and is again deposited on removing the pressure. I also found that a glass rod with a small round termination, pressed with a force of ten pounds against a plate of rock salt, had in the course of a year produced a well-marked depression, surrounded by a ring of small crystals raised above the level of the original surface. The salt had been exposed to the atmosphere, in which case a thin film of moisture is generally present on the surface; and, since the force of capillary attraction varies inversely as the width between two plates, where the salt was in almost

absolute contact with the glass the force with which the liquid would penetrate between them would be very great. It therefore appears to me nearly certain that the pressure would be to a considerable extent sustained by a thin film of liquid, which being thus under pressure would dissolve more salt than the rest of the solution, and, by slow diffusion amongst it, the salt would thus be transferred from where the pressure is greatest to where it is less.

Now these experimental results entirely satisfy the conditions met with in the case of the impressed limestone pebbles. Pressed one against the other with great force, at a considerable depth below the surface of the earth, and surrounded with water saturated with carbonate of lime, in accordance with the principles I have described the limestone would dissolve, so that in time one pebble would penetrate into the other, and carbonate of lime would be deposited in a crystalline form elsewhere, where the pressure was less. This explanation agrees admirably with the various facts. The structure of the limestone proves most conclusively that the depressions were produced by the actual removal of material, and not by its yielding as a plastic substance. Moreover, it is only the carbonate of lime which has been removed—only the soluble part of the pebble—the insoluble earthy portion having been left behind at the bottom of the depressions; and therefore the removal cannot have been effected by mere mechanical means, which would have removed the whole indiscriminately. I attribute the solution of the material of one of the pebbles, and the unaltered outline of the other, to a difference in their hardness, or the amount of earthy or sandy impurities; whilst, at the same time, I think it probable that a difference in curvature may have considerable influence.

If then the principle of the convertibility of mechanical pressure into chemical action serves so well to explain the

formation of the impressed pebbles, it appears to me that it is not likely to be the only case to be met with in geological inquiries. I have indeed observed a number of facts connected with the structure of limestone rocks which cannot be explained in a satisfactory manner on any other principle. Striking examples are met with in the case of rocks affected with slaty cleavage. There certainly are some peculiarities in cleaved rocks which strongly point to the more or less chemical origin of that structure; but these can now be completely reconciled with the mechanical theory which has so much to recommend it to our acceptance. Probably various other examples will be found, to which similar principles may be applied; but, at the same time, the mechanical equivalent of chemical changes is usually so great, that we can only expect them to apply to cases where the affinities are extremely feeble.

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Thanks were voted to the readers of the various Papers.

The CHAIRMAN said it was a somewhat singular fact in connection with this meeting, that, although it was a Geological Society, not a single Paper bearing upon geology had been read, if they excepted the Paper forwarded by Mr. Sorby. He hoped that at their next meeting the members would have their attention directed to one or more geological subjects. He knew much more of antiquity than of geology; but, at the same time, he should be glad to hear geological Papers read the next time the Society assembled.

W. CHADWICK, Esq., of Arksey, proposed a vote of thanks to Lord Houghton for presiding.

The vote was unanimously agreed to.

His Lordship, in acknowledging it, observed that it was to such Societies as this (over which he had had the pleasure that day to preside) they were indebted for much valuable

information and research both in history and archæology. He was proud to think that of late years the most interesting feature in connection with such Associations was the desire to spread education and knowledge amongst the great mass of the people; and that especially in this large and intelligent county of York there was a growing desire not to be behind-hand in the good work such Societies were effecting. He would ask them to do whatever they could in the circles in which they moved to assist so important a Society as this



# PROCEEDINGS

## OF THE

# GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SIXTY-EIGHTH (THE ANNUAL) MEETING, HELD IN THE  
PHILOSOPHICAL HALL, LEEDS, ON MONDAY, AUGUST 6TH, 1866,  
AT THREE O'CLOCK IN THE AFTERNOON.

CHARLES CHADWICK, Esq., M.D., President of the Leeds Philosophical and Literary Society, in the Chair.

Leonard Thompson, Esq., of Sheriff Hutton Park, and Fearless Barber, Esq., of Brighouse, were unanimously elected members of the Society.

The General Secretary then read the annexed financial account of the Society for the past year:—

### STATEMENT OF RECEIPTS AND EXPENDITURE

OF THE GEOLOGICAL AND POLYTECHNIC SOCIETY OF THE WEST-RIDING OF YORKSHIRE.

From June, 1864, to September, 1865.

DR.	£. s. d.	CR.	£. s. d.
By Cash in hands of General Secretary .....	2 0 4	Printing and Advertising .....	16 8 0
By Subscriptions—		Philosophical Society for Rent of Museum Room .....	20 0 0
From 1 Member for 1861 ..	0 13 0	Collecting Subscriptions .....	2 17 4
" 3     "     1862 ..	1 19 0	Postages and Postage Stamps ..	1 17 3
" 22    "     1863 ..	14 6 0	Expenses of Meetings .....	6 0 6
" 92    "     1864 ..	59 16 0	Lithographing Plates .....	2 15 0
" 7     "     1865 ..	4 11 0	Subscription to the Palaeontographical Society, 3 years	3 3 0
		Carriage of Parcels and Sundry Expenses .....	0 16 9
		General Secretary on Account ..	20 7 4
	£83 5 4		£83 5 4

The following noblemen and gentlemen were re-elected as the officers and council of the Society for the ensuing year :—

President.

THE EARL DE GREY AND RIPON.

Vice-Presidents.

THE DUKE OF LEEDS.  
THE EARL OF EFFINGHAM.  
THE EARL OF HAREWOOD.  
THE EARL OF DARTMOUTH.  
EARL FITZWILLIAM.  
LORD WHARNCLIFFE.  
LORD LONDESBOROUGH.  
VISCOUNT GALWAY.  
VISCOUNT MILTON, M.P.

VISCOUNT HALIFAX.  
EDWARD AKROYD, Esq., M.P.  
JOHN WATERHOUSE, Esq., F.R.S.  
W. B. BEAUMONT, Esq., M.P.  
E. B. DENISON, Esq.  
LORD HOUGHTON.  
J. SPENCER STANHOPE, Esq.  
J. GARTH MARSHALL, Esq.  
THOMAS WILSON, Esq., M.A.

Council.

HENRY BRIGGS, Esq.  
DR. WM. ALEXANDER.  
H. C. SORBY, Esq., F.R.S., F.G.S.  
HENRY HOLT, Esq., C.E.  
BENTLEY SHAW, Esq.  
T. P. TEALE, Esq., F.R.S.

RICHARD CARTER, Esq., C.E.  
T. W. EMBLETON, Esq.  
REV. DR. BURNETT.  
DR. SCHOLEFIELD.  
WM. CHADWICK, Esq.

Honorary Secretary.

WM. SYKES WARD, Esq., F.C.S.

General Secretary.

HENRY DENNY, Esq., A.L.S.

Honorary Curators.

J. G. MARSHALL, Esq., F.G.S. | T. W. EMBLETON, Esq.

Local Secretaries.

H. C. SORBY, Esq., Sheffield.  
HENRY BRIGGS, Esq., Wakefield.  
DR. ALEXANDER, Halifax.  
DR. SCHOLEFIELD, Doncaster.

BENTLEY SHAW, Esq., Huddersfield.  
RICHARD CARTER, Esq., Barnsley.  
REV. DR. BURNETT, Bradford.  
DR. PALEY, Ripon.

The Chairman, having briefly addressed the meeting, and read letters from the Right Hon. Earl de Grey and Ripon, the President, and Lord Londesborough, one of the Vice-presidents, regretting their inability to preside in consequence of other public engagements, called upon Mr. Ffooks to read the first Paper :—

ON THE FLINT IMPLEMENTS AND WEAPONS FOUND AT  
BRIDLINGTON. BY JOHN FFOOKS, ESQ.

The pre-historic history of Britain can only be illustrated by means of an extensive collection of ancient relics, carefully examined and arranged, and by the facts which they disclose being received with unprejudiced judgment; but the extent of our researches must not be considered as bounded by the stone circle and the barrow: there are other resources of equal extent and value, if not far greater, at our command. One of these is a collection of the various weapons and implements left by the inhabitants in the Ancient British villages. These may be gathered up, with all their circumstantial information attached to them, as little affected by time as the deposits in the tombs, if done with discretion and care. The object of this Paper is to relate discoveries of this kind at Bridlington, in this county; but before doing so, I wish to point out, very briefly, the connection which exists between various sources of information which contribute their quota to increase our knowledge of the earliest inhabitants. Yorkshire appears to have been peopled as soon as any part of the island, and the immigrants who first set foot upon the shore have left memorials of the event, which are still visible in the foundations of their huts and the implements they used; and I may say they communicate their history as correctly as the people would have written it themselves, if we read it with a steady recollection of their position and circumstances. At Bridlington we find they paddled their canoes into the bay, which was then more contracted than it is now, and, upon landing, ascended the highest ground overlooking the cliff, where the soil was dry and healthy and supplied with abundance of good water, and there they built their huts; the woods in the neighbourhood supplied them with game, and the sea with a variety of fish. I shall

refer to this village again further on. They afterwards migrated to the interior, and remains of their villages are traceable on the hills and moors.

Amongst the number of settlements which exist, I notice some in particular which require special investigation, because they all differ materially, and seem to have belonged to distinct peoples or tribes. In Cleveland, on Danby Moor, Dr. Young described two parallel lines of pits, like a street, which were enclosed by an embankment, with a stream running through the centre, and at the west end a circular walled space of 35 feet in diameter, with remains of a stone circle or cromlech, and to the north several high stones, and to the south three large tumuli 100 feet apart, and to the east of these a large tumulus with a fossæ round it above the base. This unique relic of another age has yielded some important evidence, and is capable of supplying us with an entire history of its people, if examined and described as a whole; but if parts are removed without being carefully recorded, then so many pages are torn from its volume.

Another village at Skipwith is totally distinct in character. There the remains of huts, slightly raised above the level of the land, exist, which indicate a different method of keeping them dry. They are enclosed by a double line of embankment, with ditches, while the tumuli are surrounded by fossæ of a square form. The members of the Yorkshire Antiquarian Club found these barren of relics; but still they illustrate a settlement of distinct people, and form an important link of pre-historic knowledge. The flint implements which belong to them have not been identified.

The third form of foundations for huts, indicating a different people, exists at Ingleborough, where stone walls were built to support a roof. There are, no doubt, various flint implements to be found on all these sites which would identify the people with the relics that have been taken from

barrows at other places, and likewise with particular systems of fortification, such as the Skipwith double and triple line of embankment with ditches; the single line known as "Danes Dike," and the enclosed camp at Ampleforth; and the diminutive ramparts in Cleveland: all of which have their counterparts in other fortified places in England.

These distinct methods of laying out villages, and building the foundations of huts, and of fortifying them, as well as enclosing whole districts for confining the range of their cattle, are very naturally accompanied with evidence of their having had distinct modes of burial and ceremonial customs; and, from the descriptions given by antiquaries of various classes of barrows, and of different relics which have been found in them, it is evident that there were as many various kinds of interment as there were tribes or races of people in Britain at that very early period. The long barrows are considered to be the earliest of all; I presume because they are few in number, and the skulls are of the *dolicho-cephalic* type. They are certainly very peculiar, on account of their having a clay trench in them, and the remains of a large number of bodies, or rather a large quantity of bones, placed in them after cremation.

We next find distinct evidence that some of the round barrows were the tombs of a rather more civilized race, who appear to have had chiefs, and a religious ceremony at the time of interment. They did not burn the body, but doubled it up into the smallest compass (like the ancient Peruvians), and deposited it in a cist, and scattered flint implements and broken pottery about the mound of earth that they raised over the body; or otherwise bent the legs at a right angle with the body, and buried it without a cist, with a small vase near the head, as the Yorkshire Antiquarian Club found them in the Acklam tumuli; or buried numerous bodies in a sitting posture within what is supposed to have been a previous residence, and named the "Passage Mounds."

A third series of barrows are also intelligible. In these the body has undergone cremation, and the bones or ashes have been placed in a rude urn; and it is remarkable that in this class of interments a circle of stones has been erected within the circumference of the barrow, precisely similar to the stone circles that are so common on the surface; and in some instances the circle of stones has been found to enclose several cists. In another similar class of burials at Ford, in Northumberland, many cists have been found in one tumulus, with calcined bones in them, covered with a flat stone of the same kind as the cist is composed, and a very slight mound of earth raised above them, but without any circle of stones round it. These have contributed jet beads, a piece of bronze, and a flint weapon of the description which is represented at Hunter, near Bridlington, by the best class of flint implements that are found in England. This tumulus is, without doubt, a relic of the last of the flint-using tribes in Britain.

I wish here to draw your attention to the proof just mentioned that Druidical worship cannot have been connected with the stone circles, which are so numerous in this as well as other countries. If you remember, the Druidical ceremonies are not mentioned, in any ancient author, as having been performed in the great stone circles, while they are expressly stated to have been performed in the deep recesses of the oak forests; which is strong negative proof that they were disused and neglected, and had no connection with the prevailing religious customs of that period, and that the religious faith with which they were connected had been superseded by the Druidical worship; and when we find there were no stone circles round the earliest long-shaped barrows, or surrounding the most primitive round barrows, and that there can be no question that there were circles of stones intentionally placed within the circumference of the barrows that were raised by the third tribe of people, we

must conclude that this tribe brought the custom and mode of worship with them from the Continent, and established it in the island, and built a large number of the circles (which we are now studying as antiquities) for different purposes connected with their religion. As additional evidence in support of this conclusion, the excavations of a number of the barrows at Stonehenge, by Sir Richard Hoare, disclosed that the people who used iron were not buried amongst the dead in those mounds, although he found bronze in many of the tumuli.

We are also made acquainted by Sir J. Lubbock with the fact that the Avebury circle and stone avenues are very roughly formed, and distinctly indicate that they were erected by a people who were not so far advanced in the art of masonry as those who built the sister circle of Stonehenge, and that they could not have possessed such good tools for chipping the stones into shape. The explanation of this variation in the skill of the builders of these two circles appears to be disclosed by the relics of the barrows, both in the immediate neighbourhood of these circles, as well as in the northern part of England.

Sir Richard Hoare found a great many of the barrows on the Salisbury Plain without any trace of bronze in them, while he found 36 had bronze deposited with the remains; but the custom of cremation was adopted in all; and in the northern counties it has also been discovered that in one case the calcined remains of this class of burial were accompanied by bronze; while in the other instance, though the cists were surrounded by circles of stones, there was no trace of bronze. Now, the use of metal was an acquired art, which no one will believe was ever lost after its discovery; and the absence of metal in the tumuli which are surrounded by circles of stones is positive evidence that the people who were buried in them preceded those who omitted this practice, but placed bronze

with the remains of their dead; and this forms the main point of identity between these parallel instances, while it establishes the fact that the habit of erecting stone circles was introduced by the people who adopted the custom before they understood the use of metal, when they were incapable, with stone axes and chisels, to reduce stone pillars into such excellent shape as those who succeeded them and built Stonehenge. It is evident that between the interval of the building of these two circles a gradual improvement in science had taken place, in consequence of the Phœnician merchants having supplied them with implements of bronze manufactured for their use.

The flint implements found at Bridlington add the weight of their evidence to this conclusion, and, if I have interpreted their signification correctly, they explain and confirm the course of events which I have deduced from the variation in the mode of burial and the distribution of the relics found in the tumuli, where the three first classes are without a trace of metal, and the fourth with bronze. At Bridlington three distinct classes of flint implements bear evidence that their owners were not acquainted with the use of metal; and a fourth, at Hunter, are of the class of implements that correspond with the implements of flint that were found with bronze in the Ford tumulus; while the fifth class of tumuli, which has iron deposited in them with bronze, has no representative in flint at Bridlington; and yet the presence of a conqueror is everywhere visible in the distribution of the flint implements of the other tribes.

In this fifth class of tumuli we find the people who were buried in them possessed a great additional instalment of the knowledge of the arts which distinguishes civilization from barbaric ignorance, and express by the description of relics (which includes a war chariot) that they were the people whom Cæsar encountered. These people dispensed with



cremation, and with this religious custom the religion that had previously existed, which required such structures as the enclosures at Avebury and Stonehenge.

In these tumuli the chief is laid in an excavated cist, with his arms folded across his breast, and with his legs crossed; the head of a wild boar, a wheel of a chariot, and a horse placed on either side of the body; the wheels made of oak, which had an iron tire on them; with various ornaments of iron plated with copper, and rings and buckles with their tongues remaining in them, as well as pieces of iron, which were supposed to be the bridle bits. The umbra and bosses of bronze, which formed part of a shield, arrow-points, and spear-heads of iron, and a variety of personal ornaments made of these metals, have also been found in these tumuli.

No one can examine these different classes of relics without feeling their distinctness of character, and perceiving that different customs prevailed during each separate era, although they all raised mounds over the remains of the dead; nor does there seem to be anything extraordinary in this sudden change of people and religion; for if we were to hazard a conjecture, without any further evidence, we should assuredly conclude that the last people could not have failed to overthrow the others, and dominate in the islands, and impose their religion on the conquered, from their being in possession of metal weapons; while it follows, as a logical deduction, that if the last were Druids, and they did not use the stone circles, some previous people must have built and worshipped within their precincts. Still, as we are involved in such a maze of dark illusions, we naturally grasp with satisfaction any convincing evidence that may present itself, to throw light upon the twin questions, When was iron first used in England? and, Was its value discovered by the inhabitants or brought by invaders? and, When was the religion extinguished which required such structures as Avebury and Stonehenge?

That these two events are closely connected is probably the reason why we shall ultimately arrive at a correct conclusion relating to both; but, since there is no written testimony regarding either, there is no resource from whence any positive evidence can be derived, except the remains of the barrows and flint implements in the ancient villages of the Britons.

I shall now confine my remarks to the flint implements and weapons which are found at Bridlington, and to some ancient fortified lines of intrenchment in the neighbourhood, which were constructed by the people who used these flint implements.

Soon after I had commenced making a collection of these relics, I discovered that at some places white flint was used, at others gray, and sometimes both these coloured flints, by the same people, but that there was a marked difference in their form, as well as colour, and then that a distinct people had come among them, who used only red and black coloured flint; and these, with other reasons which will be apparent in the context, made me decide that I must divide them into classes. I found that those who used only white flint had two settlements, one on the cliff at Sewerby, and the other at Bempton, and that they manufactured their implements in such a rude, unskilful manner, that, although they are evidently intended for the same use as those made by other people, yet, if they were not specimens of the first attempts to manufacture flint into useful implements, no person would pick them up; but, as they form the first link of the chain of pre-historic evidence, their value in a museum is infinitely enhanced. But this observation must be understood to relate to the implements found at these two places only, as at other parts white flint is manufactured into beautiful forms.

The gray flint implements have a peculiarly small, stunted form; but those who made them had a very superior know-

ledge of the art of chipping flint, and, from this kind having become the most common, it must be supposed the people who made them were much the most numerous.

Those who used the red or black coloured flint appear to have been comparatively few in number; but they manufactured their implements upon a larger scale than the gray, and with a bold, skilful stroke, which give them an entirely distinct character.

There appears to be considerable misapprehension respecting the degree of skill in manufacturing flint implements, many scientific persons supposing that none but the implements that have been minutely chipped into form are to be considered excellent workmanship; but in this Bridlington district there appears to have been a uniform method of forming the implements, by chipping slices off their entire length, and thus by three or four skilful blows producing the desired pattern; while at Hunter, though only an adjoining parish, the method of producing the finest implements was by chipping off small pieces, or very narrow slices, and thus, by minute and patient ingenuity, producing the shape and beauty which some of them possess.

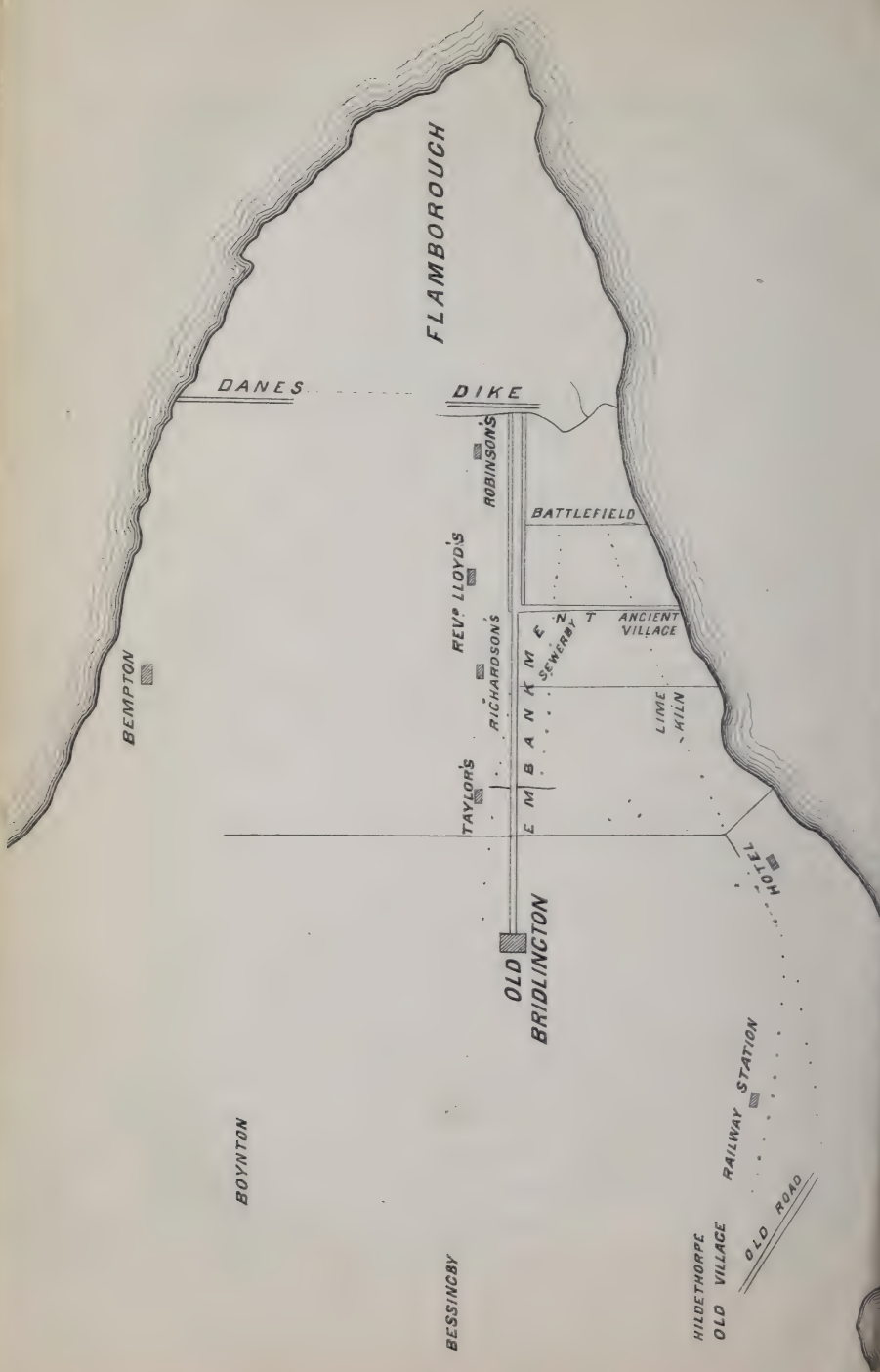
I may make another useful observation with regard to forms. It is commonly thought that there are only a few forms in which flint implements were made; but the truth is they were extremely various, and may be properly compared to our modern household implements, our mechanics' tools, and our military and ordinary weapons. By comparing the implements found at all points of this district, it cannot be doubted that the families who used the white flint were far more limited in their knowledge of the civilizing arts than those who followed them. They appear to have been confined to killing wild animals for food and clothing, and to fishing. They may have made things of wicker-work, and canoes; but they had no saws, planes, drills, or hatchets, which we find the other tribes possessed.

Those who used the ordinary cut gray flints were much more enlightened; they were skilled in the art of making pottery, wicker-work, coopering, and general carpentry, and canoe building, and they cultivated grain; while those who made their implements of red and black flint were undoubtedly far in advance of either: but there can be no doubt that they all remained in ignorance of the use of metal. This is apparent from the description of tools which they used. A flint hatchet is a poor substitute for an iron one, a flint plane would never have made smooth work, a flint saw must have been only useful for cutting bone, and flint fish-hooks of the most perfect form must have been very difficult to procure. The flint drills (although they show the principle of the screw was understood) must have been very difficult to use, and very imperfect instruments; flint knives and other cutting implements, while they show by their excellent edges how much pains was taken in their manufacture, at the same time show how much the people required iron. Flint arrow-points and spear-heads, we find, went out of use after iron was introduced, but sling-stones were more available, and therefore were used down to a late period.

The district included in this Paper is not more than two miles in extent in any direction, commencing at Hildethorpe and ending at Danes Dike, and in the transverse direction from Bridlington to Bempton (see plate); but it forms a distinct district, because, not only are all the classes of flint implements found there associated with the earthworks, but there is distinct evidence that the people were all on friendly terms, when a sudden catastrophe overtook them, and they were all driven from the district at one time, and never returned to it; yet the weapons used by the invaders can nowhere be found, which is sufficient negative proof that they were the people who first used iron.

At Sewerby I found there had been an Ancient British





FLAMBOROUGH

DANES

DIKE

BEMPTON

BOYNTON

BESSINCBY

OLD BRIDLINGTON

HILDETHORPE  
OLD VILLAGE

RAILWAY STATION  
OLD ROAD

HOTEL

TAYLOR'S  
RICHARDSON'S  
REV. LLOYD'S  
ROBINSON'S

BATTLEFIELD

ANCIENT VILLAGE

LIME HILL

EM BANK  
SEWERBY

village, of which only a few traces remain, in the field in front of the Rev. Mr. Lloyd's house, the chief part having been destroyed by the falling of the cliff that once extended into the bay an unknown distance. This village had been enclosed by an earthwork 10 feet high by 14 feet across the base, which appears to have commenced at the cliff, and, passing round the eastern side of the village, was continued on in nearly a straight line to old Bridlington, to which point it can be easily traced, but not further, though it is not probable that it was intended to have terminated there abruptly. It was perfect up to the time of the enclosure of the parish about 60 years since, when the present road was formed, which is partly on the line of the embankment; but where it deviated, to form a more direct line, there some part of the old embankment remains nearly perfect.

There were also two lines of embankment from the angle at Sewerby, leading in a straight line to the "Danes Dike," with a road between them, which was intended to connect the two great lines of intrenchment, and to form a secure passage for cattle from one to the other. One of these banks was taken away at the same time that the new road was formed, but a part of the other bank still remains, with a hedge planted upon it. The sunk fence in front of Mr. Lloyd's house is a part of the enclosed road, and shows its original level, with its exact line and position.\*

Danes Dike is a natural ravine, which drained the south side of the promontory which forms the parish of Flamborough, and does not extend far. The embankment which crowns the eastern edge of it was intended to have been carried across the promontory, but it was only commenced at the two extremities, when those who were forming it were

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\* I received this information from a very old man, named William Ward, who is now in the employ of Mr. Lloyd, and remembers the alteration being made,

interrupted; and this event appears to explain why the line leading to old Bridlington was also left unfinished.

When we look at the strategical effect of the two embankments, running at right angles, we can easily comprehend that the intention was, first, to form strong encampments against attack from any quarter, and at the same time to command a safe retreat in case of either being carried by assault.

I have mentioned the classes of flint implements that are found in this neighbourhood. I have now to describe the discovery of several distinct sets of implements, that indicate there were different trades established at that early period; and, in order to convey to you the expression of my feeling regarding their significance, I shall transcribe the notes which I made at the time I collected them, which I still think are based on correct reasoning.

I commenced March, 1865. On the left hand side of Mr. Robinson's farm-house, if facing Danes Dike, I found the whole of the implements of three families, lying on the surface in three heaps, only slightly scattered by the plough, on the elevated ridges of an undulating field; they are of a peculiar reddish-yellow and greenish-black colour. The disposition of these weapons appeared to indicate that there had been fighting in the field; for, although the household implements and tools were lying together, on three sites, where I presume the huts of the people stood, the weapons were all scattered at a distance from them, round sets of implements which, I have strong grounds for believing, were dress-fastenings, and which showed that both men and women were killed there; and I could not doubt that they had all decayed upon the surface without having been buried, and that their relics had lain where I found them from the day of the fight. As the number that were killed here was only small, I conclude it was simply in defence of their



homes—a vain effort! they were all either killed or fled, and none ever returned to bury their relatives, or remove the excellent implements that they possessed. There must have been a reason for this. Some of the sling-stones, of gray colour, that I found here are the common kind found in the neighbourhood, that, no doubt, belonged to friends who assisted them. I afterwards found a few red flint weapons on a battlefield close by; and I have no doubt some who survived reciprocated the kindness by joining in the general engagement.

I consider these three families represent the last race that emigrated to this island previous to the use of iron, and that they had only recently become friendly with the older inhabitants. The implements found here are the most varied and the best assortment that have been ever found together in this neighbourhood, but they indicate that the people did not understand the use of metal. They consisted of tools that are considered to have been used for basket-making or wicker-work, coopering, carpentry, and fishing; such as hatchets, hammers, nails, chisels, wedges of various sizes, drills, scrapers for cleaning skins or for stripping willows, and fish-hooks, as well as weapons which may be named javelins, bills or beaks, beautifully-formed sling-stones, spear-heads, arrow-points, and the supposed dress-fastenings, as well as a large number and variety of knives of all sizes, and curiously-shaped implements, the use of which is not now understood.

A short distance from this place, on the right, in a field abutting upon the grounds in front of Mr. Lloyd's house, and immediately between the cliff and the double line of embankment before described, there is undoubted evidence of a severe battle having been fought; it was literally strewed with sling-stones, spear-heads, and dress-fastenings, with a very few general implements, and, with the exception of a few red

flint weapons, the whole were of gray flint. To me, the dress-fastenings appeared the most convincing proof that a battle was fought there, for where I found one I invariably found three. I have since noticed this fact as being a general rule all over the district, which precludes any doubt of the truthfulness of this test; and I have been enabled by it to understand what was the fate of the people.

When I found so much evidence of fighting in this field, and that neither the weapons nor dress-fastenings had been taken away since the battle was fought, and that the field could not have been occupied as a place of residence again, I concluded that the invaders had won the battle. I was struck, also, by the fact that there were no weapons, or any other relics, that could have belonged to the invaders. This appeared to be a most important fact, as it clearly shows that they used metal weapons, which corrosion has totally destroyed during the time that has elapsed, or, being of value, every vestige has been taken away. I afterwards noticed this absence of all remains of implements or weapons which could have been used by the invaders, throughout the district. This battlefield extended further towards the sea than it does now, probably half a mile, so that it is impossible to conjecture the numbers that were engaged; it may, however, be considered fortunate that even this extreme end of the battleground remains. The double embankment was evidently used as a protection on the left wing, as the relics of the fight terminate at this line, and the line of battle was immediately in front of the embankment which enclosed the village of Sewerby, where the white flint implements were only used. I conclude that this embankment was not defended, but that when they were beaten they were pursued over the embankment, and the village was destroyed, and not afterwards occupied, at least by flint-using people, as there are traces of a flying host from the battlefield across the district and far beyond.

Passing over the Sewerby fields, numbers of sets of dress-fastenings and weapons can be found leading in two directions, one towards old Bridlington, and the other towards Hildethorpe, past the quay. There is a cross road leading from the sea to the upper Sewerby road. A limekiln on this road marks where there were some huts that were inhabited by people who used gray and white flints. The women of the neighbouring village of Sewerby appear to have fled for refuge to a field a little below these cottages, which was very low ground, and was probably covered with underwood and rushes, and to have been pursued there and slaughtered; as I found in this field a great number of women's dress-fastenings, and a number of sling-stones which they had used in their defence.

On the other side of this low ground, which is now intersected by the railroad embankment, I found on an elevated mound an entire set of what I suppose to be coopers' and basket-makers' tools\* (see note), formed of gray flint; and

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\* [As basket-making may appear to some persons too modern a process, or trade, to ascribe to the primitive inhabitants of this country, I venture to extract a few passages bearing on the subject from a valuable paper in the fifteenth volume of the *Journal of the Archæological Association*, by G. J. French, "On the Sculptured Stones of Scotland, Ireland, &c.," in which the interlaced ornamentation so common on these ancient relics naturally suggested the origin of such decorations from the earlier basket-work:—"The aborigines of this or any other country of corresponding climate, after discovering some natural cave, or making for themselves a rude hut, would probably take their next step in constructive art by attempting to form such utensils as might contain the seeds and fruits necessary for food. Assuming that they were then unprovided with even the rudest tools—for we refer to a time before our far-off ancestors knew the use of bronze or iron,—they would form these utensils by twisting together the long pliant osiers with which the land abounded. . . . No other branch of art is even now so independent of tools, and none has been so universally diffused, or so long and uninterruptedly practised, as basket-making. It is the humble parent of all textile art—the most elaborate tissues produced by the loom or the needle being but progressive developments proceeding from the rude wattle-work of unclothed savages. . . . The earliest authentic records of Britain refer to its inhabitants as expert basket-makers; their houses were made of willows and

on another elevated part of the same field, very close to this mound, a large number of general household implements. The whole of them are remarkably well formed, and appear to have been constantly in use for a long time, and their adaptation to the trades are so perfect, that a cooper could use them without difficulty at the present time. They consisted of small axes fit for cutting willows, small scrapers for stripping them, hand-instruments for forcing the willows into place in the

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reeds; their fences and fortifications were living trees with intertwisted branches; their boats, or coracles, were baskets covered with skins; their domestic furniture, defensive armour, even their images employed in their erroneous religion, were of basket-work. . . . The monastic historians of the succeeding ages continue to mention wicker-work as the principal architectural material used in Britain and Ireland, not only for the rude dwellings of the inhabitants, but also for their more important public edifices and churches." Glastonbury, supposed to have been the earliest Christian church in England, was, on the authority of William of Malmesbury, "a mean structure of *wattle-work*." A manufacture which was probably progressing for many centuries before the Romans invaded Britain must necessarily have acquired a certain amount of refined ornament, as a result of so much experience and practice. We have, indeed, indirect evidence that the Romans greatly admired the ornamental baskets of the British, which were exported in large quantities to Rome, and became fashionable appendages among the extravagantly luxurious furniture of the imperial city. Juvenal, writing about A.D. 120, mentions the popularity of these baskets: "*Adde et bascaudas et mille escaria*" (*Juvenal*, Sat. xii. v. 46). And that they were productions of the British islanders is distinctly stated by Martial—

*"Barbara de pictis veni bascauda Britannis,  
Sed me jam mavult dicere Roma suam."*—*Martial*, lib. xiv. Epig. 99.

Mr. French also believes that the earliest symbols of the Christian faith—crosses, erected by the first Christian missionaries—were constructed of basket-work, which was closely connected with the earlier pagan or Druidical religion. Cæsar, writing of the Druids, states that "they have images of enormous size, the limbs of which, formed of wicker-work, they fill with living men, which being set on fire the men perish enveloped in flames" (*De Bell. Gal.*, lib. vi.). Again, Mr. Bateman, in his *Ten Years' Diggings*, found at Throwley "a deposit of large pieces of calcined human bones, which lay within a circular hole in the natural soil, about a foot deep, of well-defined shape, resulting from contact with a wooden or *wicker-work vessel*, in which the bones were placed when buried, the vestiges of which, in the form of impalpable black powder, intervened between the bones and the earth" (p. 130).—H. DENNY.

process of basket-making, chisels, wedges with sharp edges of various sizes, a blunt-edged hatchet for driving down hoops of casks or wicker-work, blunt wedges, also, similar to those used by coopers for driving hoops, knives, a saw, and various other implements. There were also a number of sling-stones, spear-heads, and tomahawks, with dress-fastenings scattered about the field, showing that some few persons had been killed there.

At another part of the same field I found an entire set of the supposed coopers' tools, formed of red flint, all new. They are beautifully formed, but much larger in size than the others made of gray flint. These red tools were as entirely separate from the others as if the owners had lived miles apart. The most remarkable thing is, that these red tools appear never to have been used after they were made. They seem to express that the person who was to have used them had just come there to work with the other people, when he and they were attacked, and either killed or driven away, and never returned; and it is certainly as strong a proof as could be discovered of the overwhelming character of the attack that was made upon them; the evidence of fighting in the field cannot be considered to have been merely between themselves, or with other natives whom they were unfriendly with in the adjoining fields. If such had been the case, it is not probable that all would have been killed, or that they would have been driven out of the neighbourhood; but it is quite certain that if only people had been fighting here who used flint implements, those who expelled the others would not have left their excellent tools upon the ground. Yet here were found both gray flint implements which had been much used, and red flint which appear not to have been used at all, lying on two distinct parts of the same field, with no remains of any enemy's weapons.

Nor can it be said that these tools were abandoned because

of the introduction of metal. There is no sign of any gradual change taking place, as even the older tools made of gray flint are good, and were apparently in use at the time of the catastrophe, and the red ones were quite new : in fact, if any change of the kind was taking place, it was from gray flint implements to red ones ; but this does not account for both kinds having been left on two spots where the people had their workshops. The man who owned the red flint tools had certainly not bought them, or made them with the intention of not using them, and there must have been an impossibility for the people who were driven from their homes to have returned again to remove their valuable implements, or they would have done so. At the same time we perceive that those who drove them from their homes did not value the rude flint implements that the vanquished had left, or they would have appropriated them after they had expelled their owners. Every circumstance, therefore, leads me to suppose that the people who expelled them must have used metal weapons.

Passing along the cliff towards Bridlington Quay, on a field on the north side of the new Alexandra Hotel, which was ploughed up this year (1866), I found various things that appear to have been used only for the purpose of agriculture ; and, from the positions of the tools, I considered they had been left in scattered buildings that were connected with the residence. They consist of what appear to be well-defined ploughshares of stone, with their coulter of flint, and stone wedges to fasten the framework of the ploughs together ; two stone hammers, a part of a machine of stone for grinding corn, hatchets of stone and flint, with various knives, spear-heads and sling-stones of both stone and flint. These flint implements are of the red and black colours, and the corn bruiser agrees in form with one found with the relics of the three families. In other instances I have found farming

tools in connection with these coloured flints, which seems to indicate that some of this race were farmers, who followed that occupation alone, while the collection of implements shows how few things a cultivator of the soil required at that time.

From the evidence of this district, I believe the people who used the red and black flint were the first people who adopted farming as a distinct trade, which must have been a considerable advance in civilization beyond their predecessors.

The next most remarkable collection which I made was in a field opposite the portico of the railway station at Bridlington. I am not aware how long this field had been ploughed up, but I could not fail to be astonished when I found within a square yard of ground an entire set of tools made of flint, which appear to have been only used by a carpenter, as they consist of hatchets, a plane, a hammer, various kinds of wedges (evidently formed for different uses), drills, and a stone ploughshare (as if the carpenter had been employed in making a plough). There were several sling-stones lying near, and one spear-head, but no evidence of his having lived there, as a single small knife constituted all the household implements on the spot. It could only have been his workshop; and he, with all the other flint-using people in the neighbourhood, had either been killed or driven away, and had not returned to remove these implements, which show so clearly that he was engaged in a distinct trade, and by their colour and size that he was one of the race that used red and black flint.

This brings the link of evidence from the field of battle to Hildethorpe, where there was a large village occupied by people who used white and gray-coloured flint. I was not sufficiently careful in collecting the implements in these fields, as it was the first that I examined; but those that I can still identify as having been found there, as well as those which I have since taken up on the spot to verify my knowledge of

their character, are sufficiently distinct for me to describe them as being of the common type of gray and white flints, and to know that the people who lived there were driven from the place after considerable slaughter. Dress-fastenings can be found in all directions without difficulty, though most of the weapons have been picked up. A large number of the implements which constitute my general collection were found in this village, and will ever be valuable for their description of the forms associated with each colour.

Returning to the battlefield, we may follow the other line of retreat in the direction of old Bridlington, and in this instance, as in the former, there is no difficulty in tracing the line by the sling-stones and dress-fastenings, which are always accompanied by weapons which the persons used who were killed and decayed on these fields. They are very numerous on both sides of the embankment. When I came to the field lying to the right of the road leading to old Bridlington from Sewerby, that is beyond and slopes down to the farm-house occupied by Mr. Richardson, I found a complete set of what I designate coopers' tools, and with them an excellent chisel. They were all made of gray flint. The chisel was formed by being first chipped into shape, and then rubbed on one side of the edge nearly smooth, showing that the maker or user of it knew perfectly what he wanted, but at the same time did not understand the mechanical method of grinding, and was, therefore, satisfied by rubbing the edge on one side only, to make it as sharp as he could. This fact proves the great antiquity of the tool. On the slope of the hill, about a hundred yards from these tools, I found several sets of dress-fastenings, of three each, as usual; each set had its sling-stones and spear-heads lying close around them, one of them had a tomahawk, another a small axe, and another a large-sized beak; and having become thoroughly acquainted with the character of these relics, their position



appeared peculiarly interesting, as describing minutely what occurred in that field. The men seemed to have fled in the direction of their homes, and to have been exhausted by the length of their flight as they ascended the hill, the enemy in pursuit following close upon them. There these men fell, and decayed, and I was the first who had observed their relics, after thousands of years had passed away. I could not avoid feeling sympathy for them, though there remained no trace of human forms. The imperishable weapons which they had used, and the dress-fastenings they had worn, which lay before me, testified that they were killed in defence of their homes, and that the enemy had passed on in pursuit of their kinsmen, I knew not where; but I felt confident that none of their friends had returned to bury them, or remove the implements which they must have highly valued: and it was evident their conquerors considered them of no value, for the reason I have given.

In a paragraph which I cut out of a newspaper, copied from the American *Washington Star*, I observe how identical the mode of recognizing the place where men have fallen in battle may be of distant eras. Quartermaster-General Meigs was contemplating the removal of the remains of Union soldiers, and he remarked—"They lay together, friend and foe; and a *button or two*, or a shred of blue or gray clothing, afforded an uncertain index of their politics."—*May*, 1866.

In a field on the left side of the old embankment, I found quite a line of dress-fastenings and weapons. On the other side of the road, which is on the old embankment, opposite Mr. Taylor's farm-house, there had been a settlement, and there implements and weapons in considerable numbers, with dress-fastenings, lay in a straight narrow line through the field. These lines of relics seemed to indicate that a stand had been made here, and many were killed, but the continuing evidence of weapons thrown away shows it was ineffectual.

Rather to the north, in a small field, I found there had been another small settlement, and there all the implements and weapons that the people possessed had been abandoned. Such is the kind of evidence in all directions, invariably leading towards the west, which, probably, may be traced in this way until some interior settlement is reached where they gained security from the pursuit of their enemies. At Bempton I found precisely the same features as at Sewerby. There white flint had been entirely used in some fields, and gray in others; and all were abandoned, with no apparent cause but devastating war, which the people could not resist, and therefore fled from their homes, and left the country in the hands of their conquerors, whose weapons are nowhere to be found.

In the Paper on Ancient British Coins, read by Mr. Evans at your last meeting, he alluded to some historical facts in a manner which corroborates my impression, that the last people who inhabited Bridlington before the Roman invasion were the first people who were acquainted with the general use of metals. He said: "As far as I know, the Ancient British coins are confined to the *South Eastern* portion of the territory of the Brigantes, and have not been found in Lancashire or the counties north of Yorkshire, and they certainly do not appear to have derived their coinage from the Iceni."

This confines it to Holderness, in which district Bridlington is situated.

I object to the people being confounded with the Brigantes, as there can be no doubt that they were Gauls, and known as the Parisoi.

If we couple another historical passage of his to this one, it will express the length of time that the people who then possessed Bridlington had been there, which agrees with my idea of this people having conquered the old inhabitants and

driven them into the interior. He said: "The immigrants from the Continent who had *driven back the earlier inhabitants into the interior*, were, no doubt, considerably in advance of them in civilization, and were *the first* to introduce the art of coining. . . ." And again: "With reference to the date of the Yorkshire coins there is a certain amount of evidence to guide us. Their type is perhaps the rudest of all the copies from the prototype, and so barbarous in imitation of the Philippus as to place them amongst the latest of the British coins. The metal is also much deteriorated." In other words, they were the last invaders from Gaul before the Romans.

The collection of weapons and implements mentioned in this account of my researches are in the hands of Mr. Postil, jun., and Mr. G. Anfield, jun., to be handed over to trustees that are to be appointed by the Sailors' Club, in Bridlington, in order to preserve them for general inspection, and form the nucleus of a museum of relics from the neighbourhood. They have been preserved for thousands of years, through the absence of public curiosity regarding the earliest emigrants to this island. I trust the information which they convey—that can be found in no history—will induce the present and future generations to preserve them as indelible records of past ages during the infancy of Great Britain.

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In a discussion which ensued after the reading of the Paper, the following questions were asked, and replied to by Mr. Ffooks:—

1st.—"How can you identify the dress-fastenings?"

"By their general form, which is not adapted for any other use. By there being always a notch chipped out of one, or both sides of the neck, to prevent the thong slipping that was attached to it; and by there being always three found within the length of a man, of three sizes, a large one,

a middle-sized, and a small one, and some weapons close to them."

2nd.—“Are the flint weapons and dress-fastenings found in all the fields in the neighbourhood?”

“No; only where they can be readily accounted for. Many fields have no flint implements upon them, or only stray weapons, thrown by the people when hunting.”

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Mr. Denny read the next Paper:—

NOTICE OF EARLY BRITISH TUMULI ON THE HAMBLETON HILLS,  
NEAR THIRSK. BY HENRY DENNY, A.L.S., OF LEEDS.

To know something of the district in which we reside, the historical events of which it has been the theatre, or the various peoples and races who have preceded us, ought to be subjects of deep interest to every thinking mind. For what can be a more interesting or instructive study than to compare the present with the past, even as regards the various phases in the history of the human family since their first occupation of Britain?

It is true, much information as to the past is already placed on record. But it is equally true that much which is prehistoric remains to be collected and collated by those of the present generation, or the materials now accessible will be irretrievably lost; and although the surface of the country, on the one hand, may have undergone many and mighty changes, thus leaving little to mark the actual site of memorable occurrences which are presumed to have taken place in particular localities, its primeval inhabitants, on the other, have left us only their burial-mounds, the sites of their *Oppida* or fortified villages, to indicate the tribe or nation to which they belonged; yet even these memorials, after the lapse of many centuries, furnish so many faithful

records or pages in the history of the people to whom they refer; and though at best but scanty, are all the materials we have to guide us in compiling the earliest and most important chapters in the chronicles of the nation to which we belong, or the county wherein we reside.

When Cæsar landed in Kent, in the year 55 B.C., he found this country inhabited by various races of men, known under the general name of Ancient Britons. But different portions of it were occupied by separate tribes, under distinct rulers; hence these different localities are associated with the historical records of those early races, and each portion has some memorable occurrences connected with its people, their wars, or subjugation. Thus the Malvern and Breiddyn Hills witnessed the last defence and defeat of the Silures under Caractacus; while, probably, Cambridge witnessed that of the noble Boadicea and the Iceni of Norfolk and Suffolk; and those tribes inhabiting the coasts of Kent and Sussex had to contend with, and finally succumb to, the repeated attacks of the Roman and other hostile invaders, who in succession landed in Britain.

But probably no portion of this island is so rich in historical associations, or has shared more in the vicissitudes attendant upon war or internal rebellion, than Yorkshire. In the fastnesses of its hills, and on its extensive moors to the north, dwelt the Brigantes, the most powerful nation of the aboriginal Britons; and on the south-east coast the Parisoi, a maritime tribe of importance. From one extremity of the county to the other, the soil has resounded to the tread of the conquering legions of Rome. The Saxons, Picts, and Danes have in like manner exhibited their military prowess on its mountains, plains, and shores; and, if we come down to more recent scenes of strife, as my old friend Professor Phillips has said, "from the walls of York we may see three decisive battlefields,—where *Hadrada* fell at Stamford Brig,

*Clifford* died at Fowton Dale, and *Rupert* fled from Marston Moor."

It is, however, to the earlier period of our history only that I have now to add a short paragraph "On the burial-mounds of our ancestors in the neighbourhood of Thirsk;" though I am well aware that to many persons the examination of these early graves, or tumuli, with their rude implements of flint and vessels of sun-dried clay, possesses no interest or value. But such parties probably forget that these memorials form an important link in the chain of past history, and are intimately connected with the present; that they contain the progenitors of our own race, with whose origin and progress we ought surely to be anxious to become familiar, as the Briton of to-day owes his elevated and social position entirely to the various nations by whom this island has been conquered or colonized, and whose remains, now disinterred from their burial-mounds with the simple objects the latter contain, alone mark the slow progress of the skin-clad hunter of Britain in the arts of war and peace, and contrast strongly with the refined productions of their Roman subjugators, and even with their subsequent and less civilized Saxon rulers.

The northern and eastern parts of this county still exhibit numerous tumuli, earthworks, and intrenchments of the Britons, Anglo-Saxons, &c., in the former of which peaceably repose the remains of those hardy defenders of their native fastnesses. From the elevated position of these rude constructions on the Hambleton Hills (a magnificent range, extending for eighteen miles), an extensive panoramic view of the surrounding country is commanded. And here was, doubtless, a strongly-fortified position in the year 50, when Iseur, afterwards Isurium of the Romans (of which Aldborough near Boroughbridge is the site), was the capital of the Brigantes, under Cartismandua, and afterwards occupied by the revolted Britons under Venutius against their perfidious

queen, and again during the civil wars, from the year 52 to 70; or it may have been one of the last strongholds of the Britons, to which they retreated from the invading forces of the Romans under Petilius Cerealis, and also subsequently that of the Anglo-Saxons.

On glancing at the Ordnance Map, embracing that portion of the Hambleton Hills in the neighbourhood of Thirsk, numerous tumuli are indicated—on Boltby Moor, Hesketh Moor, Hawaby Moor, Kepwick Moor, and Southwoods,—nearly all of which have been examined by the Rev. W. Greenwell, of Durham; Mr. Craster, of Middlesbrough; Mr. Verity, of Southwoods; and Mr. Murray, of Daleside; with varied results, some of which I purpose to detail. My own attention was first called to this locality and its sepulchral mounds by an interesting series of objects presented to the Museum of the Philosophical Hall by Jas. Fox, Esq., C.E., which had been obtained by Mr. Johnson, of Hesketh Hall, on the 9th of July, 1864, from a tumulus on the adjoining moor, 1,025 feet above the level of the sea. As these objects presented a somewhat varied character, and also differed in manufacture so as to suggest a difference of date, it appeared highly desirable that another examination of the tumulus should be made, and all the circumstances of disinterment carefully inquired into as far as was possible. I therefore visited the locality myself on two occasions, in August and September, as also in company with Mr. Fox and Mr. Abraham Horsfall, of Leeds, and explored what remained of this tumulus, and of three others in the adjoining fields; and I can bear witness to the zeal which both these gentlemen displayed in the laborious task of grave-digging. The tumulus just referred to was about 50 feet in diameter, and probably 3 feet 6 inches in height above the surface of the moor, of a conical shape, and appeared to contain indications of having been used on more than *one* occasion as a place of

burial. On the north side, at about two feet below the surface, the skeleton of a female had been found extended at length, and was probably that of a young person. The skull was destroyed, but near the neck were the remains of a necklace, which originally consisted of, probably, about 120 variously-shaped beads of jet and kimmerage coal; of these forty-seven are of cylindrical form, and twelve are slightly conical studs, about the size of a shilling, pierced on the back with two holes meeting at an angle in the centre. Both these forms are much acted upon by time, and are beginning to split up, while the remaining fifty-six were small circular discs perforated in the centre, slightly countersunk, and quite unaltered by time; also a connecting fragment of bone. In a similar necklace, found by the Rev. W. Greenwell in Northumberland, the beads were also of two different materials, *jet* and *shale*. Towards the centre of the tumulus, and about five feet below the surface, the remains of several skeletons were found, of various ages and characters; in one lower jaw the last molar or dens sapientiae was just breaking through, while in another the alveolar cavities were entirely absorbed, indicating, on the contrary, extreme old age. Again, while the frontal bones in several were of the ordinary form, one of the skulls had the low receding forehead and the superciliary ridge very prominent. All the bones were intermixed with soil, fragments of pottery, and chippings of flint. There were also numerous shells of *helix nemoralis* and *zonites radiatus*, whitened by age. It may suggest a curious inquiry, How had these shells become associated with the other remains? They could not have been of *recent* introduction, as no apertures existed, and I found them in the firmly-packed soil, which had not been removed for a long period. If a single individual or two had been exhumed, and near the surface, the above supposition might have been probable, but here they occurred in too great a number to have



entered when the barrows were temporarily plundered and filled up again. The former species also occurred at a considerable depth below stalagmite in the Dowkerbottom cave, near an infant's grave. Could they have been interred with the original occupants of the barrow as articles of food, or for some other superstitious rite at present unknown to us? Above the whole, a considerable number of flat masses of limestone had been placed, apparently to form a cairn. On the east side of the tumulus, about three feet from the surface, a layer of calcined bones, perfectly white, were discovered, showing that a separate interment, evidently after cremation, had taken place.

From the fragmentary condition and heterogeneous assemblage of objects in this tumulus I suspected that it had been previously disturbed, and the bones and other remains thrown in again by the ruthless treasure-seekers.

A careful examination of the fragments of pottery found therein indicates that originally there had been five vessels, of different sizes and varied form and ornamentation. Two, which I have been able partially to restore, were what Sir Colt Hoare terms drinking-cups, and are, as I am informed by the Rev. Wm. Greenwell, of Durham, rare examples of the kind. The portions of two others differ from the preceding; one, which has been also a drinking-cup, having the herring-bone or lozenge-shaped pattern on the upper part, and below parallel perpendicular lines separated by broad transverse plain bands; while the fourth fragment is a much stronger vessel, a cinerary urn; the fifth resembling the coarse black Roman pottery, with indications of burning.

The number of apparently independent fragments of different urns, mixed with the bones and chippings of flint, is a curious circumstance, affording a somewhat conclusive evidence that in many instances they are *not* the portions of urns which had been subsequently broken, as then the con-

necting fragments might be again recognized and restored; but that these had been *fragments only* when originally deposited with the bodies. Again, the flint chippings appear somewhat obscure as to their use. Flint implements, or articles of personal decoration, have a history attached to them, as connected probably with the former owner with whom they are interred.

In the tomb of Mithridates, in the neighbourhood of Kertch, which was in a huge tumulus 120 feet in height by 150 feet in diameter, the skeleton of the king was discovered, with various golden ornaments, his sword, &c., and a multitude of little *sharp flints* were lying at the feet heaped up in a pyramidal form.\*

There seems to be an allusion to this custom in the Septuagint Version of the book of Joshua, chapter 24, verse 31, for the following translation of which I am indebted to the Rev. Canon Atlay, D.D., vicar of Leeds, which reads thus: "There they placed with him, in the tomb where they buried him, the stone knives with which he circumcised the children of Israel, at Gilgal, when he brought them out of Egypt, as the Lord commanded them; and there they are until this very day."

Now although this passage does not appear in the present Masoretic text of the book of Joshua, and may therefore be presumed as an *addition* to the original text, it matters little, as it clearly proves that the practice of interring stone implements with the dead was known at least 300 years before Christ. As instances like the above are not of unfrequent occurrence, both in Britain as well as on the Continent, they have had evidently a peculiar object. The Rev. Wm. Greenwell, of Durham, in an interesting account of the opening of some barrows at Ford, in Northum-

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\* See *Journal of the Archaeological Association*, vol. xiii., p. 299.

berland, under similar circumstances, observes,—“The facts which the first barrow discloses suggest many questions, hard perhaps to solve, but worthy of solution, and are indeed of the highest interest. Why were some bodies buried unburnt, whilst others were consumed by fire? Were the burnt bodies those of slaves or wives, killed to be ready for the chief in the land of the departed? What was the purpose of the small urn placed by the side of the corpse? Did it contain food for the use of the departed in the interval whilst he lay in the tomb? The flint arrow-head or the bronze spear, laid beside the hunter and warrior, or enclosed in the urn among the calcined bones, speak of war and the chase in other worlds, or, as some think, they tell of a purpose accomplished with the owner’s death. But what mean the flint-flakes—mere shapeless chippings,—of which so many are found accompanying the old interments?”

“It is probable that this custom of placing broken potsherds and flint-flakes in the tomb may have a religious significancy, which as yet we cannot explain. From the frequency of their occurrence, we cannot suppose them to have been accidentally deposited; and their being found associated with the dead is strong evidence of their being linked to some religious chord in the faith of these ancient people. A passage in *Hamlet* (act 5, scene 1) may have originated in a lingering remembrance of this custom, where the Priest, answering Laertes relative to the burial of Ophelia, says,—

“ ‘ Her death was doubtful;  
And, but that great command o’ersways the order,  
She should in ground unsanctified have lodged  
Till the last trumpet; for charitable prayers,  
Shards, flints, and pebbles should be thrown on her.’ ”

From what I have previously stated, it would appear that *three* distinct interments had taken place in this tumulus, the most recent being that of the female—probably a Briton.

Mr. Bateman informs us that in North Derbyshire it is not an uncommon occurrence to find the Celtic tumuli taken possession of by the Saxons and Romano-British people.

In a second circular tumulus, situated at a short distance from the preceding, a skeleton in the position peculiar to Celtic interments was discovered, and a portion of the brow antler of the red deer; but no pottery or personal ornaments or implements of any kind occurred. The bones appeared to rest upon the surface of the moor, stones had been placed over it to form a cairn, and, finally, over all was heaped the soil to form the tumulus.

It will have been observed that I have not been able to describe with any degree of minuteness the precise character of the interments in the *first* of these tumuli from personal examination, as the greater portion of it had been removed with its contents previous to my arrival, and the human bones scattered about in considerable numbers on the surface of the moor. The old man, however, who had been employed by Mr. Johnson, and afterwards by myself, stated that nine skulls had been dug out comparatively perfect,\* mixed with other bones, and which appeared to lie straight or at *full length*; but, as these were not the articles for which they were in search, they were broken with the spade as useless, and thrown out: which is much to be regretted, as from an examination of the fragments it is very probable both the brachycephalic and kumbe-cephalic forms of skull might have been obtained. Besides the flint implements and chippings found mixed with the bones and pottery, numerous examples, of larger size and better finish, are scattered over the moors, several of which were procured from the residents at the farm-houses known as Upper and Lower Paradise, by Mr. Fox, and presented to the Museum of the Philosophical Society.

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\* I picked from the bones scattered on the surface fragments of nine lower jaws, besides various portions of the skulls.

In the village of Hawaby are numerous indications of tumuli. On the estate of Mrs. Hamer, of Daleside Lodge, on Sunny Bank, there are twenty of these mounds. This locality is a sort of spur running out from the eastern side of the Hambleton Hills, and overhanging the village. It is crossed by an ancient dike, on the west side of which there is a group of tumuli, consisting of a large one in the centre of eight or nine much smaller, and has apparently been a cemetery. These have all been examined by Mr. Murray, of Daleside Lodge, and Mr. Verity, of Southwoods, and only three of them supplied any interesting results; for an account of which I am indebted to these gentlemen. The larger tumulus, to which I have just alluded, probably Anglo-Saxon, was 120 feet in circumference and four feet in height. It contained the skeleton of a young female, evidently of high rank, who, from the various decorative articles and personal ornaments which still accompanied it, might once have been a form of considerable personal attractions. At the head was a bowl of thin bronze, with three handles, about eleven inches in diameter, which had a wooden cover ornamented with strips of bronze arranged in a diamond pattern, and fastened with a bronze hasp. The wood was decayed, and the lid had fallen inside the bowl. Her waist had been encircled by a leathern girdle, of which the buckle or clasp was made of two plates of gold, one of which, worked or engraved in a cross-shaped pattern, and set with four garnet-coloured glass ornaments, still remained. These plates were riveted together by four gold rivets, leaving a space between, in which a fragment of the leather was still in its original position. Near the head were two pins, one of gold, about two inches in length, with a flat pear-shaped head, on which a design in lines was marked; the other silver, of larger size, probably a bodkin, with two holes perforated through the upper part. There were also several rings made of silver wire, the ends joining together in a

twist, blue glass beads, a portion of a knife, and several much corroded fragments of iron, a small circular stone perforated in the centre, probably the whorl of a spindle, and an oblong bronze ornament of unknown use. The body was lying with the head to the north, and the bones much decayed. The cutting edge of the front teeth were *filed* into *three points*: a singular custom, probably indicative of some peculiarity of rank or tribe to which the deceased belonged, and to which I have not seen any allusion in previous disinterments.

Dr. Barnard Davis, however, one of the learned authors of *Crania Britannica*, informs me that he has in his possession an Ashantee skull, the upper front teeth of which have been chipped to points. This is a most remarkable circumstance, as it shows that a similarity of custom has prevailed between two tribes so widely separated by time and locality, as an *Anglo-Saxon* of probably the fourth or fifth century of our era, and a native of Western Africa of the present day. The only difference is that in the Ashantee the pointing has been confined to the *upper front teeth*, and in the Yorkshire skull to the *lower*.

It is much to be regretted that the above series of personal ornaments, &c., were not retained complete. The bowl is now in the possession of Mr. Craster, of Middlesbrough, and the other articles, with the exception of the gold buckle, are in the possession of Mrs. Hamer. Of the eight smaller tumuli, only two or three were found to contain interments, or at least the remains of such. One had a skeleton with its head to the west, and the legs bent backwards in the usual position of those found in Celtic or British tumuli, but no ornaments or utensils accompanied the remains. The other tumulus, about fifteen feet from the above, was eight feet in diameter and two feet in height, surrounded with stones, and contained the skeleton of a man, lying at full length on his right side, with the head to the south. Near the thorax

was found a small circular bronze box, about two inches in diameter, with a lid, both of which are ornamented; attached to the box was a short portion of a bronze chain, two larger bronze links, a ring-shaped fibula, and a small iron knife. These objects, together with the skull from this skeleton, have been presented to our Museum by Mrs. Hamer. The skull, which is much compressed by the weight of the soil, has a narrow forehead and considerable protrusion of the jaws and teeth, and enlarged occiput: a general conformation which would lead to the supposition that it belongs to the long boat-shaped or kumbe-cephalic type of Wilson; the position of the body, however, and the different articles interred with it, are evidently not indicative of a Celtic burial, but of Anglo-Saxon.

In a third tumulus, on the Moor Ings, a spear-head or arrow-headed weapon, ten inches in length, was found. Its form is somewhat peculiar, as it is hastate or perfectly arrow-headed, but attached to a shaft of the same material, which, however, is not perfect, but appears much acted upon by time on the surface edges, from the drawing sent to me. It is described as bronze; which, however, from its corroded condition, I think may be an error.

On the Hambleton Training Ground are two flat tumuli, one on each side of the Cleave Dike, known as the Grooms' Stools. These are about 70 yards in circumference, and four feet in height. One has been opened by the Rev. Wm. Greenwell, in 1864, with what results I am not aware; and the other by Mr. Manners Verity, on the 31st of July, 1863, who found between forty and fifty flint flakes, about 18 inches from the centre. On reaching the natural surface of the moor, a little to the west, a rough flat piece of stone was discovered resting upon a bed of clay, and closing the mouth of an urn 13 inches in diameter and 12 in depth, which was sunk in the soil, and surrounded with clay mixed with charcoal and pieces

of calcined bone. The interior was half full of burnt bones and human teeth, and several fragments of a smaller urn. In the cavity below the larger urn the soil was greasy and black, also mixed with charcoal and small pieces of bone, probably the remains of cremation on the spot.

Near to the road leading from Boltby to Hawnby is a long dike or embankment, about 5 feet 6 inches in height, on the side of which, and at a spot called Silver Hill, a tumulus 64 feet in diameter and 5 feet 6 inches in height, was opened by Mr. Manners Verity and Mr. Murray, on the 15th of August, 1864. From the remains of two skeletons which occurred near the surface, it was evident it had been previously disturbed. The original interment, however, on a bed of stiff clay, was found to consist of the male skeleton of an aged individual, lying on its left side, with the knees drawn up to within 7 inches of the chin, the head bent forward, the arms crossed, so that the right hand lay on the knees, and the left in front of the pelvis. The clay under the body was black and discoloured, several stones were placed round the body, and upon one the head, which was turned to the east, rested. The whole space occupied by the entire skeleton was only about 30 inches by 24. The teeth were much worn, and amongst the bones of the left hand was a bone ring of rather small size and with an unusual horizontal projection of the same material to extend over the fingers on each side at right angles. The tumulus and the adjoining embankment exhibited parallel black lines extending through them, as if formed by layers of vegetable substances now partially carbonized. In a section of the embankment were found two long and narrow flint flakes.

At Boltby Scar, 1,075 feet above the level of the sea, and on the summit of a steep precipice, is an indication of an oblong tumulus, and two circular ones, situated within a semicircular intrenched camp, which has been protected by



a ditch, known by the name of the *Cleave Dike*, extending north and south for about two miles. These tumuli bear marks of having been previously examined, but with what success I have not been able to ascertain. From their position, however, they may probably have been the last resting-places of an early British chieftain and his family, interred within his own camp; as the site is peculiarly that of a stronghold, defended in front by the rocky declivity, and overlooking the country for many miles, by which the distant approach of any hostile force could be perceived and timely guarded against, while, by the sunken intrenchment or dike alluded to, the encampment could be equally protected from any surprise attempted by crossing the moors. There is a peculiarity in the construction of the Cleave Dike intrenchment to which my attention has been called by Mr. Verity, which consists in its being divided by the soil left standing about a yard thick across the trench, so as to form a raised partition at every three yards. These divisions are best seen in the north part of the Training Ground, adjoining Hesketh Farm; at other parts of the dike they have been more or less obliterated by the surrounding soil falling down during centuries of exposure. For what purpose have these numerous divisions been left standing? Could they have been for the safety of separate defenders along the whole line of intrenchment, like the sunk pits or earthworks in modern warfare, to command an important position? Mr. Verity suggests "that these cavities, walled in by the continuous mound of earth on both sides, and covered with wattle-boughs, might have been the rudimentary huts of this populous Ancient British village, and with the adjoining camp and tumuli made up probably what Cæsar calls their *Oppida*, which in this instance was a long one-sided street of defensive habitations; and as there are other lines of dike crossing the hills in different directions, they may indicate the jurisdiction of the various petty chieftains of the

Hambleton, Kepwick, and Hawnby tribes, between whom, probably, feuds would frequently take place; so that sites which are now almost deserted may have been busy scenes of savage polity in pre-Roman times."

Finally, from these several interments, we ascertain that the Hambleton Hills have been occupied by different races of men during a long series of years. The earliest, or *long barrow*, dating very probably 3,000 years since, the *circular* British barrow not less than 1,800 years; though the Rev. William Greenwell considers that 1,000 years before Christ is not too remote a period to assign for the earliest of this class; and the latest, or Saxon, from the fifth to the ninth century of our era.

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ON THE PLEISTOCENE MAMMALS OF YORKSHIRE. BY WM. BOYD DAWKINS, M.A. (OXON.), F.G.S., ETC. (*An abstract only*).

In examining with some care the remains of animals embedded in caverns, peat mosses, river beds, and other early deposits, we find them indicate or point to distinct and widely-separate periods of time since their entombment. Some of the animals are still living in the district, and others of an earlier date no longer occur in Britain, but whose former existence is recorded in the early annals of this country. Another class embrace species, in addition, of which we have no record of their ever having been natives of Europe. To the first we apply the term *Prehistoric*; to the last, *Pleistocene*, which is synonymous with the terms *Post-Pliocene*, *Preglacial*, and *Glacial*. It applies to all deposits or formations, from the top of the Norwich Crag up to the prehistoric deposits comprising the preglacial, the forest-bed, the glacial drift, the post-glacial brickearths, loams, gravels, and the contents of the older ossiferous caverns. In some instances, species of animals appear to have lived through the earliest of these periods down to the present time; while others ceased to exist at a very remote epoch, and whose bones are either

embedded in river deposits or caverns in the limestone districts, which, in many cases, owe their formation to the action of underground currents of water from streams or the accumulation of springs, while the majority of caverns owe their contents to the falling of animals into open fissures and the transporting power of water: others, again, have been inhabited for ages by wild animals, and filled with the remains of their prey. The fissures, or old swallet holes, are in many instances still open, and more or less erect; and farmers will tell you that they have lost sheep, horses, oxen, and dogs, that had no means of regaining the surface. In caverns, however, which have afforded shelter from the weather, man and wild animals have resorted from the Pleistocene times to the present day; hence in such localities remains of different epochs are found. As in Kent's hole, for instance, where, overlying the mass of bones dragged in by hyænas in Pleistocene times, and sealed down by stalagmite, a layer of dark-coloured earth, containing various implements of bone, flint, and pottery, and exhibiting upon its surface the indications of the feasts and fires of some early race of people. The Kirkdale cave, in this county, contained several Pleistocene mammals intermixed with those of our own day. The Paviland cave, again, exhibited a mixture of Pleistocene and Prehistoric remains; while, in other instances, those of Prehistoric age only are met with. The old river gravels, loams, and brickearths, which are sometimes very high above the level of the nearest stream, are the result of the erosion of the rocks during the formation of the valleys by the ancient rivers flowing at a far higher level than at present, which has cut down their beds to the present level, so that the remains from the caverns and the river deposits are, geologically speaking, of the same date. Some of these deposits are of vast antiquity, and contain the remains of the extinct mammals that inhabited Yorkshire, and happened

to be swept down by the floods. From these two sources the following Pleistocene mammalia have been obtained in Yorkshire:—

KIRKDALE.	CAVERNS.		RIVER DEPOSITS.	
	KIRBY MOORSIDE.	KIRKDALE.	BIELBECKS.	LEEDS.
<i>Felis spelæa</i> ... ..	×	×	×	—
<i>Hyæna spelæa</i> ... ..	×	×	—	—
<i>Canis lupus</i> ... ..	—	×	×	—
<i>Canis vulpes</i> ... ..	—	×	—	—
<i>Mustela erminea</i> ... ..	—	×	—	—
<i>Ursus spelæus</i> ... ..	—	×	—	—
<i>Ursus Arctos</i> ... ..	—	×	—	—
<i>Bos primigenius</i> ... ..	—	—	×	—
<i>Bison priscus</i> ... ..	—	×	×	×
<i>Megaceros Hibernicus</i> ... ..	—	×	—	—
<i>Cervus elaphus</i> ... ..	—	×	×	—
<i>Cervus tarandus</i> ... ..	—	×	—	—
<i>Elephas antiquus</i> ... ..	—	×	—	—
<i>Elephas primigenius</i> ... ..	—	—	×	×
<i>Hippopotamus major</i> ... ..	—	×	—	×
<i>Equus fossilis</i> ... ..	—	×	×	—
<i>Rhinoceros leptorhinus</i> (Owen) ... ..	—	×	×	—
<i>Arvicola amphibia</i> ... ..	—	×	—	—
<i>Arvicola agrestis</i> ... ..	—	×	—	—
<i>Lepus timidus</i> ... ..	—	×	—	—
<i>Lepus cuniculus</i> ... ..	—	×	—	—
<i>Mus musculus</i> ... ..	—	×	—	—

To this list Professor Owen would add the *Bos longifrons* and the Woolly rhinoceros (*Rhinoceros tichorhinus*); but a careful examination of the remains ascribed to these animals in the museums of York, Oxford, and London, has convinced me that they belong respectively to the bison and the Leporhine rhinoceros. Amounting in all to 22 species, which is nearly half of the entire number of Pleistocene mammalia whose remains have been found in Britain. These fall into five distinct groups. The first comprehending all the extinct species; the second, those confined at the present day to northern climates; the third, those confined to southern; the fourth, those common to northern and tropical climates; and, lastly, those still inhabiting the temperate zones of Europe.

1st. *The Extinct Species.* Out of the 53 species proved to have inhabited Pleistocene Britain, but 14 are no longer to be found on the face of the earth:—

Machairodus latidens.	Elephas meridionalis.
Ursus spelæus.	Hippopotamus major.
Megaceros Hibernicus.	Rhinoceros tichorhinus.
Cervus dicranios.	Rhinoceros megarhinus.
Elephas antiquus.	Rhinoceros leptorhinus.
Elephas primigenius.	Rhinoceros etruscus.
Elephas priscus.	Castor trogontherium.

2nd. *Species confined to Northern Climates.* This group of Pleistocene mammals is now confined to the colder regions of the north, or the high altitudes in the northern hemisphere, where a low temperature obtains, and consists of eight:—

Gulo luscus.	Spermophilus citillus.
Cervus tarandus.	Spermophilus erythogenoides.
Alces malchis.	Lagomys spelæus.
Ovibos moschatus.	Lemmus.

3rd. *Species confined to Southern Climates.* This group consists of only two:—

Felis spelæa, variety of Felis leo.
Hyæna spelæa, variety of Hyæna crocuta.

4th. *Species common to Cold and Tropical Climates.* The *Felis antiqua*, or fossil representative of the leopard (*Felis pardus*), extend, at the present day, throughout Africa and Persia into Siberia. The fox and the wolf are other instances of some of the living carnivora being able to endure almost every degree of temperature without being specifically modified by it.

5th. *Species still Inhabiting the Temperate Zones of Europe.* This is the largest group of Pleistocene mammalia, and embraces 28 species which are still living in the temperate zones of Europe:—

Homo.	Canis lupus.
Rhinolophus ferrum-equinum.	Canis vulpes.
Vespertilio noctula.	Mustela erminea.
Talpa vulgaris.	Mustela putorius.
Felis catus ferus.	Mustela martes.

<i>Lutra vulgaris.</i>	<i>Sus scrofa ferus.</i>
<i>Meles taxus.</i>	<i>Equus caballus.</i>
<i>Ursus Arctos.</i>	<i>Castor Europæus.</i>
<i>Sorex vulgaris.</i>	<i>Arvicola amphibia.</i>
<i>Sorex moschatus.</i>	<i>Arvicola agrestis.</i>
<i>Bos primigenius.</i>	<i>Arvicola pratensis.</i>
<i>Bison priscus.</i>	<i>Lepus timidus.</i>
<i>Cervus elaphus.</i>	<i>Lepus cuniculus.</i>
<i>Cervus capreolus.</i>	<i>Mus musculus.</i>

This analysis, therefore, of the 53 Pleistocene species gives—

- 14 as extinct.
- 8 confined to northern climates.
- 2 as confined to southern climates.
- 1 as common to temperate and hot climates.
- 28 as still inhabiting the temperate zones of Europe.

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The inference drawn from the first of the above lists of mammalia, as regarding the physical conditions and the climate of Yorkshire, at the time they lived in the county, is highly important and interesting. Again, the proportion of 14 extinct to 39 living species proves that, in the geological sense, the present order of things is separated by a small interval from the Pleistocene; while, from the fact that half are still living in the same European area, we may infer that the conditions of existence, the climate, and food, and the like, were then very similar to those now obtaining in the area in which we live.

That, however, some great physical change has taken place in Europe since the Pleistocene times, is proved by the presence of other groups of mammalia—those confined now to cold and to hot climates. They afford evidence that at first sight appears conflicting, but which, upon analysis, we find to be very conclusive, that the climate in Britain in those days was very much more severe than at present. From the conditions under which the surviving Pleistocene herbivores now live, we can infer those under which they lived in Britain in that early period. The Northern group of Pleistocene mammalia, living only now in a severe continental

climate, consists of species that have very different powers of resisting cold and heat. Thus the musk sheep is found now only under the lowest temperatures in the vast treeless, barren grounds of North America, while the reindeer lives also in the forests, along with the elk of the Europæo-Asiatic and North American continents. The red deer and the bison range up to the edge of the province inhabited by the other animals. The lemmings live under a very severe climate, while the marmots are found in the higher and colder districts in Southern Europe and Central Asia. Each of these Northern species is dependent upon the oscillation of the climate for its particular habitat in a given year, retreating northward or southward according to the temperature that regulates the supply of food necessary for its existence. By some such oscillation of temperature the remains of the animals of two contiguous zoological provinces may be found together in one spot, as in the case of the northward retreat of the musk sheep, from the neighbourhood of Fort Churchill, where it once lived, and which is now occupied by the elk and waipiti. In this manner the admixture of the remains of animals living at the present day, respectively in a severe and in a temperate continental climate, may be accounted for in the Pleistocene caverns and brickearths.

The hypothesis of a series of conditions obtaining in Pleistocene Western Europe, similar to those now found in some portions of Northern Asia, is necessary to complete the evidence afforded by the fauna, and the deposits in which they are found. Now, the contortion of the gravels, and the angular state of the pebbles of which they are often composed, are, as Mr. Prestwich infers, explicable only on the theory of ice having been found in our rivers in far larger quantities than at the present day—the one being the result of the grounding of miniature bergs, the other of the melting away and depositing their burden of pebbles. The large

plateaux of brickearths are probably the deposit of the floods caused by the sudden melting of the winter snow, similar to that which takes place in Northern Siberia and in the area north of the Canadian lakes. The winter cold would be sufficiently intense to allow of the Northern groups of mammalia living in the winter; and the musk sheep might have been obliged to leave the Pleistocene "tundras," and take shelter in the zone of the elk, and even the bison, in an unusually severe season. On the other hand, in the summer, the animals that are now found in the temperate zones of Europe might advance even into the country of the elk and the reindeer; and even carnivora, now confined to hot climates, find their way into the temperate zone of the day. Thus the *Hyæna vulgaris*, or common living hyæna, is found fossil in the South of France, without penetrating as far north as Britain, France, or Germany. In fact, the evidence afforded, both by the fauna and deposits of the Pleistocene, seems to us to prove that the climate in Pleistocene Britain was more severe than it is now; that at a time when Britain formed a portion of the Europæo-Asiatic continent it more closely resembled that now obtaining in the fur countries of Northern Asia than elsewhere; and, lastly, that it was subject to oscillation, by which the migrations of the herbivores were directed northward or southward, as the case may have been. Strong evidence is afforded by the thick woolly covering of the carcasses of certain larger pachyderms—as the Mammoth and Tichorhine rhinoceros of Siberia—that the temperature of the countries in which they resided was very severe. The *Hippopotamus major*, also, which was cotemporary, *may* have been, in like manner, supplied with warm covering; but of this fact we have no proof, and the aquatic habits of this last mammal militate somewhat against this supposition, and are apparently incompatible with a climate suited to the reindeer and other terrestrial mammals confined to cold climates.



Again; as its remains have never been found in high northern latitudes, it may more probably have been only a periodical visitor in England, France, and Germany, and not a dweller throughout the year, like other herbivores—as the elephant, rhinoceros, Irish elk, bison, reindeer, and its headquarters have been confined to the shores of the Mediterranean and the north of Africa, where its remains have occurred near Constantine, in Algeria. Again, the occurrence of the hippopotamus may be accounted for in a somewhat different manner; for instance, as it appears self-evident that the general climate of Britain, during the post-glacial epoch, has been more severe than at present, a period or periods of some length may have intervened, while England and Ireland formed a portion of the European continent, when the climate may have been less severe, and the rivers free from ice throughout the year. This inference is somewhat strengthened; but the fact that the remains of the hippopotamus are most frequently associated with those species of elephant and rhinoceros—*i.e.*, *Elephas antiquus* and *Rhinoceros leptorhinus*—which not only occur in this hemisphere, but have had a southern or tropical, rather than a northern range; and as certain plants belonging to the Lusitanian flora are found on the west coast of Ireland, it is only reasonable to suppose that their migration from a southern land has occurred along a coast line since the glacial epoch, which would have exterminated them by its severity. Is it not probable, therefore, that at the period which favoured the migration of the flora, certain southern forms of mammals have migrated also?

The evidence of a gradual increase of temperature in France and Germany during the Historical period appears perfectly certain. From Diodorus Siculus we learn that the Rhine and the Danube, during the first four centuries, were frequently frozen over in the winter; and Cæsar mentions

the reindeer as existing in the great Hercynian forest that overspread Northern Germany, along with the gigantic urus and the elk. This statement is singularly corroborated by the discovery in the peat bogs of Pomerania, according to Professor Nilsson, of the remains of these three animals; so that there can be no doubt of his accuracy in this particular instance. From some cause or other the temperature has increased on the banks of the Rhine; and from the fact that the reindeer cannot live, at the present day, south of the Baltic, we may recognize a proof of a diminution of cold in that region since it was inhabited by those of a severe climate. This change of temperature is very generally accounted for by the drainage of morasses and the cutting down of woods; but may it not, with more probability, be ascribed to a much deeper cause—to a secular change operating throughout Europe, which began in the Pleistocene, and was going on throughout the Prehistoric, and happened, incidentally, to be noticed, as we have seen, in Historical periods? The presence of the reindeer in the Prehistoric deposits of England, Ireland, and Scotland, affords precisely the same evidence as those mentioned by Cæsar, as at the time they lived in Britain and Ireland the climate must have been suited for them. There may have been oscillations of temperature, but the progress, on the whole, seems to have been gradual, from the intense cold of the glacial period to the temperate “insular climate” obtaining in Britain at the present day. In conclusion, I most earnestly recommend a careful and minute examination of the contents of the Prehistoric and Pleistocene caverns which occur in the mountain limestone districts of this county, as from such details much important information may, doubtless, be added to our knowledge of the former inhabitants of Pleistocene Yorkshire.

# PROCEEDINGS

OF THE

## GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SIXTY-NINTH MEETING, HELD IN THE  
SALOON OF ST. GEORGE'S HALL, BRADFORD, ON MONDAY,  
MARCH 4TH, 1867.

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The Rev. Dr. CAMPBELL, in the absence of the Vicar, who had been announced to preside, was called to the chair.

The CHAIRMAN announced that indisposition prevented the Vicar's attendance, and that Mr. Meade, the president of the Philosophical Society, who would naturally have succeeded the Vicar, was engaged in professional duties. He (the Chairman) was present at the former meeting held in Bradford, and was very glad that the society had chosen Bradford again as the scene of its meeting. He would attempt to represent the spirit of the respected and reverend gentleman of whom he was the substitute when he said that the religion of which the vicar and he were ministers had not, and ought not to have, the slightest jealousy of the advancement of any department of knowledge. In their judgment, and he believed in the judgment of all intelligent believers in that religion, it had every interest in the progress of all kinds of true knowledge; and instead of dwelling upon a middle ground, and saying in a vague manner they believed that the discoveries of science and the progress of knowledge

in secular departments would be found in harmony with religion, their whole experience, and their experience of those very departments of science to which this society devoted its attention, had shown that it tended to the progress of intelligent religion. It was not merely to be found that religion was in harmony with science; it had benefitted, not only by the strengthening of the faculty and the passion of man's free, candid spirit of inquiry, but science was always bringing proofs and attestations of the truth and divinity of religion. The Chairman then made a short statement of the objects of the society, after which

Mr. F. W. Tetley, of Leeds, and Mr. Burgess, of Brighouse, were elected members of the society.

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ON THE INHABITANTS OF YORKSHIRE IN PRE-ROMAN TIMES.  
BY THE REV. WILLIAM GREENWELL, M.A., CANON OF  
DURHAM.

We have few, if any, traces of man in Yorkshire before times which approach those that may be almost called historic. Of the men who lived when the mammoth, the tichorine, rhinoceros, and other extinct mammals occupied our country, we have no evidences at present, but we may expect to find them in deposits similar to those which, in Bedfordshire, Suffolk, Wiltshire, and other counties, have supplied them abundantly. Yorkshire has afforded many extinct mammalian remains, and I look forward confidently to the finding the implements of contemporaneous man. Nor have our caves given us any relics which, like those of the Dordogne, tell us of a later period, indeed, than that of the rhinoceros and its congeners, but still of one of enormous antiquity, when the reindeer ranged over central France, and when man had attained sufficient skill to represent, even artistically, that and other animal forms. And here we may

regret that the celebrated Kirkdale Cave was examined in days when it was never dreamt of that man and the mammoth could have lived together, and when flints had not become of importance as evidences of man. It is more than probable, that amongst the large quantities of animal remains in the cave, may have been deposited the implements of flint or bone which would have shewn a human occupation coeval with the hyena; but they were not looked for, and in consequence not found, because they were not then understood. Of the species of man to which I have been referring, no osseous remains have as yet been discovered to tell us how far they differed from, or how near they approached to, the existing form of the European man.

Was there as much difference between the men of the flint implements of the Somme and the Ouse valley and ourselves, as between *Elephas primigenius* and the existing elephant of Asia? At present we have no evidence to decide the question; but we shall have it, there can be no doubt, before long. A vast period intervenes, and we find England occupied by the present system of vegetable and animal life, and by a race of men who differed in no very important way from ourselves—the race of men of whom I am about to give you some account.

It has been proposed to divide what are called “pre-historic times” into three eras, the stone, the bronze, and the iron age. This division, first propounded by the Danish antiquaries, has met with a pretty general acceptance, and, indeed, there is a great deal to be said in its favour. But it has, I think, been pressed by some too strongly into the service of British archæology, where we have not those marked distinctions so clearly defined as they are in Denmark. I believe, however, that there is decided evidence, at all events in some parts of England, of an age when only stone was in use for weapons and implements; and that the people, who at that

time occupied our country, were of a different race from the metal-using people who intruded upon and subdued them. I will very briefly give you my reasons for this belief, at the same time I must tell you that Yorkshire affords only a few facts which bear upon this question.

In many districts, and more especially in Wiltshire and Gloucestershire, there still remain a number of sepulchral mounds of peculiar shape, where are found the burials of men, women, and children, whose skulls present very marked features. In these mounds, which are very long in proportion to their breadth, the interments are always at the east end, which is higher and broader than the west; and the skulls of the buried people, like the mounds, are long in proportion to their breadth, and also different in many other particulars from the heads of the bronze-using people who lie buried in the round barrows. Now with these apparently earlier interments, no objects of metal have ever been found associated; the only implements or weapons being made of flint or bone. The discovery of secondary burials, of the people of the age of bronze, evidently introduced into these mounds, at a time subsequent to their first erection, proves that they belong to an earlier time than that of these round-headed bronze-using people, and as in no case, and a very large number have been examined, has any article of metal been found in them, it is not an unfair inference to assume that at the time they were raised, metal was unknown to the people who erected them. Other features of a very peculiar kind have been observed in the burials of the long barrows, both in Wiltshire and elsewhere. In one I opened in the North Riding, near Ebbertson, there were the remains of about fourteen bodies, of all ages and of both sexes; and of several of these the state of the bones, broken and widely scattered in fragments, shewed that a violent death had overtaken them, and that the flesh had been removed before the bones were interred. Is the conjec-

ture a forced one, which suggests that these fractured bones were the relics of persons slain at the funeral of the chief, and eaten by the guests? Cannibalism has not been so unfrequent that we need wonder at such a feast.

The way in which the bodies were deposited in the long barrow at Scamridge, near Ebberston, was very singular, and I could not at the time exactly understand the method of burial; this was, however, made quite plain by another on Willerby Wold. The body of the person in whose honour the barrow was erected, and the broken and dislocated bones of others, had been laid upon the ground in a line running east and west; over them had been heaped, at Scamridge, oolite rubble; on Willerby Wold, flints and chalk; upon this had been placed wood, which was then set fire to, and thus the bones were consumed by the ignited lime. After this the barrow was thrown over all, the bones only reaching to about one-third of the length from the east end. At Scamridge the burning had not extended over more than one-half of the deposit of bones, and so I was enabled to recover several skulls, though not in a complete state; but at Willerby the burning had gone the whole length of the bones, which were completely calcined, and therefore useless so far as the type of skull was concerned, but enough remained to shew that they had been laid there broken and disjointed.

I will not, however, linger any longer upon this question of an earlier race than that of the metal-using people, about whom I am addressing you, for it would require more time than I can ask you to give me to enter into the subject at length. I thought it well just to allude to it, for it is of great interest, and one which I think will, with further explorations, be satisfactorily worked out. Indeed, my last diggings on the Wolds have afforded me several facts which may prove of great service in this investigation. I found in many barrows the burials of persons who presented the two types of skull

I have just referred to—the long and the round head; and some who, judging from the features of the skull, had been descendants of a mixture of the two races. Now this is just what we might expect, for many of the earlier and conquered people would continue to live under the new state of things, and would intermarry, in time, with the intruders. But there were indications which seem to shew that the long-headed race was the earlier, and though conquered, perhaps the most numerous for some time after that conquest; for I found in five barrows that the original interments had been disturbed to put others in their place, and in three of these instances, whilst the secondary burial was of a round-headed person, the primary and disturbed burials were of the long-headed race.

Before I proceed further, I wish to state that the facts I am going to bring before you are deduced entirely from the observation of myself and others upon remains that have been seen and handled. I put aside all historic facts, *i.e.* those of written history, not because I think them altogether without value, but because I wish to bring these people before you as we know them from their weapons, implements, ornaments, habitations, and burial-places, rather than as we have been accustomed to regard them in our histories—at one time as unclothed and painted savages; or at another time as philosophic sages, handing down a recondite and mystical knowledge to crowds of appreciating disciples; or cutting, with golden sickles, the sacred mistletoe beneath the mysterious oak. Under the false light of history—I do not deny a true one—the simple burial circles of the olden race have, with clouds of witnesses, and long arrays of quotations by learned writers (learning, how much abused!) been erected into Ophite and Dracontian temples, and fanes of the *Helio-Arkite cult*. Even within a few months we have seen a work, called “Our British Forefathers, who were they?”



in which the author, who appears to have read every book under the sun, and to whom everything printed seems to appear equally true, has produced such a farrago of nonsense as I thought could never have been written by a man who has been blessed by being allowed to see a barrow opened. Very different is Sir John Lubbock's "Pre-historic Times," where true learning has produced a most valuable and trustworthy book.

The ancient Briton—I can find no better name for him—that is, the man whose race, in the main, occupied this country when Cæsar landed, belonged to no mean section of the human family. He was of good stature; his skeleton shews him to have been of an average height of from 5 ft. 7 in. to 5 ft. 9 in. Of powerful and symmetrical frame, and though of course subject to disease (I have seen the skeleton of a strong-made man whose joints shewed that he had been a martyr to rheumatism), many appear to have reached the period of advanced life in sixty and seventy years. It is not an easy thing, even in imagination, to clothe again the dry bones with flesh, and to restore to the tenants of the tomb the manly grace, or the still lovelier form, which once adorned them. We may, however, form some idea, imperfect though it may be, of the personal appearance the Britons presented. The lines of the face must have been, on the whole, harsh and severe, for all the prominent features are strongly developed, and wanting in that softness of outline which adds so much to beauty of form. The mouth was slightly projecting, the cheek bones high, the eyebrows rugged and very projecting; the nose, on the whole, prominent and well marked. The forehead erect, a little low, but broad, and in no way wanting in capacity. The hinder part of the head remarkably broad. We cannot, judging from numerous remains of the skull, attribute much beauty to the face of the Briton, and he must have presented, at the best, a fierce and savage

aspect. The main characteristic of the skull is breadth, and especially in the occipital region; and the form is most distinct from that of the modern English head, which, in the main, is oval, as it is also from that of the so-called Kelt, whether Irish, Scotch, or Welsh, which is oval too, but of a somewhat different form from the oval Teutonic head. It may serve to give you some idea of the relative proportion, as regards breadth, between the British and Anglo-Saxon skull, when I tell you that thirty British skulls, taking one hundred to represent the length, had an average breadth of eighty-two, whilst thirty Anglo-Saxon skulls had an average breadth of seventy-four; the whole sixty skulls being taken at random, and not selected in any way. The teeth are usually well preserved, rarely shewing any signs of decay, but are always very much worn down, due, no doubt, to the food they principally lived upon. I only know of one instance where any hair has been observed, and that occurred near Pickering, in the North Riding, where, in a barrow, one urn was found covering another, round the base of which was laid a tress of light auburn hair, braided in four plaits; a long-treasured memorial, perhaps, of one who had died before her husband.

As regards their dress, there is not much to be said, for its very nature precludes the possibility of its remaining to our days. Portions, however, of garments have been found, usually of woollen fabric, but in other instances of leather. I found under a barrow in Craven, enclosed in a coffin made out of a split and hollowed oak-tree, a body which had been enveloped, from head to foot, in a textile fabric of wool, loosely woven; unfortunately, the decayed state of the stuff made it impossible to recover more than mere fragments, so that nothing as to shape could be made out. Judging, however, from similar interments found, under almost identical circumstances, in Denmark, it is probable that the body had been buried in the ordinary garments of the owner.

The Danish coffin contained two caps, a cape, much like a poncha, a sort of petticoat, short trousers fringed at the bottom, and leggings, all made of wool. Another tree interment, in Dorsetshire, contained a dress made of deer-skins, and a considerable quantity of gold thread, evidently the remains of some rich material, the perishable part of which had gone to decay. From a stone cist, near Rothbury, in Northumberland, I have a javelin head, which had been wrapped in two fabrics of woollen cloth, the pattern of which has been preserved upon the oxidised metal: the one is very open and coarse, the other of very much finer texture, both apparently woven. Such, I think, is all that can be said of an ancient Briton's clothes, without following the historian into the realms of fancy, where he takes wider flights indeed than even poetic license might allow; into which, if you like to follow him, you may see our worthy forefathers appearing in almost every guise, from that of the conventional Roman senator or Grecian sage, to that of a tattooed New Zealander.

But when we come to ornaments, a wider field is opened to us, for here we get at less perishable materials. Large gold torques for the neck are by no means uncommon, and frequently of beautiful design and workmanship, including many varieties of the cable pattern. Very similar ornaments, but smaller, adorned the arms and perhaps the ankles, generally pen-annular and widening into a sort of cup-shaped end, but sometimes fastened by a hook at each end, or by an ordinary hook and eye. I possess three fine gold armlets, made by simply twisting a riband of metal into a spiral. The jeweller of whom I bought them, told me that, thinking the fashion was very elegant and a likely one to take, he set his best workman to make some, and that after wasting two days in vain attempts to produce the like, he gave it up. I have also three hollow gold beads, or rings, for it is difficult to say what they are. On showing them to

an intelligent working-jeweller, he told me that he could not make out how they were fabricated, and that he never saw more admirable metal-work. I adduce these instances to show to what a refinement in goldsmiths' work these people had attained. These armlets are also frequently made of bronze, in some cases enamelled and set with vitrified pastes. Plating of one metal upon another was also done in the most skilful manner. I have seen gold plated upon bronze, and bronze upon iron. Finger rings of gold and bronze are sometimes found, and some rings which look more like nose rings than aught else, though they might of course have been placed in the ears. Necklaces are abundant, and have at times occurred round the neck of a skeleton. They are of various materials, gold, glass (often prettily streaked in different colours), clay, amber, most frequently perhaps of jet, or other inferior lignite. They occur in jet of more varied shape than in any other material; round, cylindrical, oblong, button-shaped, heart-shaped, and square, at times very ingeniously arranged; and in some cases having a pattern upon them, made by very minute gold points inserted into the jet. And as there is nothing new under the sun, small objects, like the charms which youthful Britons sometimes hang to their watchguards, have been found. I possess a miniature jet axe, and another also has been found, and I have seen a toy bronze dagger, and a toy socketed celt: all of which are pierced for suspension. In one or two instances gold plates have been found upon the breast of a skeleton, and in one case a corselet, for such it appears to have been, enclosed the whole breast and shoulders; it is of gold and entirely covered with a pattern of raised lines and circular dots of hammered-up work. Before leaving the subject of ornaments, I may here mention that many, if not all, the pen-annular rings very possibly served the purpose of money as well as of decoration. Though a regular coinage, based upon a rude

Gaulish imitation of the well-known Macedonian didrachm, called, after its first coiner, the Philippus, was in use in Southern Britain, those parts of the island north of South Yorkshire seem to have had no coined money, at least none has ever been found. Now these peculiar-shaped rings have occurred of all sizes, and that in a number deposited together, from one too small to go on to any finger, and graduating from that size up to one that is large enough to surround an arm. I have six small gold rings, found in the north of Northumberland, each ring made of three wires soldered together, and when discovered strung in chain fashion. Showing these to a friend, who had just returned from Nubia, he told me that rings precisely similar were used there for money, and that he had seen them made. Large quantities of brass and iron rings, called manillas, of various sizes, almost exact models of the British rings I am speaking of, are now made at Birmingham for exportation to Africa, where in some parts they form the currency. Taking all these facts into consideration, we may, without much doubt, suppose a similar article to have been used for money in Britain.\*

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\* I referred above to the coins which have been supposed to belong to the British tribe which occupied, amongst other counties, Yorkshire, and though they probably belong to a time after that to which my lecture is devoted, they cannot be passed by without some slight account of them. They are very rude imitations of imitations of the Philippus, in which the head of Apollo has degenerated into a wreath of lozenge-shaped leaves, with what a very vivid imagination may call locks of hair, and the biga on the reverse into an animal in which no Yorkshireman could recognize a horse. Upon some of them are legends of which no satisfactory explanation has been given. They are of very base metal, and having been found associated with Roman Consular coins and some early Imperial ones, may probably date from about our era to fifty years after Christ. I have mentioned bronze in connection with the ancient Britons, but you must remember that the use of this metal has been denied them. Some writers, and especially the well-known antiquarian author, Mr. Thomas Wright, have attributed all bronze weapons and implements to the Romans or to those who had come under Roman influence. This view I hold to be perfectly unten-

Whatever skill these people showed in the fabrication of their ornaments, they showed almost still more in that of their arms. Nothing more exquisite in shape, or more skilful in workmanship, can be seen than their leaf-shaped bronze swords and spear-heads. To take their arms, however, in order; and first I will notice those for defence. Nothing like a helmet or any defence for the head has been found, in fact the shield seems to have been the sole arm of defence. Of this there are two varieties; the one, which belongs to the bronze age, is circular and about two feet in diameter, slightly convex, and the metal very thin. It has a handle at the back, and has not been worn on the arm, but held in the hand. The outer surface is ornamented over the whole of it by concentric raised circles, between which are small circular bosses; the whole of hammered-up work. Of

able, and to rest upon no sound argument. Mr. Wright's principal facts are these: that a bronze leaf-shaped sword was found in a Roman camp, that these swords, as well as spear-heads and celts, have been found near Roman roads, and that they are like representations of such weapons upon Roman coins. His first fact is of no value, for there is no proof that such a sword was found in a Roman camp, and even if one had been, it would have proved nothing as regarded its date, for we might find in one of our gardens a Roman coin, and then we should have to call it, according to Mr. Wright, an English coin. That bronze weapons, &c., have been found near Roman roads, is not surprising, for it is difficult to get very far away from a Roman road, and also in many cases such roads followed the line of earlier British ways. The representation on coins, very small objects, shows nothing as to exact shape or minute detail, and cannot be allowed much weight in the argument.

The facts on the other side seem quite conclusive as to the native origin of bronze swords and spear-heads. The Roman sword was of iron; the very word *ferrum* shows that. The leaf-shaped swords have been very rarely found in Italy, whilst they have been found in the greatest abundance in Ireland and Denmark, places where Rome never exerted much, if any, influence. And not to multiply proofs, I will only add one more, that amongst the swords, spear-heads, celts, and other bronze articles, which have been found in large quantities and on very many occasions, not one single object has ever been discovered which, without controversy, was Roman; a fact quite inconceivable if those articles were Roman, or made by a people who had been for long in contact with Roman art and civilization.

these shields, specimens have been found in Northumberland and Durham, and a very fine one was exhibited lately in York, by Sir George Wombwell, found, I believe, near Newburgh. The other type of shield, which belongs to a later period, when iron had come into use, is oblong in form, and generally profusely covered with the peculiar style of ornamentation which has been attributed to the late Keltic period, and which is almost peculiar to the British islands. These shields are sometimes further ornamented with enamel, a magnificent example of which, found in the Thames, is now in the British Museum.

The offensive arms were the sword, spear, javelin, dagger, sling, and bow. The first four were made of bronze. The sword, which varies from twenty to thirty inches in length, is leaf-shaped, and meant for thrusting; the handle, which is small, has been made of wood or bone, riveted to the metal tang, but no trace of it has as yet been found, nor, except in a single instance, has any scabbard been discovered, though metal chapes for the scabbard end are frequent. The sword was attached by rings to the person, and as many as four have been found in connection with it. The spear and javelin heads are of various sizes, and have sometimes loops at the sides, apparently to attach them to the shaft; the usual mode of fixing them is, however, by a single rivet through the socket. The dagger is a short, broad, and strong weapon, and has frequently been found buried with its owner, which is not the case with the sword and spear. It has had a sheath of wood, the remains of which I have seen still left upon it, and a handle of horn or bone, sometimes prettily ornamented with small gold studs. A later type of sword, corresponding to the time of the oblong shields, is made of iron, with a sheath of bronze, in rare cases ornamented with enamel. The shape of this sword is not so much like a leaf as is the bronze one. I have a fine specimen of a sheath,

with part of the iron sword still in it, found near Carham, on the Tweed, and three have been found in Yorkshire; they are, however, of very uncommon occurrence. The arrow was always tipped with flint, indeed I do not know of a single instance of a bronze arrow-head being found in England, one recorded by Sir R. C. Hoare as an arrow-point being really a miniature dagger. The contemporaneous use of metal and stone for various purposes is a certain fact. Bronze daggers and pins are found frequently associated with flint arrow-heads, knives and scrapers, in the same grave. Nor have I any doubt that, for certain purposes, flint was used for some weapons and implements to the close of the bronze period. And the explanation of the particular use of each appears to be this. Bronze was, of course, a valuable material, and was probably not in the possession of every one, but the same person had also articles both of it and of flint; those that he kept by him, such as his sword, dagger, or spear, were made of bronze, such as he threw from him, as the arrow, were made of flint, the commoner material. A sharp flint was almost as useful as one of metal to scrape down bone into pins and other implements, or to prepare hides with, by removing the hair; and, therefore, for such purposes it was ordinarily used, bronze knives being very scarce. Sling-stones of flint and other stone are very abundant, not only about fortified places, but scattered over the surface of the ground, with arrow-heads and other flint objects.

It remains to mention a very important weapon of offence, the chariot. Five specimens of such have been found, in each case buried with the owner. From the greater part being made of wood and so gone to decay, it is impossible to say what were the exact shape and size; enough, however, in bronze and iron has remained to give us some idea of it. The wheels have been nearly three feet in diameter, one had



sixteen spokes, and in every case the rim was of iron, the axle of iron plated with bronze. The chariot was no doubt small, for the horses which drew it were of small size, something like our galloways, judging by their skeletons, which have been found laid alongside the pole. With the chariot and horses have been associated quantities of rings, plates, bits, and other articles of bronze, sometimes beautifully enamelled, which had formed the trappings of the horses and ornamental parts of the chariot, and which show to what perfection in metal work these people had arrived.

The implements, like the arms, were made both of bronze and of flint, or other stone. The most common is the enigmatical article called a celt, from the Latin *celtis*, a chisel, which it is not. It varies much in size, and a little in shape, and has been hafted in two ways, by inserting the wooden shaft into the socketed end of the one type, and by inserting the wedge-shaped end of the other type, the so-called palstaab, into a split shaft. It has been conjectured that it was used as a hatchet, and as the ferrule end of the spear shaft. Though it seems ill adapted for a hatchet, because it would require a bent handle to enable it to be so used, and such a handle would be liable to break at the bend, it has, nevertheless, been found with a bent handle attached to it, and must have served as an axe. The other conjecture, that it was the end of a spear shaft, is not worth consideration, and only originated in celts and spear-heads being frequently associated. The axe was, frequently, during the bronze age, made of stone, great numbers of which have been discovered, and sometimes in connection with bronze articles. Another use of the bronze celt may have been to loosen hard soil, wooden shovels being, probably, used in conjunction with it, and to root up stones and to destroy ramparts. Besides the celt, and frequently along with it, bronze gouges and chisels have been discovered, sometimes in large quantities, together

with refuse pieces of metal, the remains of castings, and in rare instances with the moulds, in which the implements have been cast. A few bronze knives have occurred, which probably served the purpose of a dagger as well, and we may, without much straining, picture a Briton giving the *coup de grace* in the morning to his enemy, and with the same serviceable tool carving a boar's ham for supper, the same evening. But knives were usually made of flint, and very sharp and effective they must have been; they are found in considerable numbers, and not unfrequently associated with bronze articles, and accompanying an interment. Saws, too, were made of flint, not of a size adapted for timber, but probably to cut bone with; they are by no means uncommon, and very ingenious specimens of flint workmanship they are. But the commonest flint implement is what is called a "thumb flint," from a rough resemblance to the end of a thumb, the greater number are round, but many oval and long-shaped. They have been made in this way: a slice has been taken off from a core of flint, at one stroke, having a smooth and slightly convex surface on that side, the other side was then carefully chipped at the edge, so as to make the tool sharp-edged and yet strong. By this means a sharp-sided implement was made, which was no doubt used as a scraper for bone and hides. The Esquimaux now manufacture "thumb flints," for scraping with, which are exactly similar in shape to some of those we find in England. Pins were made both of bronze and bone, and of the latter material were also made long knives, very like our paper-knives, and which may have been used for skinning with. Grain was bruised by stone-pounders, generally water-worn pebbles; but millstones, in the shape of the small hand-mill or quern, are very common, and generally made of sandstone, and to the mixing of particles of this with the flour is no doubt to be attributed, in a great measure, the extraordinary attrition

to which the teeth of these ancient people have been subjected. The corn was also, perhaps, not very well ground, and required the human grinders to be brought into very active operation, which may also account for the state of the teeth. Grain must have formed no unimportant item in their dietary, and was grown upon the terraces, which are so frequent a feature on the sides of hills, in connection with British settlements. They are found in great abundance in Craven. These terraces are similar to those upon which the vine is grown on the Rhine, and were useful in preventing the washing away of the cultivated soil upon the sloping side of a hill. Two reasons may be adduced to account for cultivated ground being so frequently situated in such unlikely places as the bare and steep hill sides. The valleys were then subject to constant overflowing, and would be very swampy and unfit for growing grain; and in the disturbed and unsettled state in which these people lived, it was necessary to have so important a possession as the corn-growing land under the immediate protection of the fortresses, which were ordinarily situated on high and defensible ground. The country then presented a very different aspect from what it does now, for a very large portion of the land was forest. Nearly all our bare hills, which now grow ling, were once thickly clothed with wood, and that too of a large size. Wherever, in fact, a peat moss has been drained, or otherwise examined, there large quantities of timber are found, principally oak; but pine and birch are not uncommon. In these forests ranged numerous herds of deer and wild swine, whilst a small species of ox seems, from its remains, to have been abundant. Every man was then no doubt a hunter, and the flesh of these animals formed a principal article in their food; the large numbers of the bones of these beasts, in all cases split open to obtain the marrow, which are found near their places of dwelling, testify to the abundant supply of game

under which the table of the Briton groaned. Besides the animals mentioned, several others, now extinct in our county, were then living in it. It is probable that the Irish elk was still in existence, though no doubt very scarce; but the red and the roe-deer were plentiful, and a larger species of ox, the *primigenius*, was also abundant. Goats formed a part of the food of these people, though we do not find so many of their remains as of those of the red-deer and the wild boar. The wolf was common, as indeed it was down to the thirteenth century of our era, and the beaver has occurred in peat mosses, with bones of the deer and the ox. It is not so easy to say what animals had been domesticated; the horse and dog certainly had been, for the horse and his rider have been found buried side by side, as also has the dog, to bear his master company in happier hunting fields. We find in connection with the fortified places large enclosures, which seem to be for cattle, and it is almost certain that at least the ox had been domesticated. Whatever the earlier long-headed and stone-using race may have done, I do not think our friends the round-headed Britons indulged in cannibal feasts. Ancient writers, you know, and those too of repute, tell us that they had these unpleasant habits; but then I have not implicit faith in ancient writers, and I only believe them when facts substantiate their statements. At all events, I have never seen anything connected with their burials, and that is the place to look for evidences of such feasts, which gives any sanction to the idea. Mr. Laing has lately roused the indignation of Caithness by throwing out a hint that a broken child's jaw he found in a kitchen-midden there, was the relic of a cannibal banquet; but I think he is wrong in that conclusion, as he seems to be in many of his ideas connected with the people whose burial-places and other remains he has examined.

They were not great builders. We possess a few large megalithic structures, which have been attributed—and, I

think, justly, in spite of Mr. Fergusson, the great architectural critic—to these people, such as those at Stonehenge, Avebury, Callernish, and Stennis; but nothing of the kind exists in Yorkshire. Their dwellings appear, from what is left of them, to have been humble edifices indeed. A low wall, never above three feet high, encloses a circular space of from fifteen to thirty feet in diameter; upon this wall has been raised a conical roof of balks of timber, covered with turf or thatch: this seems to have been their ordinary habitation. In some cases a stone bench runs round the inside of the wall, and there is generally a hearth-stone in the centre, the smoke no doubt escaping through the roof.\* We find nothing like the beehive houses, or the underground chambers which exist in many parts of Scotland, nor like the somewhat similar buildings such as are seen in Cornwall. It seems strange that people who had attained to such high perfection in metal manufacture, and who decorated such things as horse trappings in the artistic and skilful way which the Britons did, should have been satisfied to live in such, to us, wretched habitations. No remains of any better dwellings have, however, been discovered; and they would, I think, have been found if any had ever existed; the more so because we find such numerous foundations of the circular huts, and there is no reason why they should have remained, and that all traces of better buildings should have disappeared. We have also in the county of Durham a cave—dark, damp, and dismal—

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\* A fine example of these hut circles remains quite untouched by cultivation, close by an entrance through the Scamridge Dikes, near Ebberston, evidently the habitations of the persons who guarded that entrance. Another, and perhaps in the North-Riding a commoner form of the same kind of habitation, is a circular pit, about five to seven feet deep, and varying, like the hut circles, in diameter. These are sometimes lined with stones, and have been probably covered by a flatter roof than those huts whose foundations were above the ground. They exist in groups both of an irregular form and arranged in rows, and frequently, as is also the case with the hut circles, they are surrounded by a low mound, apparently for defence.

which, judging from the very large quantity of animal bones found in it, must have been occupied for a long period. In this cave were discovered all the belongings of the family who lived in it, with the bones of themselves. They seem to have been overtaken by a sudden death by drowning, when the cave was overflowed during a high flood. This most miserable abode was inhabited by persons who were possessed of gold ornaments and bronze articles of the very highest excellency, whether we have regard to beauty of form or skilfulness of fabric. Nothing can exceed the swords, spear-heads, pins, armlets, and other articles there discovered; and that many of these, if not all, were made by themselves there can be no doubt, for a bronze mould for celts was found, together with some waste pieces from the castings, as well as a piece of pure copper, which proves that they made their own bronze. The greater part of the day was most likely passed by them out of doors, and there was, therefore, not the need for such houses as more sedentary populations require.

They were great fortifiers; in this differing from their successors, our Tuetonic forefathers, whose dislike to walled towns, and distrust of fortresses, is still strongly implanted in us. Let us hope that we freedom-loving Scandinavians—I love that name better than Anglo-Saxon—will always place our best trust in a stout heart and a strong arm.

The whole of the north of England is full of forts and fortlets, the defensive places of the British tribes. In some parts of Northumberland almost every hill-end has one upon it; generally of no very great extent, but strongly fortified, according to the then rules of warfare. In most cases the more or less precipitous side of a hill has been taken advantage of, and the fort abuts upon it, but in some instances it is placed upon level ground; in the first case it partakes, in some measure, of the shape of the ground on which it is placed, in the second it is circular or oval. The ramparts,

which vary in number from one to three or four, are made of stones, or of stones and earth, in height ranging from seven or eight feet up to nearly twenty. Upon these it is probable that stockades of timber were erected, indeed in one place in Hampshire the remains of such an additional defence have been found. Between the ramparts are ditches, which in general must have been dry; I have, however, seen one instance where there was an evident provision for filling the ditch with water. The entrances to these forts have frequently additional works to defend them, and what appears to have been guard chambers have also been found in connection with them. Access to and from the fort, without being seen by the neighbouring enemy, has been got by covered ways, which are very common; these, in many cases, appear to lead down to water. There are also other roads, or whatever they may be, the object of which it is not easy to make out. Large enclosures, no doubt for cattle, are very usual accompaniments of a fort.

Although many such forts as those I have been describing are found in Yorkshire, yet they are by no means so abundant as they are in Northumberland. It has suggested itself to me that this may have arisen from there having been more numerous small tribes in that county than in Yorkshire.

On the Wold district, and in other places, just as we find on the similar down county of Wiltshire, are numerous defensive lines, some of them of very great extent, the purpose of which it is not easy to understand; for they are in some cases of such magnitude that it would require an army far beyond what these tribes could have raised, to hold them. Until, however, they are properly laid down on a plan, it is impossible to gain any just notion of their purpose, and it is much to be desired that such a work should be done, and that speedily, for they are rapidly disappearing, through cultivation.

The great abundance of these forts gives, I think, some insight into the state of the country at the time, as regards its government. We seem to have, in this, evidence of a number of tribes living under distinct heads, though they may have been at times, for certain purposes and to some limited extent, joined into one general body, either under a supreme head or by a confederation of tribes. Had there been a single rule, having complete authority throughout the whole of Yorkshire, there would not have been the occasion for all the forts which we find throughout the county; a feature which unmistakably testifies to frequent wars between independent bodies. It has been suggested that they are defences against a common enemy, such as the Romans would be, but no such design is apparent in their arrangement. They would be comparatively useless as parts of one general plan of defence, but are well adapted as places of vantage against small and neighbouring enemies. They present a marked resemblance to the hill forts in Oude, or the pahs in New Zealand; and the state of the country in Britain was, no doubt, very similar to what existed, until late years, in those two places.

Wherever the foundations of the huts have been found in any number, there is always one which is of a larger size than those which surround it; this has been supposed, with much probability, I think, to be the hut of the chief of the tribe.

The transition from the abode of the living to the last home of man in the tomb, is not a very sudden one, and I now propose very briefly to give you some account of the modes of burial, and of the places of sepulture of these ancient people. The body was disposed of in two ways, evidently, to some extent, of contemporaneous usage,—by burning, and by burial of the body unburnt. It is difficult to say which is the oldest form, though on the whole I am



inclined to believe that in the earliest times, as indeed is natural, the body was buried unburnt, that to this succeeded a time of burning, to be again succeeded by the first mode. During all these periods it appears probable that the belief in a future state of existence was prevalent, as will be seen sufficiently as I detail the circumstances of the burial.

And to take that of burning first. After the body was more or less consumed, which it appears to have been in most cases, accompanied with certain of the deceased person's arms, implements or ornaments, the ashes were gathered and placed either in an urn of badly-baked clay, or in a stone kist, a hollow made in the ground, or merely placed upon the surface. Sometimes this was done on the very place of the burning, but more frequently at a little distance apart from it. Over the deposit of calcined bones was then raised a mound of earth, or stones, according to the nature of the locality. Whilst this mound was being raised, the friends or relatives appear to have thrown in, from time to time, chippings of flint or quartz, and broken shreds of pottery, it is probable with some symbolical meaning. Was flint, the producer of fire, emblematical of regeneration and a new life; and was the potsherd, the vessel, broken, and its use gone, a type of the old life departed, of dissolution, and decay? \* With the burnt bones, besides the weapons and implements which have been burnt with the body, are not unfrequently deposited unburnt arrow-

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\* What are pious rites in one religion are frequently accounted accursed in a new one, and it is not impossible that this, a sacred Pagan custom, was remembered in Christian times, but was then associated with what is irreligious and unholy. A passage in *Hamlet* may have reference to this ancient practice, where the priest, answering Laertes relative to the burial of Ophelia, a suicide, and so unholy, says :—

“Her death was doubtful ;

And, but that great command o'ersways the order,  
 She should in ground unsanctified have lodg'd  
 Till the last trump ; for charitable prayers,  
 Shards, flints, and pebbles, should be thrown on her.”

heads, knives and ornaments; and it is not, I think, a forced conjecture which regards these as placed there for an after use, or adornment in a future life. Amongst the burnt bones, whether placed in a large urn or deposited without such a protection, is very frequently found a small vessel of pottery, commonly in shape like an earthenware salt-cellar, and in most cases having two or more holes pierced through its side, often near the top, but as frequently at the bottom. These have been called "incense cups," from their supposed use; such, however, seems an unlikely purpose. I can, however, offer no more reasonable conjecture, unless they have held some peculiar portion of the body, as for instance the heart. They have not been burnt with the body, at least I only know of one instance out of nearly a hundred where an incense cup has passed through the funereal fire.\* As I said before, burial, after cremation and by inhumation, were contemporaneous; I have seen several undoubted instances of it. In one case a large central kist, containing the unburnt body of a child, of not a year old, was surrounded by nine burnt bodies enclosed in urns. In a barrow opened by the Yorkshire Antiquarian Club, on Acklam Wold, the knees of a skeleton were found to be charred by the calcined bones of another body which were laid close in front of them. It is difficult to say which of the two modes of burial is the most common; perhaps on the whole we find more instances where

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\* In the burial mounds, and often in close proximity to the human remains, are found very generally the broken bones of animals, such as deer, oxen, and swine. These appear to be the relics of the feast prepared and eaten at the funeral; and I have traced small patches of burnt matter in barrows, too small to be the spots where the body had been burnt, which may have been the spot where the feast was cooked. As in the cave-dwellings of an earlier period, and in the kitchen-middens of Denmark, the bones are invariably broken in such a way as to enable the marrow to be readily extracted. It is rarely that a barrow does not produce one or more tines of the red-deer's antler, and tusks of the wild boar are almost as common.

the body has been burnt, than where it had been laid in the grave unburnt. Burnt bodies, also, may be still more frequent than we suppose them to be, judging from the numbers which have been discovered casually, for being very frequently deposited without any urn, they may have easily escaped detection by labourers in agricultural works, whilst a skeleton is certain to have excited attention. The proportion varies too, in different, though adjacent districts; for instance, near Castle Howard I found about twenty cases of cremation, and not one of inhumation; on the Wolds near Sherburn, Ganton, and Weaverthorpe, on the contrary, to forty-five cases of inhumation there were only six of cremation; again, at Enthorpe, near Market Weighton, it was reversed, and fifteen burnt bodies were found, and only one unburnt.

The body, when buried unburnt, appears to have been deposited clothed; the remains of garments, as well as dress-fastenings, have been found, and more frequently the impression of such upon the oxidized metal of associated weapons. In districts where suitable stone occurs, the body is generally laid in a kist, made usually of four stones set on edge, with a cover or covers, sometimes of great weight and size. Where stone adapted for this purpose does not occur, then the grave is often a hollow, of various depths and sizes; I have seen them from two to ten feet deep, and from three to ten feet in diameter, sunk into the rock. At other times it is laid on the surface of the ground, whilst in very rare instances—of which the Gristhorpe burial, the remains of which are in the Scarborough Museum, is an example—the body has been placed in a split and hollowed-out oak trunk. In all these cases it is in a contracted position, the knees drawn up towards the chin and the hands crossed over the breast, or touching the chin, or on or under the knees. With whatever object this mode of placing the body was adopted, it was not caused by the size of the grave, for I have seen a kist seven feet long

where the skeleton was lying doubled up at one end, the rest of the kist being vacant. On the whole, the body is oftenest laid upon the left side, but there is no rule as to the direction in which the head has been placed, for I have found it to all the points of the compass. With the dead were deposited, in many cases, various objects,—vessels of pottery, daggers of bronze, awls and pins of that metal, so-called knives, scrapers, and arrow-heads of flint; and ornaments, such as bronze armlets, rings, and necklaces of jet, amber, glass, and shells. In a few rare instances gold articles have been found: I have seen, from Northumberland, a necklace of fifteen hollow gold beads. It might be expected that as a man was buried with some of his equipment, that the most important articles of it would be found buried with their owner; such, however, is not the case. I know of no well-authenticated instance where a sword has ever occurred, and the spear is almost always wanting; in Anglo-Saxon cemeteries, on the contrary, every free man has his spear laid beside him, whilst the head of each village has his sword. The axe, if the celt is to be so considered, has never been found, though a few specimens of the flat axe-head have turned up. Why this should be I cannot understand, nor can I offer any conjecture how it happens that one person has been buried with some weapon, implement, or ornament, whilst others in the same barrow, and those persons evidently, from their position in it, of greater importance, have been laid in the grave without any adjunct.

The vessels of pottery which accompany an unburnt body are of a different type and make from those which contain the bones of a burnt body; they are of thinner ware, better baked and more profusely ornamented, the markings, which form varied patterns, usually extend over the whole surface, whilst in the cinerary urn, the ornamentation, generally made by impressions of twisted thong, is confined to the rim,

which is almost always over-hanging, or to that portion of the urn immediately below it. The cinerary urns appear to have been made especially for sepulchral purposes, whilst some of those which accompany unburnt bodies may very possibly have been originally domestic vessels. They are often of elegant shape and very tastefully ornamented, sometimes having projecting pierced ears, probably to suspend them by, round the neck. I have never seen any glazing on them, and indeed, though made with great skill, as far as shape is concerned, the clay has not been well worked, and they have scarcely ever undergone sufficient baking. The larger vessels, and all the cinerary urns, have quantities of broken stone mixed with the clay. People have been accustomed to talk of them as sun-baked; this, however, is a mistake, they have all undergone the action of fire.

The urns which accompany an unburnt body have been considered, and with great probability, I think, to be vessels for containing food or drink for the use of the departed on his journey to another home. The North-American tribes deposit with the dead a bag of provisions for that purpose, as they also bury with them their arms and ornaments, and we may well suppose the Britons to have used a similar custom and with a like object; nor should I be disposed to deny the same use to the urns which are associated with a burnt body, but which do not contain the bones. Over the body or bodies (for several are sometimes found together) has been raised a mound, similar to that which covers the burnt bodies. These generally are placed upon high ground, often on the ridge of the hill or just below it, and we can scarcely avoid the thought that, as the arrow was laid by the hunter-warrior's side, or the necklace was hung round the neck of her whom in life it adorned, for use or ornament in another world, so the chief was laid where his eye might range over the valley where he had ruled, or over the hills where the

boar and stag had been the frequent victims of his bow and spear. In some cases no mound seems ever to have been raised over the dead, at least I have known of many bodies being found, where there was nothing to account for its destruction, if it ever had existed; in many of these instances a natural swell in the land has been taken advantage of, which in itself answered the purpose of a mound. It is also likely that it was only over men and women of mark or position that the barrow was erected; and indeed had every one had such a distinction, almost the whole ground must soon have been covered with barrows. I know of two what may be called cemeteries, the one of burnt, the other of unburnt, bodies. In both cases the burials amounted to a very large number, and there was not the slightest indication on the surface of the ground that any interments had taken place, nor was any article, either weapon or ornament, found in any of the graves. Here we seem to have the burial-place of the ordinary mass of the population, who had been interred without any mound being raised to mark the place of their burial, and who may have been too poor to admit of anything being spared for their after use; though I cannot say this seems to me a probable way of accounting for the absence of objects in the graves. I have also seen many large collections of very small barrows, amongst which was one of large size. In the small ones I have never found the least indication of a burial; and I believe that they have covered unburnt bodies, laid on the surface, which from being so little removed from air and wet have gone totally to decay. In the large associated barrow one or more cists have been found, in many cases containing an urn. The whole system of burial seems to imply, as I before observed, a belief in a future state of existence, and that differing little from the life which had just closed. The man is buried with his dagger, arrow, knife, horse, or dog, and very possibly

with his wife and slaves; for that seems a natural way of accounting for the occurrence of other bodies, besides that which appears to have been the principal interment, and which have all been certainly laid in the grave at the same time. I know of an instance where a man of good stature and well-formed head had been buried in the centre of a barrow, with his weapons and implements, whilst round him were placed several bodies, the skulls of which were all of one and that a low type, and whose stature and frame showed them to have been persons of very inferior size and strength to their lord, for such it is likely was he who occupied the central position in the mound.

The woman was buried with her ornaments, and other articles. I found a female interment on Langton Wold, where in front of the waist were laid a jet bead, two sea-shells pierced for suspension, three cowrie shells unpierced, three small bronze-awls or stilettoes, and two bone implements of uncertain use, apparently the humble jewels and tools of a British lady; the one to add, in another life, some additional grace to the charms which had already captivated her lord, whilst he lived in the valley of the Derwent, the other to minister to his wants when he ranged over wider and better-stocked hunting-grounds than those he had left.

Associated with interments of burnt bodies have been found stones, marked with the remarkable concentric circles which have lately attracted so much attention. They have been engraved upon the under side of flat stones, covering the deposit of bones. I know of four cases in Northumberland, two in Yorkshire, and several other instances have occurred elsewhere. These emblems—religious, no doubt—have now been found from Argyleshire to Dorsetshire, and in Ireland, but not hitherto beyond the United Kingdom. Perhaps Northumberland has produced a greater number than any other district; this may, however, arise from the

fact that they have been there more carefully searched for than elsewhere. Their import is shrouded in mystery, nor can anything be certainly said in explanation of them, except that they are religious symbols; this their connection with burial, always a sacred rite, I think goes far to prove. As to the religion of the Britons, or their places of worship, we have very little evidence from existing remains. The custom of placing with the body in the grave some of the weapons or implements of the deceased, seems to point to a belief in a future state of existence, though it does not prove it, for feelings of affectionate remembrance might prompt the wish to inter with the dead some object which was intimately associated with him whilst living. I should, however, be inclined to attribute this practice to the belief that the deposited articles might be of use in another life; though why, in this case, only some persons were buried with implements or ornaments, and in all cases why only a very few of such objects have been placed in the grave, is difficult to account for. Could we feel certain that the urns which accompany the body contained food for the use of the deceased, we might argue, from this fact, strongly in favour of their belief in an after life; but that such was the purpose of these sepulchral vessels is only a matter of probability, though undoubtedly the probability is a strong one. As I observed before, we do not find in Yorkshire any of those large circles of stone, like Stonehenge and Avebury, which have generally been considered as places of religious and political assembly; nor have we the large series of standing stones, such as are found in many parts of the kingdom. It is the opinion of some archæologists that all these circles are merely places of burial, and that the number of barrows which are found around them is a proof of this. I confess I have become more inclined of late to this belief, for undoubtedly the smaller circles of stone or earth are merely the sacred



fencing around graves, and fulfil the same purpose as those which surround, in many cases, the base of barrows; and the large circles only differ in size, which does not imply any difference in purpose. On the other hand it may be said that the circles, like Avebury, having avenues or lines of stones in connection with them, are distinct from the ordinary small circles, which do not possess that peculiarity. And the fact that barrows are found in large numbers in their vicinity, may be said to be a strong argument in favour of their religious use for worship, for naturally around such a site the burial-places would gather, just as in Christian times they did round the church. There are, however, in Yorkshire, some circular erections which present all the features of places of assembly, either religious or political,—no doubt in those days scarcely to be separated. Such are the three remarkable circles at Thornbrough, near Tanfield, which consist of a mound of earth, within which is a platform, bounded by a ditch enclosing the area in the centre; through this mound and ditch are two wide entrances, opposite each other. Some of these features are such as would be found in a fortified place, as, for instance, the mound and ditch; but this has clearly not been their object in this case, and the broad platform and wide double entrance are both inconsistent with any plan for defence. Close by the circles are a number of barrows, which may be said to be in favour of their supposed religious use.

Standing stones occur in several places; sometimes in a group, as the Devil's Arrows, near Boroughbridge, sometimes singly, as the very large one in the churchyard at Rudston, in the East-Riding. What the purpose of these and similar stones has been, is not certainly known. I believe, but I have no very authentic account of such a discovery, that they have been found to stand upon a place of burial; and I think it likely that they do mark graves, and are monuments

of a like nature, though of a different plan, to the burial mounds. It would be well if some of them could be carefully dug round and under, and but for continued occupation in barrow-digging, I should have done this some time ago. In many cases a single standing stone is the last relic of a circle of such. I know of one in Northumberland now standing alone, but which I remember as forming part of a circle of six similar ones, its fellows having gone to make gate-posts and walls.

I think I have now exhausted all the topics connected with our British forefathers, and I fear exhausted your patience, too. I have endeavoured to be as brief as possible, consistently with not passing by anything which might tend to throw light upon their history. I have adhered strictly to observed facts, and laid those before you as accurately as I am able, and I now leave you to raise upon them whatever theories your imagination prompts; and in doing this I give you a most pleasant task, for what is more delightful than to theorize? The worst is, that the tree is so prolific, and that, too often, its fruit is rotten before it is ripe.

In conclusion, may I urge upon you all, and ask you to press upon those with whom you may converse upon this enchanting theme, the necessity to store up and to record all facts which come under your observation. Had the numerous burials and other discoveries which have occurred during the last fifty years been accurately recorded, we should have had such a mass of evidence that I think we might have arrived at very accurate conclusions upon many of the questions connected with the pre-Roman people, about which, at present, we know but little. And should any of you be so fortunate as to become possessed of anything belonging to these ancient people, such as their weapons, implements, or ornaments, you will do well to present them to your excellent Museum.

The CHAIRMAN invited remarks upon the topic which had been so learnedly and lucidly treated.

Mr. HENRY BRIGGS, of Wakefield, referred to the discovery of some blocks of timber in digging near a hill known as the Fairies' Hill, about two miles from Castleford. It was known that there had been a Roman encampment at Castleford, and it was his opinion this hill had been an outlook. The hill had formerly been surrounded by a moat, and in fact a man of eighty years of age, now dead, had told him that he recollected the moat being filled up. The blocks of timber he had mentioned might have been used in letting the water in and out of the moat. He hoped that this hill, as well as another called Law Hill, near Normanton, would be examined, to see whether they contained barrows or not.

Mr. BARBER said he had had his attention drawn to certain British remains which existed, to a much larger extent than people would at first sight imagine, on Baildon Moor. From what he had read, he believed the Baildon Moor remains would be found to give examples of almost every class of remains that Mr. Greenwell had referred to. They were the so-called Druidical circles; there were certainly certain entrenchments, there were barrows, and there were cairns. There were also a large number of ridges, which might very possibly be terraces on which corn had grown. He inquired whether Mr. Greenwell had, in his researches, found the remains of which he had spoken in close proximity to the villages of which mention had been made, and whether he could establish a sort of identity between the parties who dwelt in the dwellings and those who were interred in the barrows? This, he observed, would be a most interesting point at Baildon, for there we were in close connection with Roman remains—the Roman *Olicana* being at Ilkley; and he could not but think marks of a transitional character might be met with there by careful exploration, and that a most

important link might be illustrated between the Britons and the Romans in the occupation of these islands.

The REV. CANON GREENWELL said they nearly always found within half a mile of these barrows very abundant traces of habitation. That occurred so frequently that he could not have the least doubt they belonged to the same people. The people belonging to the fortified places and the hut circles were the people buried in these mounds. With reference to the mounds mentioned by Mr. Briggs, from what he had said they evidently seemed to be barrows.

ALDERMAN BROWN inquired whether the remains that had been found in these barrows belonged to the original or to the conquering race?

The REV. CANON GREENWELL said in the main he supposed they belonged to the conquering race. In reply to the other question, the Rev. gentleman said he supposed the remains at the top of Ingleborough to be really the hut circles he had described.

In answer to a question from Mr. Sewell,

Mr. GREENWELL said that amongst a large number of the barrows opened there were no traces of Roman art and of Roman influence; and although Mr. T. Wright ascribed them to Post-Roman times, there were no indications favourable to such a conclusion.

Mr. BARBER, in some very complimentary remarks, moved that the thanks of the meeting be tendered to the Rev. Canon Greenwell, for his very valuable and interesting paper. He suggested the importance of Bradford gentlemen directing their attention to these archæological researches, expressed his conviction that on Baildon Moor, and other little explored places in the district, there existed ancient barrows which might be examined with profit, and said that Mr. Greenwell would no doubt find great pleasure at any time in joining an

excursion of this nature, with a view to the examination of some of these ancient barrows.

Dr. EVANS seconded the motion, expressing a hope that the Philosophical Society would seek to induce Mr. Greenwell to visit the town again, and that the result of his future visit would be to add to our archæological knowledge of the district.

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ON THE FIRE AND CHOKE DAMP INDICATOR, INVENTED BY  
GEO. F. ANSELL, ESQ., OF THE ROYAL MINT. BY  
RICHARD REYNOLDS, F.C.S.

No apology can be needed in such a district as this for introducing the subject which forms the title of this paper, but I must disclaim any pretension to possessing superior information upon it. Having the pleasure of Mr. Ansell's acquaintance, I have agreed to become, though very imperfectly, his representative to-day, in order to bring his admirable invention under your notice. Dependent, as our national industries are, upon an adequate supply of coal, we are bound to consider the extraordinary perils which surround those who obtain it for us. Mr. Holland, one of the Royal Commissioners of Mines, has ascertained that explosions of fire-damp in coal mines cause 365 deaths per annum. Thus, we may say, that one life is lost every day throughout the year from explosions alone, but as this estimate was made two years ago, how much higher will be the figures that include the slaughter wrought by the late explosions at Barnsley and in Staffordshire.

Out of the 1,644 lives sacrificed in 1864 to our necessity for coal, being at the rate of one life for every 109,715 tons raised, we cannot but feel that the accidents resulting from explosion are the most terrible of all, from their suddenness and the wholesale destruction which they deal, and we shall

hardly divest ourselves of the unpleasant feeling that they arise from causes which ought to be preventible.\*

The subject will divide itself into two parts: Firstly, the scientific principles involved in Mr. Ansell's method of detecting foul air; and, Secondly, a description of the instruments which he has invented, and the way of using them.

And here let me say a word for the claims which abstract science has upon the attention of those who call themselves "practical men," because they ignore science until the day of its fruition has arrived. But just as certainly as a tree must pass through various stages of growth, yielding leaves and flowers before its ultimate object of bearing fruit be accomplished, so is it an ordinary necessity that a knowledge of the laws governing matter shall precede the application of those laws to industrial improvements. It becomes, therefore, the interest of those who look only to technical results to encourage the cultivation of that higher science which is one essential to the production of those results. Professor Tyndall, speaking on this subject, has referred to the steam engine, electric telegraph, &c., and he goes on to say: "Remember that these are but new things; that it is not long since we struck into the scientific methods which produced these extraordinary results. We cannot for an instant regard these as the final achievements of science, but rather as an earnest of what she is yet to do. They mark our first great advances upon the dominion of Nature. Animal strength fails, but here are the forces which hold the world together, and the instincts and successes of man assure him that these forces are his when he is wise enough to command them."

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\* The official returns of accidents to persons employed in coal mines for the years 1865 and 1866 have been issued since this paper was read.

	1865.	1866.
Lives lost by accidents in England, Wales, and Scotland ..	984	1,484
Persons employed per life lost .....	321	216
Tons of coal raised per life lost .....	100,519	67,877

Our subject may be said to have its historical beginning in the observation by Priestley, that when gases were passed through red-hot earthenware tubes, they penetrated and escaped through the walls of those tubes, whilst the gases of the fire passed inwards. The permeability of red-hot metal tubes to gases, is a fact much more recently observed.

In 1825, Döbereiner observed that hydrogen kept in a cracked glass receiver over water escaped by degrees into the surrounding air, whilst the water rose from two to three inches within the receiver.

About the year 1833, Mr. Graham, the present Master of the Mint, investigated and determined the laws governing the intermixture of gases. This process of intermixture is termed *diffusion*; and as the cohesion of the particles of a gas is very small, diffusion between different gases takes place readily. Thus, if atmospheric air and coal-gas (fire-damp) be brought into contact, they readily mingle, and during this admixture the particles of each are travelling at a uniform speed peculiar to that gas. This speed remains the same whether the gas diffuses into a vacuum or into a vessel filled with another gas. The specific gravity of chlorine is thirty-six times as great as that of hydrogen, and yet, when these gases have once been mixed, they will never separate again. More than this, when a bottle filled with chlorine is connected by a long narrow tube with another containing hydrogen, and the latter placed uppermost, a short time suffices for the passage of a part of the heavy gas upwards and of the light gas downwards, until both bottles are filled with a similar mixture.

The diffusion of gases is shown very satisfactorily by the following experiment: A long glass tube, of the diameter of an inch, has one end closed by a plate of plaster of Paris; it is filled with coal-gas, and supported in a vessel of water, when the water begins to rise at once, and in a few minutes

stands three or four inches higher within the tube than it does outside. Could we have observed what took place in the pores of the plaster of Paris plate, we should have seen the particles of coal-gas passing *out* of the tube and those of air passing *into* it, but the speed at which the coal-gas moved would be much greater than the speed of the air. The ultimate product within the tube is atmospheric air and water. If hydrogen be substituted for coal-gas in a similar experiment, the water will rise in the tube twice as fast and to twice the height than it did when coal-gas was used.

Graham's law of diffusion may be shortly stated thus: "Gases diffuse into each other, or into space, in an inverse proportion to the square root of their densities." By this law a light gas diffuses rapidly, whilst a heavy gas diffuses but slowly. Coal-gas (light carburetted hydrogen, or fire-damp) represents a light gas, and carbonic acid (choke-damp, or after-damp) is a heavy gas, diffusing at only half the rate of common air.

The influence of gaseous diffusion upon our atmosphere is all-important. By it the noxious gases resulting from the respiration of animals and decay are prevented from accumulating at any spot.

We now reach the second division of the subject, being the application of the foregoing. Mr. Geo. F. Ansell has devoted many years of anxious research to the adaptation of instruments capable of applying the laws of gaseous diffusion to the detection of fire-damp in coal mines, and his instruments represent an analogous position to the safety-lamp of Davy, since both have resulted from the logical application of a known law.

A thin pellicle of india-rubber, though quite impervious to the passage of fluids, permits the free diffusion of gases, and Mr. Ansell's earliest instrument, which was made about four years since, consisted of a balloon of this material,



which, when expanding, rang a signal bell. This form of apparatus was quite successful. I shall take the description of the apparatus now used from an article in the *Chemical News*, of January 11th, 1867, because having Mr. Ansell's expression of satisfaction with the accuracy of that account.

“Mr. Ansell proposes to use an instrument of which fig. 1 is a sketch. It consists of an iron funnel provided with an iron

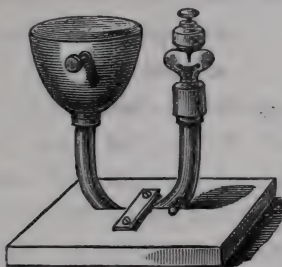


FIG. 1.

U-tube, the end of which is closed by a piece of glass tube fixed in brass, to which one pole of a battery is attached; the upper part of this glass tube carries a brass collar, through which passes an adjusting screw, to the lower end of which is fastened a piece of copper wire with a platinum point. Mercury is poured into the iron funnel till it rises in the glass tube to a convenient height. This mercury is allowed to find its level by the opening of a valve, when setting the instrument. The septum is a tile of Wedgewood's ware, and closes the open part of the funnel, good sealing wax being the best cement for securing it in its place. The other battery wire is connected with the instrument, so that, if diffusion take place, the mercury is pressed up against the platinum point, and thus communication is established. Mr. Ansell has found that this instrument gives warning in four seconds if the mixture of gas be still below the point of explosion; but, by adjusting the point, so that there is not more than the thickness of a shilling between it and the

mercury, a dangerous irruption may make itself known in two seconds. A source of great danger is that state of the pit which arises from the gradual bleeding of gas from the coal. As one walks in a pit one hears a continual click, somewhat like the noise of a cricket. In some pits this may arise from the settling down of the shale and cracking of the coal, but the experienced ear soon knows the difference. Should any obstruction arise to the ventilation, this bleeding very gradually raises the atmosphere from zero (the point of purity) to the point of explosion; or it may be that a gradual fall of the barometer admits of the oozing out of gas either from a goaf or from the mass of coal, and this, although very minute, may be to such an extent as to render explosive the whole air of a pit, if the ventilation be not very good. There are parts of the pit where gas may so accumulate in half an hour; others where it may be two hours, and again others a whole day, in rising to a dangerous mixture. To meet such cases, Mr. Ansell used, in the first instance, an india-rubber balloon; but this, although perfectly good for its purpose, was too fragile. Therefore, he has abandoned that plan, and he now uses white Sicilian marble, and, by regulating the thickness, avoids the evil of effusion to such an extent that he can, and does, in the pit, practically show these gradual accumulations. Mr. Ansell has found that by replacing the Wedgewood ware tile (in fig. 1) with marble of a quarter of an inch thick, he can show the presence of an explosive mixture of fire-damp and air which has been half an hour in forming, or by using marble half an inch thick, he shows if it has been two hours rising from zero to the explosive point. In all such cases, notice, if it be so desired, may be given before the mixture becomes explosive, the warning being continued for a considerable time, even if the atmosphere does not become more foul. It must, however, be understood that the very circum-

stances which admit of the air becoming "fouled" to the extent of ten per cent. also admit of its going on till fifty or more per cent. has been reached, always remembering that these instruments are to be fixed high up in the roadway or goaf, and that the gas accumulates there notwithstanding the law of diffusion. It is no uncommon thing to find thirty per cent. of gas next the roof, at six inches lower twenty per cent., and at fifteen inches no gas at all. The cause of this will be discussed on some other occasion. It is proposed to fix the instruments side by side, one for *sudden* and the other for *slow* accumulations, in pigeon-holes, being clear all through, so that the gas can surround the instruments or sweep over them; for the gas as it occurs in the pit is very curious in its habits, and, from causes too minute to enumerate here, it 'goes away' from a spot with very little 'disturbance.' The pigeon-holes being formed in iron posts would protect the instruments from falling roof, &c., while grooves may be cast in the sides of these posts for the telegraphic wires. It has been objected by some that these instruments would cause greater destruction of life than now obtains; but these persons forget that they are not intended to displace other means of safeguard. They are simply proposed as additional means of knowledge. For the indication of carbonic acid Mr. Ansell makes a necessary alteration, which will be seen in fig. 2. This hardly needs

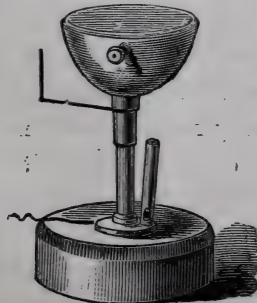


FIG. 2.

description, for it will be seen at a glance that the circuit is completed by the rising of the mercury to the wire within the precincts of the closed chamber formed by the neck of the funnel, and is adjusted for use by turning the base on which it stands, when a cork rises against a leather bag, and presses the mercury up to the required height. Whether marble will stand long without disintegration by carbonic acid has to be determined; if not, it can be replaced by another septum. This instrument is proposed for use in those mines where carbonic acid becomes a dangerous substance for the miner. It has been sought by the French wine growers as a means of telling the time of the commencement of fermentation, and it seems probable that the English brewers will use it for a similar purpose. In the event of fire-damp being known to exist, either when found by the fixed indicators or by the safety lamps, Mr. Ansell proposes for the use of the miner, the manager, or his deputy, an aneroid indicator, described in detail at page 280, vol. xii., of the *Chemical News*. This is not used for the detection of gas in the pit. The intention of this particular instrument is that it shall be used to determine the amount per cent. of fire-damp or carbonic acid gas where they are known or suspected to exist; and for these purposes it must be used rigidly according to the instructions given with it, not according to the fancy of the user *or as he thinks it should be used*. It must be taken, with its brass cap still on, into the neighbourhood of the suspected atmosphere, and allowed to remain there till it has acquired the temperature of that place; this usually requires a few minutes (say five). The valve must then be opened to allow it to find the true zero of that altitude. Then the valve must be closed, and the index watched for a few seconds to see if it be stationary, and if it be so, then the brass cap must be removed, and the indicator held by its handle in the suspected place for the time specified on the instrument—about one minute.”

The rise of the indicator is noted and compared with a table giving the per centage of coal-gas. If we have to determine carbonic acid, the fall of the indicator is compared with another table to ascertain the per centage present.

The following results have been obtained in the presence of experienced miners by the aneroid indicator :—

The aneroid indicated 1·5 per cent. of fire-damp. The Davy lamp gave no indication.

The aneroid indicated 3·0 per cent. of fire-damp. The gas could be detected by the Davy lamp, which gave a small pale blue cap of flame.

The aneroid indicated 6·0 per cent. The Davy lamp did not explode, but its flame elongated greatly.

The aneroid indicated 8·0 per cent. The Davy lamp exploded feebly.

The aneroid indicated 10·0 per cent. The Davy lamp exploded fiercely.

In the words of a competent critic, “It is impossible to conceive a more refined application of science than this, nor one that will be found of greater practical utility, as indicating the presence of fire-damp in collieries, before it becomes dangerous from accumulation.”

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In a short discussion which followed the reading of the communication,

Mr. BRIGGS, of Outwood Hall, said the instrument showed very readily the quantity of gas which might be present in a coal mine. Davy's lamp was sometimes called a safety lamp, but it was not a safety lamp. It did not indicate the presence of gas. Stephenson's was a safety lamp, because the light went out when the gas got to a certain point, and the men were then warned to leave their work. Stephenson's lamp was rather more expensive than the other. Many of the accidents in pits were caused by the improper and careless conduct of the

workmen in exposing the lights to danger, perhaps in efforts to light their pipes when the lamp was locked. Mr. Briggs cited some cases in proof of the statement, and then expressed his gratification with the results presented in the little instrument before them of the ready detection of fire and choke-damp. He begged to propose that the best thanks of the society be given to Mr. Reynolds for bringing the apparatus before them.

Mr. L. MIALL said that he had great pleasure in seconding the motion, for he felt the company were deeply indebted to Mr. Reynolds for his very lucid explanation of the scientific principles of this new invention.

The resolution having been carried,

Mr. REYNOLDS acknowledged the vote in suitable terms, observing that the successful illustration of the abstract principles of science in such an invention was a fact which well deserved their recognition, and ought to teach them that abstract science was as essential as applied science.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SEVENTIETH MEETING, HELD IN THE  
ROOMS OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF HALIFAX,  
ON WEDNESDAY, JULY 17TH, 1867.

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JOHN WATERHOUSE, Esq., F.R.S., VICE-PRESIDENT,  
IN THE CHAIR.

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The PRESIDENT having briefly welcomed the Members of the Society to Halifax, and expressed a hope that their Meetings would be held oftener there than they had hitherto been of late years, called upon the Rev. John Stanley Tute, of Markington, to read the first Paper.

THE GEOLOGY OF THE COUNTRY NEAR RIPON. BY THE REV.  
JOHN STANLEY TUTE.

The city of Ripon is built upon a thick bed of Glacial drift, which lies in a trough, between the Magnesian limestone and the New red sandstone. This drift is to the geologist particularly interesting. But before I proceed to speak of the manner in which, apparently, it was deposited, it will be well first to describe the older formations upon which it lies: and in doing so I shall take them in a descending order.

The most recent of these is the *New Red* sandstone. This lies to the east of Ripon, and rises into a gentle hill near the

railway station, thence it dips eastward at a very small angle, and forms the greater portion of the vale of York. It is commonly a fine grained red sandstone; though sometimes it is of a yellowish-white colour, as at Rainton. As a building stone it is somewhat perishable. It is entirely devoid of fossils, but contains beds of gypsum, about a mile and a half to the north of Ripon, on the west side of the river Ure. These consist of layers of grey and white gypsum, alternating with seams of red sandy clay, and are remarkable on account of their contorted stratification. Here and there the gypsum is of a pale green tint, which is perhaps due to the presence of a small amount of copper.

*The Magnesian Limestone* lies below the new red sandstone, and rises towards the west at a gentle angle, forming a series of low hills running in a south-easterly direction. The general thickness of this formation is about 250 or 300 feet. There are many quarries and out-crops in the neighbourhood of Ripon, from which a very good idea of the formation may be gained. The greater portion consists of soft porous limestone of a pale yellow tint, with occasional beds of hard blue limestone, as at Quarry Moor and Wormald Green. In an old quarry in Whitcliffe Lane there is a bed, which exhibits an oolitic structure. At Wormald Green one of the thin clay partings between the beds is strongly impressed with ripple markings. In another quarry near, and somewhat lower in the formation, there is a bed of about the thickness of a foot, consisting of broken fragments of limestone, mixed with marl, above and below which the beds are hard and compact. This seems to indicate a temporary elevation of the floor of the Permian sea, bringing the deposit within the influence of the waves by which it was broken up into fragments and re-deposited. The ripple markings and oolitic structure indicate also that the deposit was not made in deep water, but that the sea



bottom was more or less under the influence of tidal and other currents.

Towards the lower part of the formation the limestone ceases to be laid in a smooth and even deposit, the beds are of a darker tint, become lumpy and twisted, and have the appearance of having been formed under the influence of innumerable small eddies, and may, perhaps, correspond in geological age with the botryoidal limestone of the county of Durham. Here occur, in a quarry near Wormald Green, certain organic remains which have all the appearance of sponges. When broken they exhibit the sparry cavity so characteristic of this formation. And we may, perhaps, infer from this, that most of the smaller cavities have arisen from the decay of organic remains. At a quarry near Aldfield, and at another at Well, occurs a bed of hard blue limestone, containing fossils, apparently of the same age as the marl states of Durham. The fossils occurring at Aldfield, are *Terebratula elongata*, *Spirifera undulata*, *Camerophoria schlotheimi*, *Streptorhyncus pelargonatus*, *Strophalosia morrisiana*, *Producta horrida*, *P. latirostrata*, *Bakevellia antiqua*, *Axius obscurus* (small), *A. schlotheimi*, *Monotis radialis*, *Acanthocladia anceps*, *Fenestella reteformis*, septa of *Nautilus frieslebeni* and a small univalve. At Well, *Producta horrida* occurs abundantly.

As a building stone, the Magnesian limestone is too easily affected by the weather to form a good material for outside work; as, under the influence of frost, it breaks away in flakes, or crumbles into dust, leaving only the sparry veins standing out with deep intervening hollows. For inside work many of the beds are admirably fitted, from the ease with which they can be wrought and the beautiful colour of the stone. When used for mortar, it sets with extreme hardness. For agricultural purposes it is less valuable, as it is too caustic to allow a large amount to be used at once.

*Red Grit.*—Immediately below the limestone, and unconformable to it (as may be seen at Knaresborough below the castle), is a bed of coarse red sandstone, with respect to which there is some doubt whether it should be assigned to the Permian or Carboniferous formation. The evidence seems to me certainly in favour of the latter formation; as the red beds lie conformably and pass insensibly into the whiter beds below, which are of acknowledged carboniferous age. It caps most of the hills westward as far as Pateley; and out of the lower beds the ancient sea-cliff of Brimham has been formed.

The upper beds usually consist of red flaggy grits, lying upon a softish red or purple sandstone. Upon the surfaces or sides of the blocks of stone, and filling up the joints, are frequently sheets of calcareous spar, indicating the former presence of the Magnesian limestone, now removed by denudation. The lower beds are harder, and are succeeded by other beds of white or brown grit.

In some beds the grit is almost made up of rounded pebbles of quartz; it also contains pieces of drifted wood, and shale from older formations.

Quarries of this grit occur along the western edge of the magnesian limestone, at South Stainley, Scarah, Kettlespring, Cayton, Shaw Mills, upon the ridge near Grantley Lake, and at Fell-beck. It is largely quarried near Harrogate, at Birk Crag.

*Cayton Gill Beds.*—Beneath the rough grit is an interesting formation consisting of three beds. The uppermost consists of thin flags full of the remains of Encrinites. The second abounds with the casts of Brachiopoda and other organic remains. The lowest is an exceedingly hard and fine sandstone, mottled with carbonaceous markings, in which the most common fossil is *Bellerophon costatus*: it contains also pieces of drifted wood. The three beds occur not far from Fountains Abbey, on the side of the road to Sawley; the two

upper ones at Cayton Gill; in most other cases, however, only one bed is traceable. The formation extends westward as far as Pateley, northward as far as Sawley, and southward as far as Hampsthwaite; I am not able to say how much further it extends in these several directions, but I am inclined to think that it does not reach much further to the north or south; and that it is only a local deposit in a narrow arm or estuary of the carboniferous sea. The fossils most frequently found, but which in many cases are represented only by casts, are *Orthis resupinata*, *O. michelini*, *Producta semi-reticulata*, *P. aculeata*, *Spirifera lineata*, *S. trigonalis*, *Spiriferina octoplicata*, *Chonetis hardrensis*.

*Arenaceous Flags and Coal Measures.*—Immediately below these beds is a series of shales, flags, and sandstones, of considerable thickness; all more or less stained with iron. Some of the upper beds of flags contain many various and interesting shore markings, tracks of Worms, Mollusca, &c.

In the lower beds there are one or two thin seams of coal, but they are not of sufficient value to pay the cost of working. Several shafts have been sunk in various places, but they have all been abandoned as unprofitable.

The whole series rests upon the Scar limestone.

The highest point of the district under consideration is at Brimham, from which three ranges of hills sink down in an easterly direction, until they are crossed by the low range of the Magnesian limestone.

The valleys which lie between these hills owe something of their form to the forces of elevation, which have thrown the strata into folds and waves flowing from north to south, interrupted at Scarah Bank and Killinghall by two faults: but most of their configuration is due to denudation. As they ascend from the lower districts they grow narrower, and more picturesque, and are generally well wooded. One of the prettiest of these valleys is the one at the head of

which is Grantley Lake. At this point there has been a violent upheaval. For at the south side of the Lake, in a quarry on the top of the hill, the rough grit is seen to dip  $7^{\circ}$  to the west. About sixty yards to the east of this, the arenaceous flags are thrown up, and dip at an angle of  $37^{\circ}$  west. Between the quarry and the lake there is a precipitous descent of two hundred feet, down which the rocks have been thrown in wild confusion, which is now partly concealed with the overgrowth of trees. Although all the valleys in this district were to some extent modified during the glacial period, and in the time which has elapsed since, it seems to me that their general forms were pretty much the same before the glacial period as they are now, and that their denudation has been going on at least from the period of the lias. The Oolitic hills of east Yorkshire were not improbably derived from the slow disintegration of the hills of west Yorkshire. As these rose slowly from the sea, their upper parts would be exposed to the action of rain and rivers, their sides and ends to the action of the waves. In the elevation of these hills there were probably many pauses, the result of which would be to produce a series of raised beaches with intermediate slopes and cliffs, such as are readily traceable along the sides of Wensleydale; and upon which there would at that time be left masses of sand, shingle, and boulders, such as are now found on any rocky coast. The amount of material which has been carried away by the denudation of the deposits under consideration, is at least equal to that which is now left in these districts. In Nidderdale, between Brimham and Guy's Cliff, the whole series has been cut through, so that at the bottom of the valley near Dacre the Scar limestone appears.

One reason for thinking that these valleys were excavated *before* the glacial period is this: upon the Magnesian limestone, and partly upon the red grit, there is a bed of glacial

drift of considerable thickness, sometimes amounting to fifty feet, which has been partly denuded since its deposit, allowing the limestone to crop out here and there, showing sides more or less precipitous. Now it is quite clear that if these valleys had been excavated since the glacial period, the gravel would only have remained as a capping to the limestone, and not, as it does now, have covered the *sides* of the limestone cliffs, as well as their tops. This bed of glacial drift is composed of sand and clay with rounded pebbles of Carboniferous limestone and the harder sandstones of the coal measures. I have found also once or twice pieces of granite and greenstone. The stones are of all sizes from two or three feet in diameter to the finest sand, and are commonly confusedly mixed together; though the lowest deposits seem always to contain the largest portion of Carboniferous limestone. Generally these deposits are horizontal; but, here and there, there are patches of sand, several feet in thickness, which occur in pockets in the gravel. Where the beds have not been subsequently disturbed the *limestone* pebbles are all polished and covered with fine sharp scratches. Upon the pebbles from the other formations I have not been able to discover any scratches, though many of them are worn quite smooth; but the texture of the stone is such that it is very unlikely that they should have retained any of the scratches which they might once have received.

To the east this bed of drift passes imperceptibly into the general superficial deposits of the vale of York, but on the west its outline is sharp and definite, scarcely ever extending more than half a mile beyond the boundary of the magnesian limestone. The drift which lies still further westward is perfectly local, derived from the beds immediately below; whereas this seems to me to have been brought from the upper parts of Wensleydale on the drifting ice of the glacial period, and deposited upon the top of the submerged ridge of

magnesian limestone. And I would venture to suggest that these masses of drift are the sands and shingles of those ancient shores, left in the oolitic times, and swept down during the great submergence of the glacial period.

Since that period these gravel beds have been much denuded, and their materials re-deposited; the manner of which seems to have been this: as the sea bed began to rise these deposits came under the influence of strong currents, which, taking their course along the submerged valleys, then partially obliterated by the stream of drift which crossed their course, carried away the gravel from the lower parts of these valleys, and spread it in an even deposit eastward, leaving the present hills, as they at that time were just rising out of the sea, capped with thick masses of gravel, and scooping out of the sides of these gravel hills little valleys, which now run in a cross direction to the larger valleys.

Occasionally the underlying rock, as at Markington and South Stainley, is quite denuded, showing that strong tidal currents continued to flow along these valleys, until the land was gradually lifted out of their power. During this period the gravels of the Ure near Ripon, and at Wormald Green, were deposited. Those at Wormald Green seem to be the earlier, as they stand at a higher level than the Ure gravels. They rest upon the magnesian limestone, the surface of which, when uncovered, is indented with irregular grooves and pot-holes; the clear evidences of a wave-beaten shore. That they are re-deposited gravels, seems pretty clear, from the appearance of the gravels themselves; which are less coherent than the ordinary gravels, contain less clay, and are more regularly deposited. And what confirms this view is this, that *none* of the limestone pebbles exhibit scratches, these having been obliterated by the friction which took place during their re-deposit.

On the sides of the valley of the Ure, near Ripon, the gravels also have been evidently re-arranged. They consist of gravels derived from the glacial drift more or less mixed with red sand from the New red sandstone near; and seem to indicate from the manner in which they are deposited a set of variable currents, sometimes from the north, sometimes from the east, according as the drift gravels or the red sand prevail. The manner in which they are deposited seems also to show that the climate was still very cold, though the severity of the glacial period was gradually giving way. The beds of sand, gravel, and clay, are sometimes thrown together in contorted masses, and the edges of the interposed beds lie sharp against those within which they occur, as if they had been brought on drift ice, and thrown down into their present position as the ice melted.\* On the east side of the Ure one of these beds of sand exhibits a remarkable bend. It is a seam of sand which has evidently been deposited under water, and therefore horizontally; but it is now found not only inclined at a considerable angle, but bent in its course. Some strong force must therefore have been called into play to alter its primary condition. Such a force would be exerted by large masses of ice, moving down the valley, and ploughing up and pushing forwards the gravel beds below, which became elevated and bent, as they resisted the pressure behind them. These two ages of the drift and gravel are very distinct. In the period which followed, the land was raised to its present level; and here and there along the bottoms of the present valleys there were marshes and shallow lakes, the former presence of which is indicated by thin beds of peat lying from four to eight feet below the present level of alluvial

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\* SEE PLATE.

NOTE.—In the Geological Map the out-crops of the several strata are marked as follows: New Red Sandstone, two short parallel lines; Permian, a circle; Red grit, a triangle; Cayton Gill Beds, a cross; Flags, &c., a diamond.

flats, which have been formed by the gradual silting up of these marshes. Out of a small bed of peat at Markington, lying beneath four feet of silt, I have extracted hazel nuts, in some of which the form of the kernel was preserved.

The well-known and remarkable rocks, which lie upon the ridge of Brimham, consist of the lower members of the red grit. They do not appear to me to have been very much altered since the glacial sea ceased to beat against them. They form a cliff of about half a mile in extent, from the base of which a hill runs sharply down to the valley of the Nidd, which evidently once formed the bottom of the sea. At the foot of the cliff lie broken rocks which had been torn away by the violence of the waves. Many of the rocks are evidently water-worn, as if by the long-continued action of the sea. In one rock, not far from the Ape Rock, in particular, there is a small cave which has been hollowed out by the unmistakable action of the waves, which have left in the midst of it a little pillar round which they have in former ages furiously dashed.

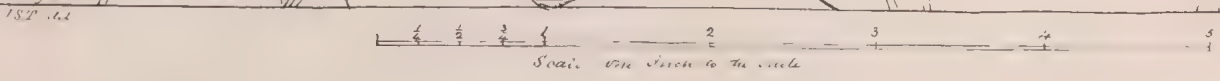
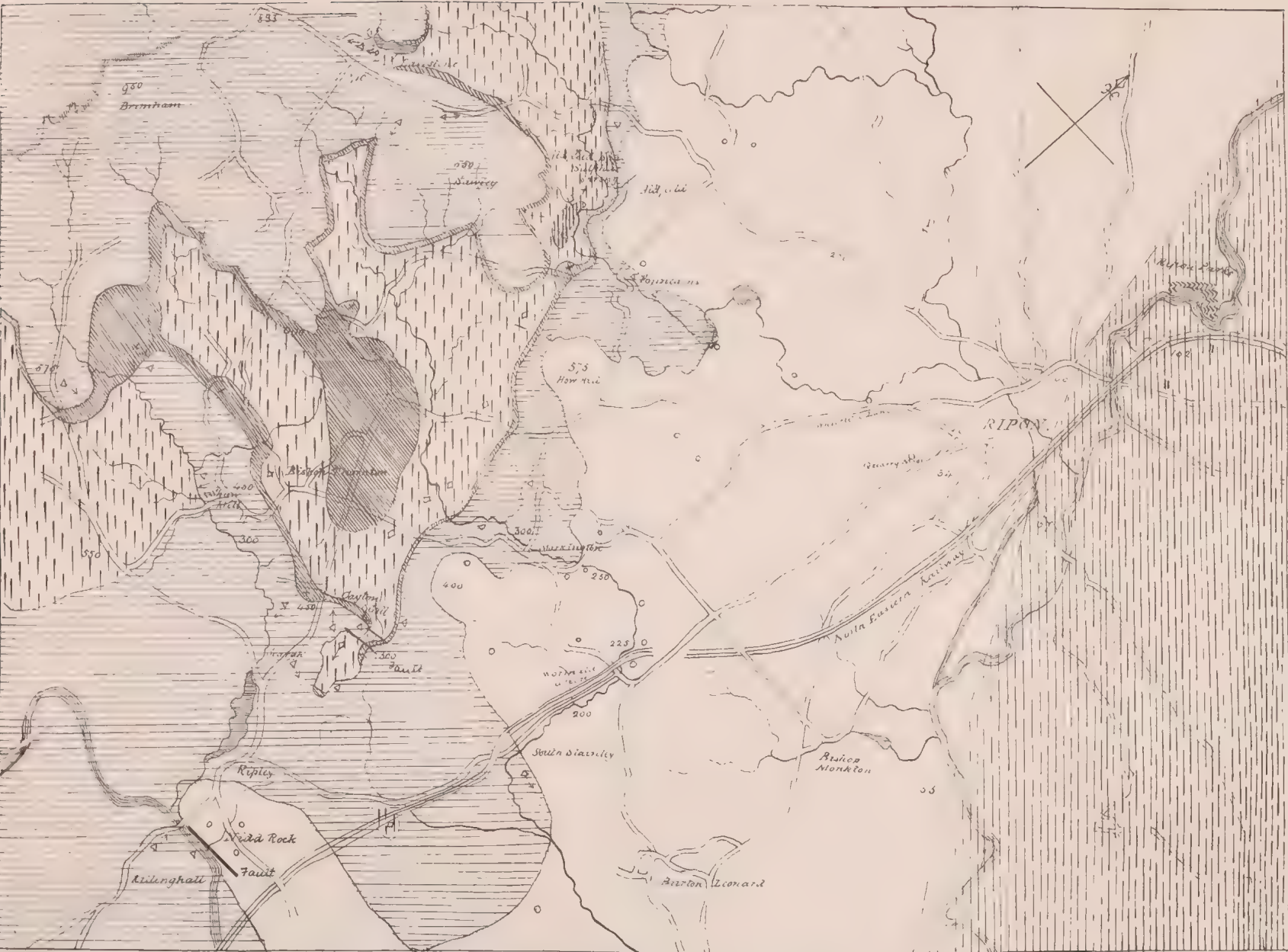
Some of the largest rocks are split across and across, as if the underlying strata had given way, or had been washed out, and these rocks had settled down upon the point of a harder bed below, and then the weight of the rocks had caused them to split into four.

The rocking stones and perched blocks have clearly been formed by the waste of the underlying beds, which happened to be softer or more exposed than these which remain, and which now appear in such singular situations. And it is worthy of notice that the very same thing is going on at this present time. The sea shore below Huntcliffe, near Saltburn, presents an appearance at low water remarkably like the moor at Brimham, with rocks perched upon others, and exhibiting forms remarkably like those which occur there.

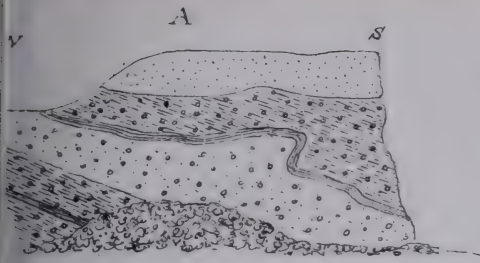
These are the chief points of interest belonging to the



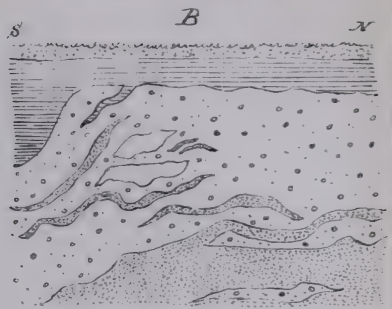
Geological Map of the Country round Ripon.



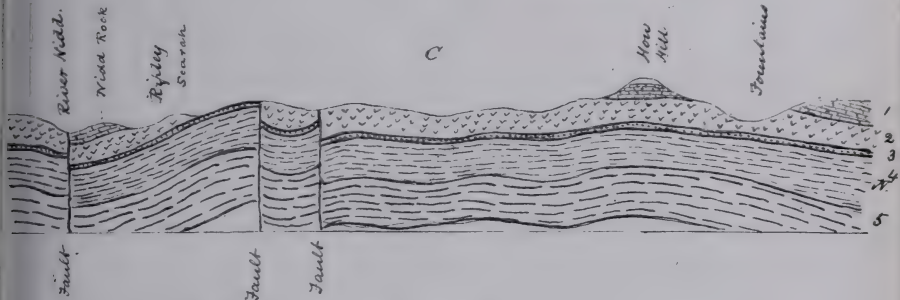




Gravel Pit near Ripon, No. 1.

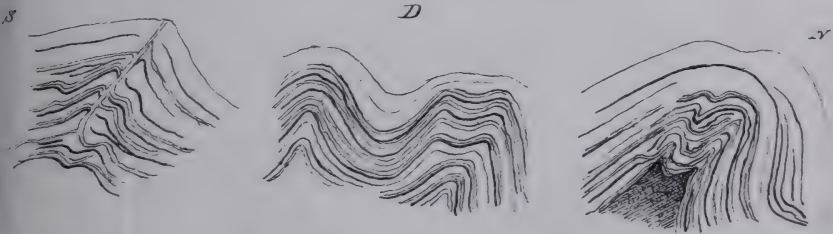


Gravel Pit near Ripon, No. 2.

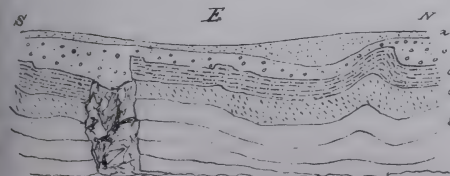


Section from Killinghall to Fountains.

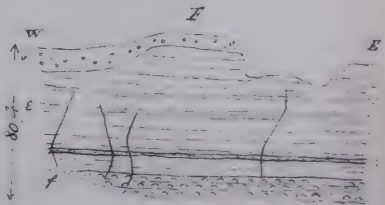
1. Magnesian Limestone, 2. Rough Grit, 3. Cayton Gill Beds. 4. Flags.
5. Flags and Sandstones, with thin beds of Coal.



Contorted Beds of Gypsum, Ripon Parks.



Magnesian Limestone Quarry Moor, Ripon.



Wallerthwaite.

10 feet



geology of the country in the immediate neighbourhood of Ripon, which have come under my notice. They are not any of them, perhaps, of any very great importance, yet they serve to fill up a little page in the general history of the earth in past ages.

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NOTES ON THE GEOLOGY OF PARTS OF YORKSHIRE AND WEST-MORELAND. BY T. MC. K. HUGHES, M.A., F.G.S., H. M. GEOLOGICAL SURVEY.

The observations on which these notes are founded were made when carrying on the geological survey of the district, and are now offered to your Society with the permission of the Director of the Survey.

I do not propose to give a detailed description of the district, but rather to call the attention of your Society to points of special interest, which may be visited in a summer's day ramble, or points of special difficulty, which require working out.

The general features of the country may be thus summed up: Ingleborough, Whernside, and Penyghent consist chiefly of Yoredale rocks, capped by Millstone grit, and resting on a great plateau of Mountain limestone, which slopes gently, with the slope of the beds, to the N.N.E. Under the southern escarpment of the limestone, and in the deep valleys of Horton-in-Ribblesdale, Crummack Beck, Clapham, Chapel-le-dale, and Kingsdale, we find different members of the Silurian series on the upturned edges of which the Carboniferous rocks lie. The Craven faults, of various ages, running nearly W.N.W. and E.S.E., bring down the Mountain limestone on the S. against the Silurian rocks, and again the higher Carboniferous, and even Permian, against the Mountain limestone. As we get near the Lune, a great system of N. and S. faults runs into these, connecting

them eventually with the Pennine system. Taking the rocks in ascending order, we have first:—

*The Silurian Rocks.*

As I have a paper in the press\* describing these beds in some detail, I will now notice only the more important points.

To the lower Silurian we must refer the Green slates and overlying Coniston limestone of Chapel-le-dale, Kingsdale, and Horton-in-Ribblesdale. The Coniston limestone and overlying Trinucleus shales of Sarley Beck and the Rawthey N.E. of Sedbergh, and of Helm Gill, near Dent, and the Coniston limestone and overlying Trinucleus shales and ash-like beds of Austwick. Professor Harkness has shown that the Green slates are on the horizon of the Caradoc sandstone. The Coniston limestone is generally allowed to be the equivalent of the Bala limestone, and the shales with Trinucleus, of Austwick, &c., occur in the same position relative to the Coniston limestone that the Trinucleus shales hold with respect to the Bala limestone of Wales and Ireland.

These older rocks were hardened, upheaved, and folded along axes running nearly W.N.W. and E.S.E. (*i.e.*, parallel to the Craven faults), and on their denuded edges the upper silurian rocks were deposited. The proofs of this may be well seen near Austwick, where, on the south side of Souththwaite farm house, there is, at the base of the Coniston Flag series, a bed of conglomerate, made up of fragments of the older series, and resting on shales containing Trinucleus and other marked Lower Silurian forms. The conglomerate occurs again just below Austwick Beck head, where it rests upon shales which I would refer to a lower part of the series than those on which it lies near Souththwaite. It is very calcareous, and in places is represented by a grey, coarse looking crystalline limestone. This is important, as in the next

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\* *Geological Magazine*, August, 1867.

valley, near Crag Hill, S.W. of Horton-in-Ribblesdale, there is no conglomerate at the base of the flags and grits, but there is a similar rough grey limestone resting on the close grained blue Coniston limestone and Shale. Unfortunately I could only find two species of Favosites, which prove nothing in this grey limestone; but they are the same as those which occur in the conglomerate at Austwick. The order of succession of the flags and grits above this is clear enough, and the series is characterised by well marked Upper Silurian forms, such as *Cardiola interrupta*, *Pterinea tenuistriata*, &c.

Upon such evidence I wish to return to the classification published by Professor Sedgwick in 1846, and say that, "on the evidence both of mineral structure and of fossils, we are compelled to separate the Coniston flags from the Coniston limestone and calcareous slates, placing the former at the base of the Upper Silurian series of the Lake district."\*

*The Old Red Sandstone and Carboniferous Rocks.*

The next question of great interest is, what is the base of the Carboniferous series? Along the cliffs from near Settle to Ingleton the base of the Mountain limestone may be traced resting with an almost unbroken line of junction on a planed-off surface of Silurian rocks. About Kirkby Lonsdale, Sedbergh, and many other places W. and N., thick masses of Old red, with its coarse drift-like conglomerate, tell of deep valleys filled with the *debris* of higher land. On the north side of the Howgill Fells, thick beds of red sandstone and conglomerates, alternating with more or less calcareous shales, are evidently the waste of neighbouring land, resorted on the sea bottom, where numerous corals, shells, and other forms of life flourished.

Near Horton-in-Ribblesdale, at Gillet Bræ, in Beecroft Hall plantation, and near Dove Cote, we have pockets of a coarse red conglomerate in the surface of the Silurian rocks,

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\* *Wordsworth's Guide to the English Lakes*, p. 223.

and the Mountain limestone, with its own peculiar thin beds and conglomerate, seems to lie on this with an even line, as it does on the Silurian rocks on either side. Fossils occur among the fragments of silurian, at the very base of the Mountain limestone. Corals seem to have grown in abundance among the loose stones and on the rocky sea bottom, but no fossil have I ever found in those pockets of Old red.

This will apply also to the larger patches near Kirkby-Lonsdale, Sedbergh, Kendal, and the foot of Ullswater, as far as we can observe them in those faulted districts. At any rate, we may say that the Mountain limestone never rests on an irregular surface; all the old valleys and minor inequalities having been filled with coarse conglomerate previous to the deposition of the Carboniferous rocks.

It would appear from this that we have in the Old red the remains of an earlier formation lying on the irregular surface of an old continent, and small patches were preserved in the deeper hollows when the carboniferous sea planed across it.

But, on the other hand, in Hebblethwaite Gill, near Sedbergh, we find the coarse red conglomerate succeeded by shales, grits, and earthy limestones; and in these shales a second bed of red conglomerate occurs, in every respect similar to that below. On the north side of the Howgill Fells, near Tebay and Shap, there seems to be a clear passage up from the coarse red conglomerate into finer conglomerates, sandstones, shales, and limestones. The shales and sandstones contain remains of plants and marine shells. On the whole, therefore, it seems most probable that, as the land went down in the early carboniferous period, the sea kept planing off everything up to the Lake mountains. Perhaps there was then a more rapid subsidence; at any rate, the sea crept up the hills, and found in the recesses great masses of *debris*, the result of sub-aerial waste. Some of these got covered up, and are still preserved; others were washed



out, and resorted over previous marine deposits, or on the bare sea bottom, and from these resorted beds there would be a passage up through the Lower limestone Shale to higher carboniferous beds.

This view will quite explain why we seem to have a passage in one place, and in another a sharp line between the Old red conglomerate and Carboniferous rocks.

It would appear probable, from the number and character of the corals and the plants imbedded in the earliest deposits of the period, that the climate was temperate or sub-tropical.

This will not affect the question next to be considered: whether the Old red conglomerate may not be an ancient glacial drift, as we might then, as now, have in temperate zones a thick glacial drift the record of previous climatal conditions.

Professor Ramsay first put forward the view that these conglomerates were of glacial origin, founding his opinion upon the following observations: (1). The manner of their occurrence in isolated patches in old valleys. (2). The character of the deposit, which is a coarse conglomerate, showing a very irregular accumulation. (3). The shape of the included fragments, which is very similar to that of the fragments of the same formations in the glacial drift; and, (4). The occurrence of scratched stones.

But we must remember that any sub-aerial or fluvial deposit, covered by an encroaching sea, must have that patchy character, that in its irregular accumulation, and the shape of the stones, it more resembles the gravel drift of the valleys than the Boulder clay; and the origin of this gravel drift is, at any rate, doubtfully glacial. I think we must be cautious, too, about referring the scratches on the stones to glacial action—though undoubtedly they are like those found in the true drift, and the shape of the stones is also the same. Yet they have never been found except

where we have other evidence that the beds have been much disturbed. We see, where the red conglomerate can be examined close to the great faults, that the beds do not get crumpled up, as in the Silurian or any even bedded homogeneous rocks, but that, because the hard and included pebbles resist more than the soft matrix, the whole mass re-adjusts itself to suit its new position, the included pebbles being often scrunched against one another, scratched, and broken.

In one place I found, inclined at a small angle to the bedding, a face of jointage, on which were striæ similar to those on the scratched stones, running across the soft matrix, and included fragments alike. This, of course, leaves it open to suppose that the old red conglomerate may be the wreck of a glacial drift; but as we know of no gravel made up of fragments of similar rocks, which are not directly or indirectly derived from glacial deposits, the arguments from the shape of the stones, &c., cannot, in the present state of our knowledge, go for much.

One point of great interest is brought out by this kind of examination of the base of the Carboniferous series. It is the enormous break between Silurian and Carboniferous times. The lowest and variable beds of the upper series rest on the upturned edges of all the formations from the Skiddaw slates to the top of the Ludlow rocks, while the Lower old red, which in Wales is conformable to the Tilstones, is not seen in this part of the country, having been, probably, denuded away. That is to say, we see that formations equalling in thickness the whole of the sedimentary deposits from the base of the Carboniferous to the present time were removed previous to the Carboniferous period; and from the nature and position of the unconformity between the Upper and Lower silurian rocks, the greater part of this denudation must have taken place in the unrepresented time between the Ludlow and Old red conglomerate of the Lake District.

The break between the Trias and Permian seems hardly equal in amount to many of the subordinate unconformities in the palæozoic rocks.

May we not, therefore, reconsider the evidence upon which one of our greatest divisions, that into primary and secondary, is founded.

The great change in the Fauna, as a group, and the new conditions implied by the appearance of such rank vegetation, should weigh more than the persistence of a few genera through Silurian and Carboniferous times, and, coupled with such clear stratigraphical evidence, force us to draw our broadest line at the base of the Old red conglomerate of Westmoreland.

#### *The Glacial Drift.*

I will now skip over a great interval, and offer a few remarks upon the Glacial period, and some phenomena to be referred to still more recent times.

There would appear to be three drifts, distinguishable in sections, though it is often impossible to trace the boundary between them on the surface.

The lowest is a stiff blue or brown clay—sometimes so hard that it is difficult to pick a bit out with a hammer—full of stones which are mostly rounded, the larger number striated, not transported from any great distance, though not always derived from rocks in the immediate neighbourhood. The only places where I feel sure of it are in positions where it would be in part protected from glaciers flowing along the present valleys; as, for instance, under a great thickness of the lighter drift in the deep gorges coming down from the Howgill Fells, on the north of Sedbergh, and in the deep valley between Lupton High and Farleton Fell, west of Kirkby Lonsdale.

Next there is the common clay drift, which is generally of a looser, more stony character than the last, hangs on every

hill side, and runs out in half-obsolete moraine-like masses in every valley. It varies according to the nature of the rocks on the hill sides along which a glacier, flowing in the country after it had assumed nearly its present configuration, must have come. To trace one, for instance, a great glacier coming down from Ravenstonedale, between the Howgill Fells and Wild Boar Fell and Baugh Fell, crossed the end of Garsdale, over to Dent, and was split on the corner of Holme Fell, where, perhaps, it scooped out the great hollow called Combe Scar; part went down the Barkin Beck, and part down the Dent and Sedbergh valleys; the hill range called the Riggs being a mere *roche moutonnée* in its path. We can trace its action all along the north side of Holme Fell, carving out deep grooves which first coincide with the bedding, then, where the valley narrows, and the glacier was squeezed up, were cut oblique to the beds, and, at the lower end of the ridge, fairly turned over the corner into the valley of the Lune. When the rock has recently been bared, the smaller strivæ are found to agree with this. At the north-west corner of Holme Fell, we see them curving over in the same direction as the great grooves I have been describing. At the south end of Casterton Low Fell, the tributaries from the E. and N.E. forced the Barkin Beck branch of the glacier over the low end of the hill. Again, when there was a glacier coming down into the Lune valley from the N., the Sedbergh glacier must have pushed it out to the W., and, agreeing with this, we find the valley of the Lune cut far back opposite the mouth of the Sedbergh valley.

As the climate grew warmer, and these glaciers were receding, they left their *debris*, as moraine matter, scattered over the undulating country they once occupied. Now, of what is this composed? and how does the evidence we get from the rocks found in the drift agree with that derived from the shape of the country and the direction of the striæ?

If we draw a line from the north side of the Sedbergh valley, over Killington, down by Gatebeck, to Farleton Fell, just where, with a free hand, we should draw the outside boundary of a glacier sweeping out from that valley, we find outside that line, blocks of granite from Shap, of pink porphyry from Bretherdale, and other well marked rocks, which must have been transported on the glacier from the north. Within that line we have nothing but what might have come down the Sedbergh valley. Again, Baugh Fell and Wild Boar Fell are carboniferous, thrown down by a great set of faults against the Silurian rocks of the Howgill Fells, and so, as we might expect, the *debris* which represents the eastern moraines of the Ravenstonedale glacier is composed of Carboniferous rocks, while that on the western bank is composed chiefly of Silurian, while at the south end of Casterton Low Fell also, there is a considerable quantity of Carboniferous rocks in the drift. There are exceptions, of course, but they are not difficult of explanation when we remember that there is evidence of a still older drift than that of which we are now speaking; and that, during the period in which these valleys have been again partially cleared out, there was time for many great modifications. Moreover, we do not yet know where these great ice streams started from.

The third drift is the gravel drift of the valleys; something allied to the kames and eskers. In general composition it is exactly the same as the drift last described, except that it has but little clay in it; also, it contains very few scratched stones, and on those the scratches are nearly obliterated, as if by subsequent washing and rolling. It lies in terraces sloping more or less rapidly down the valley, or in mounds which look like the remains of old terraces. It never runs far up the hill sides, and as we get to higher ground we find it more irregular in occurrence and more clayey in composition, till often it is impossible to draw a satisfactory line

between it and the older drift last described. On the lower side we find terrace after terrace, till we get to the modern alluvium. Now, although it is quite possible that some of these terraces may be due to an older formation, a gravelly drift, planed off by the river, it seems far more natural and simple to suppose that we have here the records of a continuous fluvial action back to the Glacial period; for, as soon as the glaciers began to recede, the streams which flowed from them must have commenced their work, and sudden flushings must have resorted and carried down the mixed moraine *debris*, leaving it often on steeper slopes than the gentler flowing rivers of modern times can ever form.

In these gravelly deposits we often find deep hollows with no outlet, as for instance the curious hole known as Hollow Basin, or Devil's Punch Bowl, in Underley Park, near Kirkby Lonsdale, and others near the gardens at Underley; and, on a smaller scale, in several places north of Grimes Hill, and near Sedbergh. Looking at the hole in Underley Park, last year, Sir Charles Lyell told me that similar phenomena were produced sometimes by a glacier receding unequally, and so at one time depositing but little moraine matter on a given area, and at another time more, and so, by unequal deposition, hollows would be left. Another way Sir Charles said they have been sometimes produced was by the breaking off of large masses from the end of a glacier, which would take so long to melt, that the glacier would recede too far ever to fill the hole occupied by the fallen ice.

About a mile N. of Austwick, there are some very interesting points connected with glacial phenomena and subsequent denudation. Resting on the mountain limestone plateau of Norber, there are a number of large blocks of Silurian grit, some to twenty or thirty feet in longest diameter. These have been forced along from beds at a lower level in Crum-mack valley, and left often on a bare table of limestone.

Now, as every one must have observed who has walked over these limestone hills, the rock is jointed in all-directions, and the water which falls on the limestone, whether as rain, or as small streams, collected on the overlying Yoredale rocks and drift, disappears in the crevices of the limestone. The result is, that there are no streams running over its surface, and all the water which reaches it at any distance from the shale or drift boundary, is the rainfall on that particular spot. Well, this rainfall has been intercepted by some of the great Silurian boulders, and the result is, that the original face of the limestone has been preserved under them, while all around it has been eaten away by the rain water, and so the boulder stands on a small pedestal of irregular shape, according as the surface has been more or less protected from the splash and wind-blown rain. We can generally see under some part of these overhanging Silurian blocks, and there we find the limestone smoothed, polished, and strongly furrowed and striated down the valley. Thus we have the print of the old glacier stereotyped as it were in the solid rock, and one good fact clearly recorded to help us to work out the history of the past.

Another question which naturally suggests itself is, how much of the limestone has been thus carried away by the rain only, and of course the height of the limestone pedestals above the surrounding part gives us a measure of this. It appears to be generally from twelve to eighteen inches. Here, again, we get more data for determining the absolute age of some of these phenomena. Assuming the average periodic rainfall to have been constant, or at any rate to be determinable, and the quantity of limestone removed by a given quantity of rain water to be known, to find how many years have elapsed since this limestone was first exposed to sub-aerial denudation. This glaciation of the limestone plateau probably belongs to a late period of the great glacier which extended from Ingleborough to Penyghent. But, still

later, as the climate became less severe, the ice was confined to, and kept working down, in the small subordinate valleys of Crummack Beck and the Ribble, where, as in Chapel-le-dale, the *moutonnéed* surface of the rocks in the valley, the rock barrier at the end, so well insisted upon by Professor Ramsay as evidence of glacial action, and the half-obsolete moraines, all point to the continuance or repetition of similar action on a smaller scale.

One question is raised by an examination of the drift to which I think the above explanation of the glacial phenomena of our district will enable us to give at any rate a plausible answer. Why are there so many scratched stones in the older clay drift, when we find so few in the moraines of the modern glacier. Now to examine this question fairly, let us consider why there are few in the modern moraine. The stones are scratched by being crushed along against the rocky bed and one another in or under the glacier. Therefore, as a large proportion of the stones are carried down *on* the glacier, and never get *in* or *under* it, they never get scratched at all; and, in the next place, as there are always streams in, and issuing from, the end of the glaciers, which roll the stones and obliterate the scratches, a large proportion once scratched get their scratches worn away. Now, under what conditions should we get least of these two causes which reduce the proportion of scratched stones? If we have an ice sheet, and no land above the glacier, there can be no *débris* to fall on to it; or, if the land is so far that all the *débris* has fallen into the crevasses, all the detrital matter being in or under must be liable to be scratched. Also, in such a case, the water which flowed from the end of the ice sheet, or of glaciers so large as to be almost continuous across the country, would collect and flow in the hollows and valleys and the moraine matter left at the end of the small hills, or on their flanks, would escape its action. The nearer the



glacier approached these conditions, the larger the proportion of scratched stones we might expect. Now we do find evidence of the great extent of the ancient ice streams, and, moreover, see, as before noticed, that the oldest drift of which we know anything in this district, and which contains the largest proportion of scratched stones, lies in the sheltered and embayed parts of the hill country.

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ON A SYSTEM OF ANTICLINALS IN SOUTH CRAVEN. BY LOUIS C. MIALL, ESQ., CURATOR OF THE BRADFORD PHILOSOPHICAL SOCIETY.

The Carboniferous district of Yorkshire may be conveniently divided into three parts: (1.) the Coal Field; (2.) South Craven, in which the southern type of lower Carboniferous rocks prevail; (3.) the tract north of the Craven Fault, which includes the valleys of the Yore, Swale, and Tees, with a considerable mountain district in which those streams rise, and is characterised by the complex northern series of strata. The typical northern and southern series may be found in the writings of Sedgwick and Phillips, but I must add two or three explanations to prevent misconception.

1. The two series are not to be taken as uniform over considerable areas. A distance of two or three miles is often sufficient to produce important variations, and we find the southern series gradually passing into the northern one by the sub-division and increased thickness of the beds. Perfect regularity of deposition is quite consistent with great local variations in vertical sections.

2. In many parts of South Craven, particularly near Skipton, the southern series becomes even less divided than the table would indicate. The limestone shales are represented by a dark, laminated limestone, which passes upwards into black or ferruginous shales, and downwards into the

Lower Scar Limestone, by such gradations that no precise divisions can be drawn. An ideal section for this district would give argillaceous shales passing insensibly into one great calcareous bed.

I shall now proceed to the topography of the district.

Between Settle and Colne lies a considerable tract of country, which in many parts of England would be considered hilly, but bounded as it is on all sides, except the west, by such elevations as Pendle Hill, Rombald's Moor, and the scars of the South Craven Fault, it is by comparison a low and level district. Many parts, especially about Gisburn, are richly wooded, and there is a general appearance of fertility and cultivation which contrasts agreeably with the wild scenery of the surrounding hills. Tradition mentions that this low country was anciently an extensive marsh, and the local etymologists explain the word Bell Busk by reference to a bell which is supposed to have been anciently rung at nightfall to warn travellers off the dangerous plain. We may find more satisfactory evidence in the fact that considerable tracts of sedgy ground still remain, that many low-lying meadows are to this day protected by "cop" and dyke, that the old road from Settle to Long Preston made a great circuit along a rough and precipitous hill-side instead of taking the level plain. The existing names of places bear a similar testimony. *Hellifield* is a Scandinavian translation of Holland; *Meer Syke*, *Moss End*, and many others, are Saxon words, which imply a former condition of marsh, pool, and wilderness. Out of the alluvial straths, however, the small eminences which I shall describe rose in ancient times as they do now.

The geological features of the district are interesting and varied. Southwards stretch the desolate grit moors of East Lancashire, Keighley, and Skipton. To the east lie the long ridge of Rylstone, separated from the plain by a range of low

hills, and the singular peaks of Flasby. Beyond Settle and Kirkby Malham rise the limestone ridges and mural escarpments of the Craven Fault. Still further away, may be seen the grit summits of Ingleborough, Fountains Fell, and Penyghent, distinguished by the purple ling from the green limestone slopes, while in clear weather the view is terminated by the long, serrated outlines of the slate mountains of the Lake District. On examining the extensive area thus enclosed, it is found to be diversified by numerous oval eminences rising out of the shales and throwing them off north and south. These little hills are soon seen to wear the bright green aspect of limestone pastures, and to be adorned by those plants (*Primula farinosa*, *Viola lutea*, &c.) which are characteristic of a calcareous soil. An occasional quarry shews that the rock is that dark, laminated limestone, of which I have already spoken. Whenever an extensive section is exposed, the beds are seen to be much contorted and often faulted, while an examination of the whole district shews that the non-calcareous overlying strata have in all cases been broken through and tilted up in such a manner that their strike is approximately east and west. The disturbances, in fact, belong to one great system of anticlinals, whose general direction is E. and W., or N.E. and S.W., though, as a geological map shews, local variations occur. Before making any deductions from these phenomena, I will read a few notes of the more important sections.

*Rain Hill and Thornton.*—The contorted beds here run through a range of low hills in the middle of the valley, and have been extensively quarried for many years. Owing to the great flexures, and the vast sections artificially made, a good view can be obtained of the entire series of limestone rocks. Uppermost are argillaceous shales, which pass into the black laminated limestone. This, again, rests immediately upon the Lower Scar Limestone, which is as violently contorted and

nearly as much divided into thin beds or plates as the rest. Instead of the solid, homogeneous character which it presents elsewhere, it is here almost schistose in the degree of its lamination, dark from bituminous exudation, traversed by innumerable veins of spar, and nearly destitute of fossils. Great faults occur occasionally, chiefly in the N. and S. line, and their course is usually marked by thick veins of spar. The northern slope of the anticlinal may be found in an old quarry near the Canal, west of Thornton. Near Salterforth the grit appears, thrown off by the protruded limestone, and dipping from it at an angle of  $15^{\circ}$  to  $20^{\circ}$ . At Keldbrook, on the southern side of the valley, there is a considerable thickness of grit, shales, and flagstone, dipping N.N.W., *i.e.* (away from the Lothersdale anticlinal), at a variable angle of  $20^{\circ}$ .

*Slaidburn.*—Here the limestone occupies two long oval spaces in a hollow, as at Thornton. The dark shales are fossiliferous at Black Hall and Harbour. The limestone beds appear to be both more complex and less contorted than in the anticlinals near Skipton. At Sykes, on a parallel axis, a remarkable vein of spar runs along a line of fault at the apex of the main flexure.

*Lothersdale.*—The mineral characters of the limestone are similar to those already described. The contorted beds dip beneath the grit of Pinnow Pike. In a small quarry N.W. of the principal works, the beds are nearly horizontal, and here intercalated chert occurs in regular seams. At Raygill is a vast quarry of contorted limestone. The beds are much faulted, but their anticlinal disposition can be readily made out. Great veins of spar traverse the limestone in the lines of fault; one such vein was 15 in. thick, and of unknown length; at least 50 yards were seen. This limestone, and the similar rock of Skipton and Thornton, is used for road metal over a great part of the West Riding; in part of Lothersdale

the spar is converted to the same purpose. "Slickensides" occur very abundantly here, having mostly a N. and S. direction; some of them are on a large scale, covering a space of many square yards with a siliceous and striated surface. At Park Quarry the anticlinal is more manifest, being parallel to that of Thornton. These two axes are separated by the synclinal of Pinnow Pike, which is two or three miles across.

*Skipton Rock.*—The strata have here been denuded so as to expose a considerable surface of limestone. Two subordinate axes are seen with the intervening hollow. The beds are frequently faulted in two directions, viz., in the line of the anticlinal, and also transversely. Near Draughton the limestone is much broken and strongly anticlinal, dipping under the grit on both sides. All the way from Skipton to Bolton Abbey the contorted beds occupy a range of low hills in the midst of a long valley, the slopes of which are shales capped with grit.

*Bolton and Blubberhouses.*—Close to Bolton Bridge the anticlinal line crosses the Wharfe. Just opposite the Abbey a natural section shews the shales dipping N.N.W. at an angle of 12°. On the Addingham road the same shales are found on the hill-side dipping S.S.E. at an angle of 17°. Between these two points the limestone may be seen as a range of rounded hills which lie in a line from Draughton to Beamsley, and may be readily distinguished from the grit and shale slopes by their conical form and verdant appearance. Near Blubberhouses, just on the edge of the moor, is a narrow "gill," with a grit edge on both sides, and strewn with grit boulders. Here the limestone re-appears, and is worked underground by adits. I have not succeeded in getting a section of the strata here.

I have now described the main anticlinal lines of South Craven; but although the contorted limestone does not come

to day further east than Blubberhouses, or further west than Slaidburn, we may trace the axes as far in the one direction as Ormskirk, where they disappear under the lower New Red Sandstone; and on the other side to Knaresborough, where they are similarly lost under the lower Permian beds. Of the western prolongation I have no direct knowledge, and I shall, therefore, merely quote Professor Phillips' observations. He says "the Lothersdale ridge is prolonged nearly in a parallel course on the lines of the 'Rearing Beds' of Barrowford, and Padiham Heights, and Whalley; the millstone grit ranging from thence by Ormskirk to the sea, and, dipping to the S.E., indicates the continuation of the same combined axis of elevation, while the coalfield of Burnley lies in a parallel depression on the one side, and Longridge Fell forms its boundary on the other." \*

Eastwards we may find evidence of a similar extension of the main anticlinal axis in the disturbed district of Harrogate. The general direction is there S.W. to N.E., viz., from Pannal Ash and Beckwith Head, across the Stray, where the fault is distinctly visible in the railway cutting near the Prince of Wales Hotel, thence on to Starbeck, where the line of elevation crosses the railway between the first and second bridges north of the station, and so on to Forest Lane and Knaresborough. Another line crosses the sulphur springs in a S.E. to N.W. direction, terminating in a cross-fault, close to the Pump Room.

The whole visible line of elevation is not less than seventy miles in length.

As to the manner in which these parallel anticlinals arose, there is little difference of opinion. All the appearances suggest a yielding to lateral pressure, such as would be caused by unequal resistance to the thrust of a mountain mass. I believe the current doctrine is, that the crust of the earth is

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\* Geology of Yorkshire, vol. ii., p. 23.

in a state of tension; that denudation, or any other agent which destroys the equilibrium, causes lateral motion, and in many cases elevation, at the weaker points. A familiar illustration of this principle may be found in the "creeps" which take place in coal mines when a considerable mass of coal has been removed. I have lately seen a remarkable representation in miniature of the South Craven Anticlinals in Manningham Lane, one of the roads leading out of Bradford. The road has been newly macadamized with Mount Sorrel granite and asphalt. Owing to a bend the vehicles preferred the west side. On the other side thirty-three small anticlinals appeared, rising from two to seven inches above the surface of the road and breaking up the newly laid portion. The lines of elevation made an angle of  $55^\circ$  with the footpath. The furrows were due to precisely the same cause as the South Craven Anticlinals, and it was amusing to observe the futility of all attempts to remove them by rolling and adding fresh material.

The ancient doctrine that igneous rocks were mainly concerned in the production of disturbances and elevations among stratified rocks, received some confirmation from a superficial examination of British Palæozoic strata. The contorted limestones of the Humbleton Hills, of Castletown, Isle of Man, and of many other districts, is associated with trap rocks. The granite of Dartmoor has been credited with the disturbances of North Devon, and some old sections, even where no igneous or volcanic traces existed at the surface, supply a subterranean peak upon which the anticlinal beds may rest securely. There is certainly no excuse for such reasoning respecting the South Craven disturbances. The regular lines of elevation extending over great areas, the contortion of the beds, and the entire absence of erupted masses, teach us to look to lateral pressure for the explanation, and not to any volcanic and cataclysmal agency. It is

noticeable that even in the days when what Professor Ramsay has called the "Jack-in-the-box" hypothesis was rampant, Conybeare and Buckland regarded the anticlinals of the Mendip Carboniferous rocks as irrefragable proofs of disturbance, produced, not by vertical eruptive thrust, but by lateral pressure; and Phillips remarked that "the general absence of igneous rocks on the line of the Pennine and Craven Faults, at all points (except Ingleton) south of the Cross Fell region, is a remarkable circumstance, which ought not to be forgotten in reasoning on the agencies concerned in producing such disturbances of the strata."\*

The violent contortions of the Lothersdale, Thornton, and Skipton limestone, seem at first sight to suggest a sudden protrusion, but the fact that so unelastic a substance as mountain limestone has been bent at sharp angles without breaking, really indicates a gradual and prolonged action. I can illustrate this by quoting the results of some small experiments which I have lately made. Two pieces of board were fitted together in such a manner that they could be set at any angle from  $0^\circ$  to  $180^\circ$ , just as you might open a book, keeping the letter-press always downwards. Means were found of estimating accurately the angle made by the two surfaces, and upon this ridge various thin plates of stone were placed. Sudden pressure being applied, the angle which was sufficient to produce fracture was noted. Then, by means of weights, a slow and equable force was tried. The following results are noticeable. A thin plate of limestone broke at  $2\frac{1}{4}^\circ$  when pressure was applied suddenly; but at  $4^\circ$ , when the pressure was distributed over an hour's time. For a lamina of Bradford Flagstone, the respective angles were  $3^\circ$  and  $7\frac{1}{2}^\circ$ . For a piece of Welsh Slate,  $1\frac{1}{2}^\circ$  and  $4^\circ$ . For a piece of Skiddaw Slate,  $3\frac{1}{4}^\circ$  and  $5^\circ$ . For a layer of shale, found in the roof of the Halifax haul bed,

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\* Geology of Yorkshire, vol. ii., p. 253.



4° and 9°. These facts will, I hope, enable you to understand that violent contortion without fracture of a rigid substance is a proof, not of an instantaneous force, but of slow and long-continued pressure.

With reference to the lamination of the Lower Scar Limestone, which is little divided, and not noticeably bedded, where it lies horizontal, but almost schistose in its character at Lothersdale, Thornton, and Skipton, I may mention a little circumstance which leads me to attribute this difference to the bending of the strata. I was lately examining the Mountain Limestone of the Great Orme's Head, and again and again I found that an apparently solid and homogeneous bed became divided into two, three, or twenty regular seams, according to the amount of flexure. This was known to the quarriers, who always worked in the more disturbed portions of the hill in order to get their stone more readily.

The principal subterranean movements which have affected the Carboniferous strata of the British isles appear to have taken place at two distinct periods. It is interesting to observe that each system of disturbance had a tolerably constant direction, and that the parallel axis of the latter elevation are nearly at right angles to the former. "Taking the counties of Wicklow, Wexford, and Waterford, we see that the strike of the older line of rolls or upheaval, though often modified, the result of pressure upon the then existing stratified mass, is about N.N.E. and S.S.W.; while the second movement, forcing the Old Red Sandstone and Carboniferous Limestone into huge ridges and furrows, especially on the South of Ireland (including the older and previously upturned rocks, as well as the covering of these two rocks above them) is marked by east and west lines. Any good geological map of the British Islands will shew that these great east and west lines are continued, though on

a minor scale, into southern Pembrokeshire."\* The same prevailing lines were laid down so long ago as 1822 in the map which accompanies Buckland and Conybeare's Geological description of the south-west coal-field of England.† In Yorkshire they are not less conspicuous, and Phillips has marked them very distinctly in a sketch-map which accompanies the diagrams of his Geology of Yorkshire.‡ In the Carboniferous district of Yorkshire, the Pennine Fault, and the South Craven anticlinals, may be taken as representing the N. and S., and the E. and W. systems respectively. Similarly, in the Rev. J. Cumming's Geology of the Isle of Man, a very perfect system of rectangular lines is described as affecting the Carboniferous rocks of Castle-town.§ The general direction of these lines is usually constant over considerable areas, though instances of local variation are not wanting. The E. and W. direction of the South Craven portion of the Pennine Fault is an example of such deflexion. On the whole, the phenomena are just such as may be looked for, when a contracting force of uniform direction acts upon strata whose lines of least resistance are not parallel.

It is an interesting and not very difficult task to determine approximately the date of the second of these two systems of disturbance, that with which we are immediately concerned. It is plain that as the grits and shales are thrown off by the protruded limestone, the movement did not take place before the deposition of the Upper Carboniferous strata. This gives us an ancient limit; the disturbance did not occur before the close of the Carboniferous period. We find again that the dolomitic conglomerates of Bristol and Kirkby Stephen, and the Lower New red sandstone of Knaresborough lie hori-

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\* De la Beche. Memoirs of the Geological Survey, vol. i., p. 222.

† Geological Transactions, Second Series, vol. i.

‡ Pl. 24, No. 14.

§ Geological Journal, vol. ii.

zontal and undisturbed upon the dislocated Carboniferous beds. This is proof that the anticlinals are earlier than the commencement of the Permian age. But the limits thus defined include a vast interval—a period greater than most of us would dare to assign to the whole history of our globe. During that blank in the geological record nearly all the Carboniferous Brachiopoda died out, animals whose low organisation implies great specific longevity. We must endeavour to establish a more precise date. It appears that part (perhaps nearly all) of the great interval between the close of the Carboniferous age and the commencement of the Permian was occupied by an enormous denudation of the coal-measures. This is known to have preceded the deposition of the lower Permian beds, from the fact that those deposits lie upon the denuded Carboniferous strata, and also from the occurrence of waterworn limestone and grit in Permian rocks. This denudation gives us another epoch. The Craven anticlinals have been shewn to be later in their origin than the close of the Carboniferous period. Did they first appear before, during, or after the subsequent denudation? We have reason for saying that they originated either altogether before the wasting of the Coal-measures, or before it had made considerable progress. The violent contortion of the beds must have been caused by lateral pressure resisted by the downward thrust of a great mass of superincumbent strata. Had the limestone been near the surface at the time of its elevation, we might have expected that the disturbing force would produce a mere fault, as it did in Nidderdale, where the superjacent strata were probably thinner.

I have now finished my remarks upon what has been to me a very interesting portion of the Geology of Yorkshire. It is necessary to own great obligations to the writings of Professor Phillips. My labour will not have been misdirected if I have succeeded in collecting and rendering more intelli-

gible the various observations on the anticlinals of South Craven which are scattered over his Essay on the Mountain Limestone of Yorkshire. I wish also to express the very great satisfaction with which I have witnessed the revival of this Society as a Geological Association. I believe that several years have passed since a purely geological paper was last read before its members. To-day we see indications of a change for the better, in the mere announcement of three papers on local geology. I hope it may be long before this Society finds itself obliged again to confess that none of its members have any investigations to report, while so many phenomena still remain unexamined and so many problems unsolved in the hills of our own magnificent county.

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ON SACOCARIS: A NEW GENUS OF PHYLLOPODA FROM THE  
LINGULA FLAGS. BY J. W. SALTER, A.L.S., F.G.S.

Seldom, indeed, do we meet with crustacea of any great size in the very old rocks, unless these be members of the Trilobite order. Of these, indeed, the largest forms are the oldest of all, for no Trilobite approaches the size of the giant Paradoxides, which characterize the Menevian group—the oldest fossil group with which we are acquainted—for, in spite of all that has been said and done, *Eozoön* has not passed beyond the *mythical* stage. Some of its admirers regard it at least with *superstitious* reverence. But into the *positive* stage it has not entered; and, therefore, the Menevian group, proposed by Dr. Hicks and myself for Britain, and recognized abroad, is the oldest known. No Crustacea, except a few small Bivalve *Phyllopods* (*Leperditia*), are known to accompany the trilobites in it. But when we ascend to the next overlying group—the true Lingula flag or Pfestrinog group of Sedgwick, while the trilobites reduce their size, a large

Phyllopod or two, *Hymenocaris*, usurps the ascendancy, and, up to yesterday, was probably the most active, and therefore the highest, of his tribe, known in these rocks.

Lately, Mr. David Homfray, the explorer of the Lingula and Tremodoc groups (Sedgwick), has struck out a still larger, possibly a rarer form, of the great shield bearing *Phyllopoda*. Instead of having an ample folded carapace, or shield, like *Nebalia*, it had a hollow oblong scute, to all appearance only slightly hollowed, after the manner of *Apus*.

Three distinct ridges on the hinder border, which is truncated, render it quite probable that the body, yet unknown, was as broad as the shield, instead of narrower, which is more like that of its compatriot *Hymenocaris*.

PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SEVENTY-FIRST (ANNUAL) MEETING HELD IN THE  
BOARD-ROOM, AT THE GAS WORKS, BARNSELY,  
ON THURSDAY, 10TH OCTOBER, 1867.

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WALTER SPENCER STANHOPE, Esq., J.P.,  
IN THE CHAIR.

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The PRESIDENT, in opening the proceedings, said:—In the absence of Lord Fitzwilliam, or any other gentleman of more influence in the county, I esteem it an honour to be called upon to take the chair for the first time at one of your meetings. I am informed by the Secretary that this is the Annual Meeting, therefore, before the reading of the papers, for the chief object for which we meet is the reading of papers and discussions upon the same, there are a few matters of a routine character to be gone through, namely, the election of officers, the admission of new members, and the reading of the accounts by the Secretary. I am informed by him, and it is well I should express the wish, that it is desirable this Society may be more generally known. If any of you here have the means of spreading a knowledge of the existence of this Society and its objects, it will be well. I think this Society being chiefly connected with geology and mining, and as mining pursuits are so much the occupation of this part of South Yorkshire, the subject is of very great

importance, and all communications which are read here will throw light upon the subjects which are so important to us in this district. I find we have four papers upon our list to-day, three of which relate to the coal-fields in this neighbourhood. As regards the first paper to be read, that by Mr. Henry Ecroyd Smith, of Birkenhead, I hear that gentleman has not been able to attend, but the paper will be read by Mr. Fairless Barber. The subject is some Roman remains found at Aldborough. This, of course, is a subject of interest, as showing the way in which the Romans carried their civilization and articles of luxury with them to the remotest ends of the known world; and although the pieces of this pavement, and other Roman remains which have been found, are not equal in design and execution to some of those which have been found near the shores, still they do show the extreme lasting character of the masonry and other work which they executed. By means of these remains, we, as I said before, learn that they carried their civilization to the remotest parts of the world. But perhaps the papers which will most interest us to-day are those which relate to our coal-fields, and the modes of working the coal. You are aware that there has been a geological survey carried on to complete the topographical map which has been issued by the Government department for that purpose. That map will now be completed in course of a short time by the geological survey. Mr. Green has been in charge of the matter in this district, and I am glad to see that he is to read a paper to-day on the Barnsley coal-field. I think we may congratulate ourselves during the past year upon the new discoveries which have come to light and have tended to show that the stores of coal to fall back upon are more, rather than less extensive, than might have been anticipated. Of course this is a matter of vital importance to the prosperity of the country, and I shall be very happy to hear





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MR. FAIRLESS BARBER then read the following paper,  
 by H. E. Smith, Esq., of Birkenhead:—

ON A ROMANO-BRITISH MOSAIC PAVEMENT, REPRESENTING  
 ROMULUS AND REMUS, DISCOVERED AT ALDBOROUGH  
 (ISURIUM OF THE ROMANS). BY HENRY ECROYD SMITH.

Aldbrough, by Boroughbridge, in the West-Riding, bears  
 a name common to many places in the United Kingdom,

inclusive of nearly half-a-dozen in the great province of Yorkshire alone. One and all of them may fairly lay claim to Saxon origin, as *eald-burghs*, but it may be questioned whether any can boast of the antiquity appertaining to that situate upon the left bank of the Ure, and but little above the confluence of this river with the upper portion of that of Isis (Ouse), now bearing the name of Swale. The site was known in pre-historic Britain as *Yseur*—a name evidently a compound of *Isis* and *Eurus*—the chief city of the warlike Brigantes, the leading people of the island at the Roman advent, whose territory stretched from the Humber and the Mersey on the south, up to the Tweed and the Solway, and who far surpassed in their abilities and energy all the more southern tribes, a character ably sustained by their successors, and, to some extent, descendants, for we rarely find proof of whole races being exterminated, or even completely driven away from their native country. The inhabitants of Yorkshire and Lancashire excel all the rest of England, whether we select arts or literature, agriculture or manufactures. Yorkshire indomitable pluck, energy, and perseverance, have contributed in no small degree in the formation of the national character, and now proudly sustains it in every quarter of the globe.

The remains of the ancient Brigantine capital are not known to be numerous; but, in all probability, much more of the early rampart and ditch which preceded the Roman circumvallation, might yet be disclosed by a thorough investigation. When a portion of these were accidentally laid bare, *ancient British pottery* was found, and among other objects a remarkable one of brass was met with, representing *the head of a human-faced cow*, the earliest form under which the goddess Isis is said to have been worshipped by the ancient Egyptians—one of those relics of the early commercial intercourse between this country and the Carthaginian

territories, which it is the fashion of Mr. Wright and other antiquaries of the present day to ignore and often to deny, but which have certainly been found in numerous places along our coasts, though but rarely inland.

Yseur, however, possessed yet earlier mementoes of her connection with archaic races in the "Devil's Arrows" (*Duil Ara*), without doubt one of the finest monuments of primæval North Britain, though by what race up-reared, whether *Brahminial* or purely *Scandinavian*, remains to be determined. Between these four (now reduced to three) mænhirs or pillar-stones, the *Betoel* of the Phœnicians, and probably the very earliest memorials in our land, and Yseur an *Idol* of stone was found at a great depth underground. It is of sufficiently rude execution to compare with any South Sea Island deity; but the material is remarkable, being of the same coarse grit as the neighbouring "Arrows"—a stone not naturally procurable nearer than Plumpton, a distance of ten miles!

The conquest of the district by the Romans in the latter part of the first century, after it had remained for some time in a tributary condition under native chieftainship, brought a marked change upon the scene. Yseur, a well-situated and strongly fortified place was at once utilized, and under the distinctive title of *Isurium-Brigantum* (Yseur of the Brigantes) it became not merely the head-quarters but the actual *capital* of the victorious invaders, until, after the pacification of the country the growing necessities of the capital of so important a province as Britain induced removal to a site more accessible to navigation as the chief means of supply of grain, &c., not alone for the army but at times for the Imperial court itself. This was found lower down the river, at the junction of the Ouse and Foss; and here up-rose the future metropolis, firstly of the Romans in North Britain, secondly of the Saxon kingdom of Northumberland or Deira, and, lastly, of the great ecclesiastical district, still

claiming as its head the truly historic city of York, than which not even London itself is more famous throughout the national annals.

Isurium, thus bereft of the august patronage and residence of Emperors or their Generals, now subsided into a second-rate town, but it could not be entirely stripped of importance as a good military station upon the great north road. It was occupied by a portion of the Sixth Legion, whose headquarters were Eburacum. The remains of temples, a basilica, and other public buildings, bear witness to the early development of the place, whilst the numerous well-executed Mosaic pavements yet existing testify to the abundance of good private dwellings. Other tessellated floors are of plainer designs and coarser work, whilst the example before us can be classed in neither category. It is a Mosaic of average size as to materials, but rudely executed, and for Romano-British manufacture, decidedly of late date, and probably referable to the end of the *third* or the beginning of the *fourth* century. Since the publication of the "*Reliquiæ Insurianæ*," in 1852, several pavements have been found in the city of York and its immediate suburbs, yet the total number scarcely amounts to one-half of similar relics found at Aldborough. This paucity of known specimens of an important and remarkable class of remains at Eburacum has been much dilated upon, and I am disposed to regard it as arising from the great depth at which such lie, rather than to their absence from the buildings of the Roman city. The slow but certain rise of the ground-level of large towns and cities is a very remarkable feature, but rarely chronicled; with the exception of London probably no place in the kingdom exhibits a greater heightening of the surface level than York, where the foundations of the earlier Roman buildings are laid upon virgin soil from sixteen to eighteen feet below the present pavements of the streets. Consequently



ROMAN MOSAIC EVIDENT

THE ROMAN MOSAIC EVIDENT

ARTIST



it is now but rarely that excavations for intended foundations are sunk at a depth sufficient for the uncovering of the pavements of dwelling rooms of Roman houses.

But to return to the more immediate subject before us, the "*Romulus and Remus Floor.*"

The example of Roman Pavement to which this paper refers, is not introduced as an artistic work; it is simply a construction of much interest and curiosity. In default of fineness of execution, it seemed the more desirable that the peculiar conformation of the details of the floor should be accurately rendered; in short, a fac-simile upon paper. (See plate xvi. accurately lithographed from a photograph executed by Mr. Hanson, of Leeds).

The floor, as now remaining, is small, being only about four feet square, but in all probability it formed the central compartment only of a twelve or sixteen feet square room or apartment, in one of the average dwelling-houses of Isurium-Brigantum. It was discovered about twenty-five years ago, but, through peculiar circumstances which it would be tedious to relate, I did not include it among the illustrations of kindred remains in my "*Reliquiæ Isurianæ.*" The site where it was discovered is adjacent to Aldborough Hall and the east gate, and lies to the southward of the main road through the village, which deviates little from the direct line of the Roman street between the eastern and western gates of the city. Shortly afterwards it was exhumed by a mason named Lonsdale, and removed to a garden attached to his cottage in Boroughbridge, where for many years it formed the floor of a small summerhouse. In 1863 it was purchased for the Museum of the Literary and Philosophical Society of Leeds, where it is still preserved.

The outermost border of this fragment consists of a series of elongated lozenges or diamonds, each containing others of a diminishing volume, but all perfectly plain, and of alter-

nating white, black, and red colours. Upon looking over numerous illustrations of Romano-British Pavements, I find this variety of configuration in fourteen different instances, but in only three of these does it occur as a border; one being the interesting and valuable pavement at Thruxton, the copper-plate of which is in the possession of my friend Joseph Clarke, Esq., of Saffron Walden, where the diamonds alternate with *crosses*, assumed, but probably erroneously, to be the Christian symbol. In the other eleven cases they are worked up with the ornamentation in the body of the floors, often in cubical patterns. All these diamonds\* are plain, but eight other examples occur—such comprising knots of the guilloche or braid, &c.,—two of which possess it in the borders, and the remainder in portions of central work. The last include three floors at Aldborough, viz., the old Manor-house, and the two corridor floors (“*Reliquiæ Isurianæ*,” plates xii., xiv). It will thus appear that as a *border* this pattern is quite a rare one in this country, though in France and Germany it is supposed to be of more frequent recurrence. The centre piece of this floor, set within its border as a picture within its frame, represents a group of Roman paternity, produced occasionally upon coins and medallets of the later Roman emperors,\* but rarely appearing in sculpture,† mosaics, or, as far as can be judged, oil paintings. This world renowned scene, the discovery of Romulus and Remus, suckled by a wolf, has been variously treated by our modern historians, some accepting the tradition as founded upon fact,

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\* It appears upon some of the large brass coins of a few of the earlier Emperors, viz., Hadrian, Antoninus Pius (two types), and Philip Senior,—re-appearing in the Anglo-Saxon series, being copied by Ethelberht II., King of Kent, from the the small brass of Constantine.

† Mr. Roach Smith owns a good intagliate carnelian bearing the group, and I find a spirited representation of it in carved ivory, part of the design of an Arabian Diptychon, engraved in a rare work, “*Thesaurus Veterum Diptychorum*,” by Ant. Franc. Gori; Florence, 1759. This engraving is described p. 205, engraved in Table 22, and stated to belong to the Vatican Collection.



others, including the deservedly honoured Dr. Arnold, holding the story as a perfect myth, invented by the imaginative history-mongers of the Consulate, to gratify the craving of the citizens of Rome for something at once sensational and satisfying to their vanity and self-love in the rapid rise and growth of their city. In the absence of perspicuous proof, this solution is the safest; and we find the traditions include several curious points not generally known, comprising the following items:—Numitor, king of Alba, had two grandsons, the children of Mars and Ilia, who were seized and cast within a wooden box into the Tiber, by order of Amulius, who had usurped the throne of his brother Numitor. The boys thus abandoned in their wooden receptacle, were carried by the overflow of the Tiber to the foot\* of Mons Palatinus, and stranded at the mouth of a cave or grotto, where, under the friendly shade of a *fig-tree*, and suckled by a large *she-wolf*, which had made a cover of the cavern's recesses, the youngsters were discovered by the king's herdman, Faustulus. In our Aldborough mosaic the compartment may be held as representing a section of the *cave*, whilst the *wolf*, the historic *infants*, and the *fig-tree* are unmistakably portrayed. Ovid repeatedly refers to the story, and a few selected extracts are subjoined:—

“Arbor erat : remanent vestigia : quæque vocator  
 Rumina nunc ficus, Romula ficus erat,  
 Venit ad expositos (mirum) lupa fœta gemellos.  
 \* \* \* \* \*  
 Constit et cauda teneris blanditur alumnis  
 Et fingit lingua corpora bina sua.”

These lines occur in Ovid's “Fasti,”† or Festivals of the Roman Calendar, and are thus translated by John Gower,‡ Master of Arts:—

“A fig-tree stood, the stump remains this day ;  
 Then *Rumina*, but now called *Romula*.

\* Erroneously stated by Lempriere to be on Mount Palatine.

† Lib. ii., l. 411.

‡ London, 1640.

To these poor barns [bairns] there comes a she-wolf wild—  
 Most strange a wild beast should not hurt a child.  
 Yet that was nothing ; she assists and nurses  
 Those whom their kindred to their death enforces ;  
 She stands and fawns upon the nuddling twins,  
 And with her tongue licks o'er their tender skins."

The cave above alluded to, and thus immortalized for all mundane time, appears to be a spacious natural grotto, possessing three large compartments. Situate at the foot of Mount Palatine, upon which Romulus is said to have laid the first foundation for his capital, of buildings subsequently replaced by the immense palace of the Cæsars, it occupied a central position in the later imperial city. In earlier times the approach to it lay through a dense forest, and several streams issued therefrom. It became sacred to the great deity of natural providences, Pan. From the traditional discovery here of the Alban infants, it was designated the *Lupercal*, or cave of the wolf, originating, it is said, from the wife of Faustulus, who nursed them, being named Lupa. Games and bacchanalian revelries in honour of Pan had their head-quarters here, whence, in the annual saturnalia, wild and licentious processions issued, parading the streets of Rome to the great indignation of the Christianized portion of the community, in the first and second centuries. These orgies were known as the *Lupercalia*, and it is a singular coincidence that I had no sooner commenced writing my description of this Romano-British Mosaic than the telegraph flashed over the civilized world the news of the re-discovery of this celebrated Lupercal, after an obscurity of many centuries. It seems that a certain "Signor Gori, an advocate, on visiting the Cloaca Maxima of Tarquin, directed his attention to a very limpid stream of water, flowing from a lateral conduit, and, after considerable investigation, guided by historical memorials and his own

deductions, found the celebrated cavern near the present church of St. Anastasia.”\*

Allusion has been made to the coins depicting the wolf and twins, but the adjuncts of cave and tree do not appear upon any. They are chiefly of the third or small-sized brass, struck by Constantine the Great in honour of the founding of Rome, and inscribed “Urbs Roma.” Mr. Roach Smith describes a rare silver denarius of this type, found in London.† In the larger brass, this design, which it is natural to assume would be a favourite one with the Roman moneyers, proves to be by no means frequent, being almost confined to the colonial series.‡ The woodcut appended displays the reverse of a Greek Colonial piece, struck in the reign of Elagabalus, and found at Jerusalem. It is inscribed “COL. AVP. ÆL. CAP.” with P. F. in the exergue. Jerusalem, restored by Ælius Hadrianus, was erected into a Roman colony, and named after this emperor, and also Capitolina, in honour of *Jupiter Capitolinus*,§ thus doubly accounting for the re-production of the wolf and twins. Illustrations are likewise supplied of two reverses of the small coins of Constantine, just mentioned. In each case the teats or dugs of the wolf are carefully produced, and in no other instance than in the pavement before us have I found them to be absent.



The general design being a most popular symbol, and consequently likely enough to occur to Roman artificers, it

\* *Athenæum*, 15th June, 1867, p. 798.

† See his Catalogue of the Museum of London Antiquities, p. 89.

‡ Cities honoured with the titles of Roman Colonies not unfrequently affected the design upon the reverses of their coins.

§ *Numismatic Chronicle*, New Series, vol. ii., p. 116, pl. iii., No. 7.

yet proves remarkably rare in works of the sculptors and mosaists of this era. Repeated enquiries have only resulted in a knowledge of one instance in mosaic, a compartment of a floor probably forty feet long, in Rome, and of an example in fresco found at Pompeii.



A curious plaque of copper-bronze found in the city of London some years ago, and figured in Mr. Roach Smith's "Catalogue of the Museum of London Antiquities," as also in his "Roman London." It is thus described:\*

"A circular ornament (plate iii, fig. 2), engraved of the actual size, embossed with a design of the mystic story of Romulus and Remus suckled by a wolf. It is formed of a piece of plain thin metal, in which copper largely predominates, shaped by stamping, and afterwards finished by rude chasing and frosting with a punch, and has been affixed apparently to wood. The birth of the fabled founders of Rome was a favourite subject with the ancient artists. It often occurs on coins as a type, as

an ornament on the shields of some of the Roman Emperors, on the obverses of their coins, and on gems and other works of art. In this instance the story is more than usually illustrated by the introduction of the fig-tree—*Rumini ficus*, of which Ovid tells us some remains were in existence in his time.

“The bird no doubt is intended for that which shared with the wolf the honour of feeding the infant heroes.

‘Lacte quis infantes nescit crevisse ferino,  
Et Picum expositis sæpe tullisse cibos!’

‘*Ovid's Fasti*, lib. iii., l. 53.’

“It was found in Moorfields, with a thin star-shaped piece of similar metal, perforated in the centre.”

The last quotation from Ovid is rendered by Mr. Gower—

“’Tis known these infants sucked a wild beast's teat,  
And that a *Pie* did daily bring them meat.”

The only exception we have to take here is the adoption of a *Picus*, or member of the Woodpecker family, for *Pica*, a pie or magpie,—a palpable but not unnatural error for a non-naturalist to make. *Picus* was a fabled king of Latium, celebrated for his beauty, and of whom Circe, meeting him in the woods of Monte Circello, became greatly enamoured. Mortified at her advances being treated with disdain, this ocean nymph, or syren, brought her celebrated magical arts to bear upon the scornful monarch, who was summarily converted into a *Woodpecker*.

In this circular engraving we have a very different treatment from that of the mosaic; for although somewhat rude, it is yet far less conventional in style, and the tree appears more shrubby, being devoid of any main stem or trunk. But we have also an addition to the group, in the introduction of a bird, unquestionably the woodpecker alluded to by Ovid, the honoured assistant in sustaining the traditional founder of Rome and his brother. The dug is large and rotund, offering a great contrast to the narrow elongated ones of the long-legged brute upon one of the smaller coins, and the

hugely clawed feet are very noticeable. This unique and very interesting little plaque or boss, formerly in Mr. Roach Smith's Museum of London Antiquities, is now in Mr. Roach Smith's Collection in the British Museum, it is, as has been stated, of bronze, but it contains a much larger proportion of copper than usual. Along with it was found a flat star-shaped object of similar metal and size; and there can be little doubt they had been connected by rivets upon some post or lintel of wood in decoration.

Reverting to the mosaic, it only remains to notice the composition and colours constituting the groundwork used in its production. The bluish-black and the white, and the few yellow, tesserae, are all natural stones, the former being blue lias, and the latter magnesian limestone. The tesserae of a red colour alone are artificial, being of baked clay. The whole are set in a deep bed of the admirable concrete of the Roman architects, too well known to require description here.



ON THE GEOLOGY OF THE BARNSLEY COAL-FIELD. BY A. H. GREEN, M.A., OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN.

Though I might occupy the time at our disposal with an account of the objects of geological interest in the immediate neighbourhood of Barnsley, and by no means exhaust the subject, I think I shall make this paper more interesting and instructive if I take rather a wider range, and show first of all the relation of the rocks we now stand upon to the general geology of England.

If we draw a line from Nottingham, through Derby and Ashbourne, to near Trentham, then wind it up to Manchester, and thence to the estuary of the Mersey, this line will be the northern boundary of the New Red Sandstone plain of

Central England. Another line running nearly due north from Nottingham to Tynemouth will mark the escarpment of the Magnesian Limestone. The country north of the first line and west of the second is, with the exception of the Lake district and the Vale of Eden, wholly occupied by rocks belonging to the great Carboniferous formation. We will first shortly describe its general structure, and then give some details respecting the district immediately around us.

The Carboniferous rocks may be grouped for our purpose under three heads, namely:—

3. Coal-measures.
2. Millstone-grit and Yoredale Rocks.
1. Carboniferous or Mountain Limestone.

The lowest, and, therefore, oldest of these, the Mountain Limestone, is a mass of pure limestone, of great but unknown thickness, with a few, but very few, thin layers of interbedded shale, and two or three beds of lava and volcanic ash, known as Toadstone. The latter are regularly interbedded with the limestone, and, therefore, must have been poured or thrown out from volcanoes during the time of its formation. The rock is often entirely made up of animal remains, shells, broken corals, and encrinites, and has, therefore, in all likelihood been formed entirely from these remains, and not by mechanical deposition of sediment. For many ages, in a sea unstained by mud, these creatures grew in plenty, obtaining from the water carbonate of lime for the formation of their hard parts, and at death these dropped to the bottom, where the heap gradually grew into a mass perhaps several thousand feet thick, which by pressure and chemical action has been converted into the well-known limestone of Derbyshire.

At length, however, this peaceful time ended, and a new set of conditions came into action, under which the rocks of the second group were formed. The division is made up of

sandstones, gritstones, and shale. Several of the sandstone beds are of great thickness, one reaching here and there to 1,000 feet, and these thick beds are mostly very massive and coarse, sometimes conglomerates. Between the thick beds of sandstone are masses of shale with thinner and more irregular sandstones. The method of the formation of these rocks was somewhat as follows—In the place of the still, clear ocean of the Mountain Limestone times we must have a sea whose bottom was from time to time raised and depressed, and into which sand and mud was carried in large quantities. When the water was shallow, sand and pebbles were rolled along the bottom till huge banks had been piled up to be afterwards consolidated into our present grits and sandstones; and afterwards when the sea bottom sank, finely divided mud was brought down, and, settling gently, formed the regularly bedded and laminated shales. We know nothing for certain of the source from whence the sediment came, but the composition of some of the grit beds shews that they have been derived from the waste of granite, and it also seems likely that the feeding ground was to the north, because the beds get thicker as we go in that direction. For these reasons the Scandinavian peninsula, or a southerly extension of it, seems a likely country to look to.

We may also notice that a few beds of coal are found in the Millstone grit, and, as coal is generally believed to have grown like peat, this shows that there was occasionally upheaval enough to bring the recently formed rocks above the level of the water.

The topmost division of the Carboniferous rocks, or the Coal-measures, resembles in many respects the group last described. Like it they consist in the main of sandstones and shales, but the former are less coarse, massive, and persistent than the gritstones, the change, however, being gradual. Thus the gritstones are in thickness from 100 to



1,000 feet, and often keep for many miles the same thickness and mineral character; the sandstones of the lower part of the Coal-measures are never more than a few hundred feet thick, they often change very suddenly from a fine flagstone to a coarse, massive grit, and very frequently die away altogether; the sandstone of the Middle Coal-measures are rarely as much as 100 feet thick; they can scarcely ever be said to have a distinctive character, and almost invariably in the course of a few miles they die out and are replaced by shale. The most important difference, however, between the topmost and middle group is the presence in the former of numerous workable coal beds. The fact that each of these required for its formation a land surface, shows that during the coal-measure epoch there was a still larger oscillation of the sea bottom than during Millstone-grit times; and this is probably one reason why the minor subdivisions are so much more changeable.

One more point requires notice. The Carboniferous rocks are conformable throughout, and, therefore, wherever we find one part, the whole group must originally have been there present.

The last consideration proves that over the whole of the Carboniferous area defined at the beginning of the paper, the three divisions stretched originally in nearly level sheets. After a time, however, the beds began to be upheaved along a line running nearly north and south through the middle of the tract, and coinciding with what is now known as the Pennine chain, or "Backbone of England." By this means the level sheets of strata were bent into a long arch, but as soon as the ridge rose above the surface of the sea the waves attacked it and eat it away, stripping off the higher measures from the centre and laying bare the underlying Millstone-grit and Mountain Limestone. Thus the central part of the district is now formed of these lower rocks, while on the east and

west they dip out of sight and are covered by the Coal-measures, of Lancashire and Staffordshire on the one side, and of Yorkshire and Derbyshire on the other. Of the latter great coal-field, the district we are now in forms an important part.

I have now endeavoured to give a history, first of the method of formation of the rocks found in the Carboniferous area of the north of England, and secondly of the manner in which they were brought into the position they now occupy. I would yet say a word on the connection between the scenery of the different parts of the country and the rocks of which they are formed.

On passing from the New Red Sandstone central plain into the northern Carboniferous district there is a sudden change of scenery which cannot escape notice. The first is low lying; broken by mounds rather than hills; with no well marked or persistent ridges; fertile and well cultivated: the latter rises into lofty hills; is traversed by long steep "edges" often running for miles parallel to each other, in lines nearly straight; and a great part of it is bleak and barren moorland. Within this Carboniferous tract, too, distinct features in the scenery mark out the parts occupied by the three divisions of the rocks. But we must first say how these features have been produced. It was explained some time back that immense masses of the rocks must have been removed by the wearing action of the sea: this action tends to plane everything down to a nearly uniform level, and when it ceased the country probably was one immense plain. On this rain would fall, and, gathering in any little inequalities of the surface, form brooks, which would step by step cut deeper into the plateau, and, aided by rain, frost, and other sub-aerial forces, at last carve it out into its present form of hill and valley: consequently this form ought to depend very much upon the nature of the rocks acted on;

their structure, whether they would easily break up or not; their unequal hardness, whether one would give way more readily than another; these, and such like qualities, ought to affect the shape of the ground very considerably, and on examination we find they do. The Mountain Limestone country is, taken altogether, tame and monotonous, with broad flats and large rolling hills, but no very marked or sharp features, and this is only what we should expect from the homogeneous character of the rock, which causes it to yield equally in all directions to atmospheric agencies. Of course, I except from the above sweeping condemnation the beautiful valleys which the rivers have cut like trenches across the general plateau. When we pass to the gritstone country beyond, we find a vastly different type of scenery. Here ranges of hill, steep on one side and with a gentler slope on the other, run across the country in long parallel lines, forming the well-known "edges" of the district. On examination we find that each of these edges is formed of one of the thick, massive gritstones, whose outcrop makes a little cliff at the top, while the slope below and the valley between it and the beginning of the next ridge are formed of the softer shale;—and we see at once that it is the superior hardness of the gritstone that has enabled it to hold out against the denuding forces better than the shale, and stand up in bolder relief. Here, then, unequal hardness of the rocks has given rise to variety in feature, while in the case of the Mountain Limestone uniform hardness has produced sameness of outline. The scenery of the Coal-measures is similar to that of the Millstone-grit, but much less marked; and this of course arises from the fact that the hard beds are not so thick and much more changeable. The escarpments formed by some of the Lower Coal-measure sandstones are quite equal to any Millstone-grit edge, but as we get higher in the measures, and the sandstones become poorer and

weaker, the features grow fainter, and it is only rarely we see anything deserving the name of an escarpment at all. One of the most striking exceptions, occurring in the immediate neighbourhood of this town, is the escarpment of the Woolley Edge Rock, which may be traced from New Miller Dam as far south as the neighbourhood of Elsecar. Beyond this, the rock, which hereabouts is a coarse and massive gritstone about 100 feet thick, dies away altogether, and is replaced by shale. I have now given a sketch of the general geology of the district of which the Barnsley Coal-field forms a part. On some future occasion I hope to be allowed to lay before you some details about the coal-field itself.

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SOME REMARKS ON FIRE DAMP AND SAFETY LAMPS. BY JOHN HUTCHINSON, MANAGER OF THE GAS WORKS, BARNSELY.

The subject upon which I am about to offer a few remarks is one of deep interest to the Colliery Proprietors and the mining population generally of this neighbourhood. And I feel sure you will excuse me if I occupy a few minutes of your valuable time this afternoon in noticing some facts and observations recently made on this subject at the Oaks Colliery and elsewhere.

Anything relating to this ill-fated Colliery is doubly interesting at the present time, since within the last few days some of the bodies of the volunteers, who so nobly rushed into this fiery mine ten months ago, in order, if possible, to aid, succour, or rescue their fellow men from a dreadful and almost certain death, have at length, after overcoming many difficulties, been recovered, brought to the surface, identified, and interred, which is no small degree of satisfaction to their sorrowing relatives and friends. Those in the town of Barnsley, who last Sunday and Monday witnessed the funeral

processions, accompanied by the widows, orphans, and survivors of the Oaks explosion, as they passed slowly through the streets which were lined with spectators, will not readily forget the solemn impression then made, the sight of the numerous train of widows brought tears into many eyes.

On the latter day the shops lining the principal thoroughfares were closed, and business suspended.

#### FIRE DAMP.

Fire Damp, Marsh Gas, Pit Gas, or Light Carburetted Hydrogen, Symbol  $C H_2$ ; sp. gr.,  $\cdot 552 \cdot 100$  cubic inches weigh 17.12 grains. Specific gravity as compared with hydrogen 8 to 1.

Fire Damp is a natural product which issues from the ground, and admits of being kindled. It is a product of decomposition from beds of coal, and when it mingles with air forms an explosive mixture. It is a colourless, invisible, inodorous gas, scarcely soluble in water; it does not support combustion or respiration. When breathed in a pure state it is fatal to animal life, but it is not very noxious when mixed with air, even when it forms 8 or 10 per cent. of the mixture the miners can work in it; however, when it is very strong it has been known to render them insensible, but the usual effects are a tightness across the forehead, with headache, which happens some time before insensibility takes place.

Fire Damp alone does not explode, it must be mixed with air or oxygen before this phenomena can show itself. If mixed with too much air, explosiveness is again lost. If the proportion be diminished to three or four times that of the fire damp, or increased to more than fourteen times its measure, explosion does not happen; for where the volume of air is very small an amount of oxygen sufficient to burn the fire damp is not furnished; where the quantity of air is too large it prevents the spread of flame, by conducting away heat, and preventing the temperature rising high

enough to inflame the combustible gas. If mingled with twice its volume of oxygen, or ten times its volume of air, it detonates powerfully. When collected and consumed in the mouth of a gas jar it burns away quietly, with a yellowish-white light, somewhat similar to coal gas, but if the light is passed into the jar it is extinguished instantly. There is no immediate chemical test for the presence of this gas. A candle or oil lamp gives a white heat, which at once determines an explosion if introduced into an explosive atmosphere.

Fire Damp being very light, little more than half as heavy as air, it ascends, collects, and lodges in hollows or recesses at the upper parts of the workings, and would of its own gravity readily escape at the surface into the open air, if there was a free course open for it to do so, so that while the lower part or floor may be ventilated and free from danger, a light brought near the roof might lead to a dangerous explosion.

When an explosion does occur the life of a miner is likely to be sacrificed from several distinct causes, arising, first, from burning, as the very atmosphere in which he exists is instantly one sheet of flame, beyond the power of man to control, and from which he can seldom escape; second, by the mechanical violence of the sudden expansion of the gases on their ignition, sweeping everything before it, or, on the contrary, a comparatively and equally frightful rush of air to fill the partial vacuum caused by the contraction of volume of the exploded gases; third, by being surrounded with, and thereby compelled to inhale, an atmosphere of carbonic acid and nitrogen. This often proves more fatal than any other cause, the entire system of ordinary ventilation being generally destroyed by the first blast, and the atmosphere, pressing with equal force on downcast and upcast, the deadly gases become as it were bottled up in the pit with an elastic cork. The gas left after an explosion is much lighter than

black damp, or even common air, and it will make its way up to the roof, whilst black damp will lie near the floor.

Fire Damp requires twice its volume of pure oxygen for complete combustion. The three volumes of mixed gases after detonation are condensed into one volume; they yield one volume of carbonic acid, and two volumes of steam, which are immediately condensed. Now carbonic acid contains its own bulk of oxygen, it therefore represents one of the two volumes of oxygen which disappear, whilst the other volume of oxygen has united with two volumes of hydrogen and formed water. Light carburetted hydrogen must, consequently, contain twice its volume of hydrogen condensed with its own bulk of carbon vapour into the space of one volume.

Thus, from the composition of fire damp, it is obvious that the gas in exploding renders ten times its bulk of atmospheric air unfit for respiration. The two volumes of oxygen which ten volumes of air contain, producing one volume of carbonic acid, and two volumes of steam, which becomes condensed, leaving eight volumes of nitrogen at liberty. Fire Damp from different localities has been frequently analyzed, and exhibits a general uniformity in composition, consisting principally of light carburetted hydrogen, with varying quantities of carbonic acid, nitrogen, hydrogen, atmospheric air, and sometimes olefiant gas, and sulphuretted hydrogen. Analysis of Fire Damp by Professor Playfair:—Light carburetted hydrogen, 92·80; nitrogen, 6·90; oxygen, 0·60; carbonic acid, 0·30; total, 100·60.

#### THE SAFETY LAMP.

The Safety Lamp is a valuable instrument in the hands of a competent person who thoroughly understands its use in testing for the presence of fire damp in coal mines, but the miner actually at work cannot be supposed to be at liberty to pay that nicety of attention to its indications that would appear desirable, but they ought to remember that the lamps

should be gently handled and carefully attended to, kept in the best possible order, and that they are not intended to be made a substitute for proper ventilation. Objections have been made by working colliers to some safety lamps for the small amount of light produced and the inability to see their work fairly, and thus, to make good wages, induces colliers when either thoughtless, or otherwise satisfied that there is no Fire Damp near, to unscrew the top of the lamp. Rules and regulations backed up by fines, and now lately by liability to imprisonment, have been insufficient to stop this tendency, and to prevent the occurrence of numerous accidents which have resulted from it. Hence it is that much attention has been bestowed on the methods of locking the lamp, to prevent the removal of the wire gauze. It will be readily conceded that good rules and strictly enforced discipline among the workpeople are just as indispensable as a perfect lamp, in the prevention of those accidents, often so cruel and so sweeping, which hurry away in one common fate the provident and innocent with the reckless and the guilty.

In some Safety Lamps as the Clanny, Morsler, and the Morrison, it may be said that there is no temptation for the men to pick the lock, or to unscrew the top, because they have what they want, they have already plenty of light. But inasmuch as safety in a dangerous place ceases with the fracture of the glass, our colliery managers have been generally averse to their use in fiery mines.

If a light, producing a white heat, such as a lamp or candle be used in the mine, no matter whether in the intake or the upcast air course, an explosion is liable to happen. If the gas ever becomes ignited the flame will follow so long as there is gas sufficient to support combustion either with or against the current. Much has been said and written upon the cause of colliery explosions, yet under the best known management they do occur. The very name of "Safety



Lamp" appears sufficient to satisfy all our scruples at once, it is relied upon with implicit confidence, and generally believed to be what its name implies. A Safety Lamp is wanted, it is bought, sold, used, and believed to be such, no one taking the trouble to test whether it is or is not what it professes to be. If an explosion does unfortunately occur, it is indeed rarely that the cause can be traced to its source satisfactorily, but the lamp is never once thought about, if the miner has his lamp all in perfect order he is said to be quite safe; let us see if such is really the case.

During the last few months I have, in conjunction with Mr. Wilson, under-viewer of the Darfield Main Colliery, and Mr. Minto, of the Mount Osborne Colliery, conducted a series of experiments upon the different kinds of Safety Lamps in use, with a view to show their comparative merits, care being taken that each lamp of its kind was perfect and in good working order.

These experiments were witnessed by a number of gentlemen connected with the various collieries in the neighbourhood. A rectangular box, constructed of deal boards 12 feet long, and measuring 11 by 4 inches inside, was inserted into a flue in connection with a chimney shaft to produce a current. A current of pure air is sent through this box, the quantity and velocity of which was regulated by a small sliding door near the inner end. In the top of the box, about the centre, is a small sliding door, which on being removed discloses an opening of sufficient size to admit a safety lamp. Through this opening a lamp can be dropped into the centre of the "level," and can be seen through a small square of glass fixed in the side thereof. A service pipe of coal gas is connected by means of an India rubber pipe, which is terminated by a small metal pipe and tap, and the gas allowed to play into the end of the box; by means of this pipe it will be seen that the current of pure air passing through the

imaginary level can be diluted at pleasure, and the changes which the lamp undergoes can be easily seen through the square of glass in the side of the box. A Stephenson lamp was inserted, when the gas was turned on there was first a flickering of the flame, which had burnt steadily while the air was pure, and at one time it appeared totally extinguished; a tiny blue light, however, remained wavering about within the top of the gauze, which gradually increased in size as it was drawn through the gauze by which it was enclosed. The gauze in a short time got red hot, and after the lapse of one minute and thirty-five seconds the gas in the box exploded; the lamp was then removed and was found to be still burning and uninjured, but generally the light was extinguished without exploding the mixture in the box. With the current of air passing through the box at the rate of five miles an hour, not an uncommon velocity in a pit, as ascertained by the anemometer, the following comparative results were obtained:—

The Davy Lamp	exploded in	5	seconds.
The Mousard	do.	6	do.
The Clanny	do.	12	do.
The Belgian	do.	13	do.
The Stephenson	do.	25	do.

All the above-named lamps were tested under the same circumstances. Some further experiments showed slight variations in the time, but all tended to two results. In the first place it was shown that all the safety lamps were really *unsafe* in a *current* of atmospheric air and gas when mixed to an explosive point. And, secondly, that of the lamps now in use the Stephenson is the best and most reliable.

In a *still* atmosphere of mixed air and gas all the above lamps were extinguished without igniting the surrounding atmosphere.

It will be noticed that the foregoing experiments were

made with ordinary coal gas. An opportunity offering at the Oaks Colliery, it was thought desirable to make similar trials on the gas given off from the coal strata, and actually issuing from the Oaks Pit, 1,025 cubic feet was being given off per minute on the 22nd of August, 1867, the data on which the experiments were made.

With the above-named arrangements of apparatus, &c., and a velocity of  $4\frac{1}{2}$  miles an hour,

The Davy Lamp exploded in from 10 to 30 seconds.

The Clanny do. do. 13 to 32 do.

The Fluted Clanny improved was extinguished in from 3 to 60 seconds, but did not explode.

The Belgian Lamp was extinguished in from 5 to 160 seconds, exploded in 30 seconds.

The Cockney Lamp was extinguished in from 3 to 18 seconds, did not explode.

The Stephenson Lamp was extinguished in from 3 to 120 seconds, exploded once in 45 seconds.

At this date the fire damp contained 4 per cent. of carbonic acid which would seriously affect its combustible properties; the gas was free from other impurities. I may here observe that the Stephenson and other lamps were several times extinguished before explosion took place, owing, it is believed, to its being impossible, or nearly so, to spread the gas equally through the entire current; there was also a strong wind blowing at the time, which materially affected the steadiness of the current passing through the box.

We also ascertained the following facts, viz., that the said fire damp issuing through a  $\frac{3}{8}$  inch pipe would ignite at a piece of  $\frac{1}{8}$  inch iron wire heated to bright redness when held in a stream of the gas. The same results were obtained with a  $\frac{1}{2}$  inch round iron rod, with a bar of  $1\frac{1}{8}$  in. square heated in the smith's fire to bright redness, and carried through the air about fifty yards, occupying about sixteen seconds in

transit, it would ignite continuously the pit gas as it issued from a batswing burner for one minute twenty-five seconds, the same bar was then immediately applied to a batswing burner supplied with ordinary manufactured coal gas, which it continued to light for one minute and twenty seconds longer; this showing that the pit gas required a greater degree of heat to fire it than coal gas. It would likewise readily ignite at glowing charcoal, also at red hot wire gauze when played upon on a particular point for some seconds.

Thus I think we have succeeded in establishing the foregoing facts, and calling attention to them; which, I trust, will be of service to the miner, as well as to the scientific world. I am of opinion that a safety lamp worthy of the name has yet to be invented. There are certainly no lack of labourers in the field, but the work yet remains to be done.

Scarcely ever before in the South Yorkshire Coal Field was the benefit of the Stephenson lamp of such signal service as proved to be the case a week ago at the Stafford Main Colliery, near Barnsley. It appears that about half-past six o'clock, a large portion of some old breaks had fallen, and given off a very large quantity of gas, which was driven down the north side of the pit, extinguishing all the lamps in its course for a distance of about 400 yards. Within less than an hour all the men, numbering over 300, were deposited safely at the pit bank, and in a short time the alarm which had been suddenly raised abated. The seam of coal being worked is the Silkstone, the shaft being about 243 yards deep.

A defective lamp or a naked light, there cannot be the slightest doubt, would have hurried into eternity the great body of the miners in the pit. The colliery itself is one that has the reputation of being very well ventilated, no expense being spared for that purpose by the proprietors.

The above confirms on a large and practical scale, the conclusion we have arrived at on the small scale, viz., that hitherto the Stephenson lamp is the one most to be relied upon, under all circumstances, and that some of the so-called safety lamps ought to be rejected as worthless, for there is the appearance of safety without the reality.

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OBSERVATIONS ON VENTILATION IN RELATION TO COLLIERY DISASTERS. BY RICHARD CARTER, C.E., BARNESLEY.

Having on two previous occasions—the 16th July, 1857, and 1st November, 1860 respectively, brought the subject of Colliery Ventilation under notice of this Society, I can only plead its vast importance, not only to private enterprise, but also to the interests of the community generally, as my apology for reverting to it again on the present occasion.

Ten years have elapsed since the first paper, which was immediately prompted by the dreadful explosion at Lundhill; and although something has been done to ameliorate the frightful hazards attendant on ventilation in practice, the interval has not sufficed to produce anything like immunity from those desolating calamities, which seem periodically to spread their fatal and ruinous gloom, over this, and similar colliery districts of the country. Minor calamities have from time to time served to keep the subject alive in the public mind, but it was reserved for another repetition of disaster at the Oaks Colliery, within little more than a mile from where we are now assembled, to renew with appalling force and impressiveness, the dread relation, in which the subject of ventilation is still associated with the interests of humanity, as well as commercial and national wealth. The awful fatality which attended the Oaks explosion of the 12th December last—surpassing in heart-rending sacrifice of life, all the events of its kind which have hitherto

occurred in this or perhaps any other country, testifies the truth, that much remains to be done, which humanity and patriotism alike demand, as well for the protection of that laborious class who toil in the grim recesses of our mines, as for the social and public interests, which suffer in common, the consequences of disaster occurring to them. If anything were requisite to give force to this declaration, and press home its claims upon a society like the present, it would surely be found in the combined horrors of this last sad calamity. Not enough that 334 poor fellows are swept off the stage of human existence, without a moment's warning beyond that which told them alike of calamity and death, but heroism and philanthropy are made to contribute to the melancholy sacrifice, and grief unparalleled in the history of explosions, arises from the common ruin which overtakes the rescuers and the lost. The future annals of our mining history will preserve with sacred lustre the noble-hearted bravery of Parkin Jeffcock and his companions, whose mortal remains are only just now being recovered from the grim sepulchre in which they have been entombed since the 13th December last.\* But the loss of so many lives, valuable and promising to the cause of colliery enterprise, in this neighbourhood especially, must ever keep alive the duty of improving its details, so long as ventilation and disaster remain in such intimate and unavoidable relation to each other.

In our previous observations we ventured to allege, that the systems of coal working, generally in practice, were to a great extent, if not altogether, established upon principles of expediency, rather than upon any well-regulated application

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\* This paper would indeed be barren if it did not embrace its tribute, however humble, to the self-devotion and heroic philanthropy which, especially in the case of Mr. Jeffcock, will be held in highest honour and admiration of all parties.

of scientific truth. And without attempting to deny the varying conditions under which the practice of coal mining must necessarily be carried on—thickness of seam, and quality of coal as respects its production of gas being always taken into consideration—there is a diversity of opinion, even amongst mining engineers themselves, which tends greatly to strengthen and confirm the accuracy of this sad conclusion.

In many respects the occupation of a coal miner must be regarded as an exceptional one; and from the peculiar difficulties and unforeseen dangers attendant upon its grim pursuit, it is necessarily beyond the reach of that general observation and control, which are applicable to all the other departments of labour, in which our industrial population are engaged. Hence the omission in mining operations of many of those salutary enactments, which have gone far in other departments of labour, to promote the mutual interests and security alike of employers and employed.

To the province of what we term *accidents*, many events continue to be assigned, which ignorance or neglect give rise to, above-ground as well as below; and so long as individual consequences *only* are threatened, it may be sufficient to rely for protection upon the natural alliance which exists between responsibility and danger. It is essentially different, however, the moment it is expanded, and individual risk becomes the representative, it may be of *scores*, or, as we have recently seen, of *hundreds* of lives, all liable to immediate extinction, without warning or the remotest chance of escape. One after another, the catastrophes in this district have revealed the increasing force and importance with which the truth of this assertion applies to the mining operations of the country on the one hand, and the obligation on the other, which rests especially with a Society like the present, to stimulate and exert every precautionary effort, by which, so far as its influence will extend, the misery of human suffering and loss, conse-

quent upon such operations, may be reduced to its lowest possible amount. The duty becomes still more urgent and imperative, when we contemplate the rapidly increasing ratio in which the mining operations of the country are being extended; and nowhere, perhaps, is this increase more perceptible than in the coal-fields of West Yorkshire, and of this immediate locality in particular. Not only have we to reflect upon a production, which has nearly doubled itself within the last 20 years, and now amounting to about 100,000,000 tons per annum from the collieries of Britain, but we must bear in mind, the increased and increasing difficulty and risk, which necessarily attend upon the extraction of this enormous quantity of coal from greater depths, and from expanded areas more vigorously worked, both of which conditions imply a far more active generation of gas, and the exposure of a much greater number of lives to all the dangers and consequences of explosion and death.

Proceeding from a commencement in which expediency and economy exert the dominant sway, the systems of ventilation now in common use, are but the expansions of an evil theory, and are unentitled to be regarded as the offspring or result of any scientific principle, adequately applied to the exigencies of so vast and precarious an enterprise. Our objections are against all attempts to render ventilation dependent upon downward currents; or, in other words, against a system of ventilation, which relies for its action, upon the ability to compel the exudation of gas, and vitiated air, along passages and currents, to which, by their natural gravity, such gases are utterly opposed.

In our previous papers we asserted, and mining experience has confirmed, the truthfulness of the observation, that a part only of the conditions are considered, which ought to govern the selection of the points from which the products of our coal fields should be won. The mechanical operations of



winning the coal has taken precedence of the graver question of ventilation. Hence the almost universal practice of placing the winnings on the dip, or lowest portion of the field; which serves the mechanical convenience of extracting the coal, both as regards its *drainage* and underground transit; but in the matter of ventilation, is directly opposed to the selection of such a point, as would best facilitate the free escape of explosive gases from the mine.

In every coal mine there must be "goaf," or chasms from which the coal has been exhausted; and it is to the quiescent abode presented by these spaces, and the apertures and cavities in the roof above them, that the more dangerous gases resort; escaping by their undisturbed seclusion, admixture with the circulating current which would otherwise effect their expulsion.

In the history of colliery explosions, it has rarely, if ever happened, that the true cause of mischief has been thoroughly and conclusively probed and understood. The presence of gas in an inflammable condition is manifest, but whether as the result of a sudden disclosure of what is termed a "blower," or the stealthy invasion of the goaf-secreted enemy, consequent upon a change of barometrical pressure, the fall of roof, concussion of air, or other contingency, remains a problem of undefined and unfathomable mystery.

At the door of this treacherous foe the mischief has long been laid; and to the unavoidable presence of "goaf," and the dangers inseparable from its existence, on present systems of ventilation, we chiefly owe the invention and use of the several forms of that humane instrument, known as the "*Safety Lamp*." Far be it from us to underrate the value and good service which have been rendered by this important invention. A retrospect of our mining experience does, however, justify us in the inquiry, whether the "*Safety Lamp*" has in reality been a blessing or the reverse? That its use

indemnifies us, where the atmosphere without it would be instantly fatal we freely admit. The grander question, however, at the present moment is—whether any such atmosphere ought ever to exist, and whether the proper business of *ventilation* has been performed, where in the ordinary operations of a mine, the safety lamp becomes necessary? On this issue the vital question of mining security must be fairly tried.

It has already been more than insinuated, that descending currents and effective ventilation are, for colliery purposes, incompatible in theory, and inoperative in practice. The air, we admit, is capable of being attracted by the agency of high rarifying power along the downward courses of a mine, and currents may thus be established which indicate a total volume sufficient for every purpose, if they were diffused in the mine, and made to scour its cavities as the very idea of ventilation imports. But here we encounter the difficulties and uncertainties of the entire system. The air impelled against the law which its own gravity stamps upon it, is ever struggling to escape by the shortest possible tracks which lead to its exit; and hence it is, that ventilation by the processes in most general use is made to assume the form of sharply-defined jets, which pierce the apertures and passages of the mine, in the direction, and with a form, proportionate to the degree of coercive influence which compels their obedience, and beyond this any such principle as that of voluntary diffusion is utterly abortive.

Another aspect of the difficulty arises when we turn from the ventilating air to consider the gases generated in the mine, which it is requisite to dilute and expel.

The most prominent gas, because that which imparts the inflammable constituent—carburetted hydrogen—is well known to possess a remarkable degree of lightness, its specific gravity being very little more than *one-half* that of ordinary atmos-

pheric air. This singular property imparts a facility to the gas, of which a perfect system of ventilation ought to take the most careful advantage. Its natural tendency being to ascend, with a degree of activity and force proportioned to its peculiar lightness as compared with the surrounding air, nature herself would seem to dictate the kind of arrangement which should be provided for the escape of so treacherous a foe, and surely this would be to reverse a great deal of that we now witness in practice.

It has been already suggested, that existing systems have professed to take cognizance of the natural habit of the gas here referred to, and the workings have obtained a supposed assimilation to the direct form of evils, by affecting the equilibrium of all parts of the mine, in the proportion due to the length of the up-cast shaft, and the degree of rarification produced and kept up in it. The theory may be accurate enough, but in practice it is utterly fallacious.

In the case of a coal mine we have a series of isolations, which, from causes already referred to, escape the general current of ventilation, and thus become stagnant pools or receptacles of gas, which answer to the term we have previously used as undrained "goaf."

Without stopping to discuss the very probable relation in which these "goafs" have stood to every instance of extensive explosion, we may remark, that their constant drainage or ventilation, has always been held a great desideratum. The operation has not, however, been thus far accomplished. And so long as the leading currents of ventilation, are forced in directions, directly opposed to the habit which the lighter and more dangerous gases naturally obey, isolation must continue, and with it those magazines of danger and of death, which make the use of the safety lamp necessary and imperative. Harmonize the direction of such currents and habit, and the result must go far towards

realizing the security and convenience so necessary to be attained.

It is scarcely necessary to incorporate in this paper, a discussion of the details of particular systems, resorted to in the merely mechanical operation of getting coal. They are to a great extent, quite independent of the scheme, and theory, upon which the ventilation of the mine is established. Assuming them, therefore, as applicable to one direction or the other, it must be evident, that the most active and important facilities may be obtained, by allying them to currents, which follow an *ascending* plane, and that all such advantages are frustrated, when the isolation is produced, which *descending* currents of necessity give rise to.

Without wishing to diminish the censure sought to be stamped on what may be termed the *unnatural* or *downward* direction of ventilating currents, for the operative parts of a mine, there may be sufficient to justify in practice, the adoption of a descending plane for the final course, by which the return air is directly expelled from the mine. The operation of coal-getting should, however, be so manipulated, as that each separate working "face" should have access to the return air-course at the highest point to which the face may be carried; the fresh air admitted at the lowest part, being made to sweep out the goaf in its passage to the face, and so prevent the accumulation of secreted gas, in places to which it is attracted by repose, rather than habit or natural choice.

The vast importance of improved systems of ventilation, might be urged as a necessity of winning coal from far greater depths than we have hitherto been accustomed to; the proposition is, however, too self-evident to warrant further observation.

The events of the present moment in connection with the recent explosion, and the recovery now in progress of the vast multitude who perished at the Oaks Colliery in December

last, speak in language which human sympathy is powerless to resist. Suffice it that this appalling catastrophe, which costly as it has proved, in the valuable lives of so many experienced and estimable men, whose mortal remains have only been disentombed from the pit, whilst this paper has been in preparation, will not be without its useful effect, if it tends to stimulate a determined resolution, on the part of all who are interested in colliery pursuits, to leave no effort untried, until the resources of ingenuity and scientific skill have been exhausted, in promoting the comfort, and security, of all who are called to labour or occupy themselves, in the mining industry of the country.









PROCEEDINGS  
OF THE  
GEOLOGICAL AND POLYTECHNIC SOCIETY

Of the West-Riding of Yorkshire,

AT THE SEVENTY-SECOND MEETING, HELD IN THE  
LECTURE HALL OF THE MECHANICS' INSTITUTE, ROTHERHAM,  
ON WEDNESDAY, APRIL 15TH, 1868.

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THE RIGHT HON. EARL FITZWILLIAM, VICE-PRESIDENT,  
IN THE CHAIR.

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EARL FITZWILLIAM, in opening the proceedings remarked that this was the first time the Society had met in Rotherham, and he hoped the visit would be repeated on some future occasion. It was established about thirty years ago, the object of its founders being to collect information with regard to the Geological formation of the county; and also as to the engineering works which from time to time were needful in carrying on the mining operations. It was of great importance, said his Lordship, that every little fact of this nature should be brought to the knowledge of a Society like that, for they would thus be recorded for the benefit of the public at large. His Lordship concluded by proposing the following gentlemen as members of the Society:—John Guest, Esq., and John Yates, Esq., of Rotherham; H. A. Nicholson, D.Sc., F.G.S., of Keighley; and Rev. C. H. Middleton, F.L.S., of Badsworth.

His Lordship then called upon Mr. Fairless Barber to read the first paper.

ON THE ORIGIN AND USE OF MENHIRS, OR PILLAR STONES.  
 BY THE REV. R. J. MAPLETON, M.A., CORRESPONDING  
 MEMBER OF THE SOCIETY OF ANTIQUARIES OF SCOTLAND.

In walking through a cemetery, or better still, through a burying-ground of some ancient church, we are struck with the variety of monuments that surviving friends have erected to the memory of their dead. The simple headstone, as well as the costly mausoleum, tells its tale of affection and sorrow. And in every age, as we go backward in time, the peculiar feelings of the period are strongly marked upon them. At the present time, crosses in various designs, with simple inscriptions, have succeeded to the cherubs, and skulls, and hour-glasses, and funeral urns, and the long catalogue of virtues, that were the fashion of the preceding age. And yet these were the ancestors of the sepulchral crosses. The idea is the same, although each bears the impress of the feelings of its age. And we can go back still further to the so-called "Iona-stones" of Scotland, the sculptured Runic stones, the village and churchyard crosses. But whence did these derive their origin? The answer that it is "natural to place a cross or sculptured stone, as a memorial," is no answer at all. Can we not go still further back, and trace the custom to a period still nearer to its real origin?

Few persons who have travelled in the Highlands can fail to have been struck with the great "standing stones" that rear their hoary heads among the heather, or stand in solitary grandeur in the fields—a memorial of ages long past: often protected, by a superstitious reverence, from the desecration of the ruthless hand of the "improver." It seems almost a miracle that they have been preserved.

“Some remnant of Druidical worship,” is the common remark. If they had but a voice, what wondrous tales could they tell of the old lords of the soil! And yet now are they beginning to speak, and to tell the feelings of their age, even as their descendants in our churchyards tell their tale of hope and faith, or of sorrow. As the cairns and sepulchres of unhewn stones, with their urns and rough implements of war or domestic use, or articles of female ornament, can most surely claim to be the forefathers of the vaults and shrines of later days, so these venerable stones can point to our crosses and obelisks and pillars and tomb-stones, and say, “These are our children; from us came the idea that has pervaded each age, although stamped with its own peculiar mark, and each telling its own tale of religious belief and social feeling.” But whence are the stones themselves? However natural it may now seem to place a tomb-stone, it could not have been very natural in those early days; for the carriage of huge slabs of stone, sometimes sixteen or twenty feet in length (and in some instances even sixty feet, and weighing about 250 tons), for many miles over a rough and wild country, and afterwards erecting them in their upright position, at a time, too, when metal was not much in use, so that their machinery could not have been very powerful;—surely this was not “natural,” not so natural and easy as the cairn.

These ancient stones tell us, indeed, that at that spot may lie the ashes of some hero, or that there was fought some great battle, or that some grand covenant was made there; but they tell us more: they tell us their own history; they tell us the feelings and worship of their day, even as our crosses will tell to those who come after us, what were the hopes and belief of this age. They utter with silent tongue the name of their God: the God by whose strength the battle was said to be won, the God who was invoked as a witness to the covenant.

These hoary stones, called by some "Men-hirs," *i.e.*, erect upright stones (hence the word "Hare-stone," used in Scotland), were at one time very common in Scotland; so much so, that hardly a parish could be found 100 years ago but what had several of them still existing, or at least the tradition of many that had existed a short time before. Standing in various situations, alone and in groups, on hill-tops and by the river-side, in stone circles and on the tops of cairns, they seemed to proclaim some universal principle, and to be co-extensive with the country. As direct historical record will take us back but a short time comparatively, and as the earliest accounts of Britain are derived from those who would ridicule its religion and despise its natives as barbarians, and who could judge of its creed only by what little they saw, interpreted by their own prejudices (for the Druids, it is known, would commit nothing to writing, and were very careful to keep their mysteries and their learning a profound secret), we must try to gain some glimpse of the origin and use of these men-hirs, by comparing the superstitions and legends and proverbs of the people still existing, with those of other lands, of which we have a record. We may feel sure that so universal a custom, as that of erecting menhirs, must in some way or other be connected with religion—although they might afterwards be used for different purposes. This is more evident, when we consider that these stones are by no means confined to Britain: on the contrary, they seem to have been almost universal. They were spread through Britain, Ireland, the Isle of Man, the Channel Islands, to France (where they are most abundant in Brittany), through Spain, the north coast of Africa, Asia Minor, Palestine, Phenicia, through Persia and Media to India, where they exist in vast numbers, and are still erected, through Greece and Italy: they proclaim some very general, almost universal, principle, that must

have existed in the very remotest ages, so remote, that their origin is lost in antiquity. It was so even in the days of Josephus, who states that two pillars were erected by the children of Seth, before the flood, to record their knowledge of astronomy. Though this statement is improbable, it proves, at the very least, how very ancient they were, and how distant was their origin.

So also in Scotland, Armorica, the Dekhan, and Africa, the origin of these stones is lost in antiquity. They are mostly referred, in the legends of the people, to human beings or other living creatures metamorphosed into stone: even as among the Greeks, everything that was beyond history and reliable legend, was referred to the "gods." Some slight guess at the age of some of them may be formed, from the fact that at Classernish, in the Isle of Lewis, only the tops of some stones were visible, but the bases were found 20 or 23 feet below the surface, when the moss was removed.

The original form of these menhirs was a plain unhewn stone, upon which "no tool had passed," but often made into a pyramidal or conical shape. In some situations, especially on the east coast of Scotland, they are found with sculptures, such as the "double disc," the "crescent and sceptre," the "serpent," &c., &c., and gradually passing into that wonderful interlaced pattern, with Christian sculptures, of which so many beautiful specimens are found in nearly every part of Scotland and the North of England, and the Isle of Man.

The same thing may be said of cairns and tumuli, *i.e.*, heaps of stones or earth. They seem to have been equally universal; in fact, as from their nature they are less liable to destruction, their remains seem even more widely distributed than the menhirs. There can be little doubt that cairns were chiefly sepulchral—sometimes for honour, sometimes for disgrace—but they were used for other purposes, as *e.g.*,

for sacred fires and judicial proceedings. There is an old saying in Gaelic, "Cuir mi clach ad charn," "I will put a stone on your heap." This is used as a compliment—alluding to the custom of making great heaps as a memorial. Of this description was the tumulus raised over Patroclus, and also the "mountain" that was raised over Andromache's father. These often became places of worship, or the seat of some temple. Thus the temple of Pallas in Larissa was the sepulchre of Acrisius; and Lycophron, when speaking of the temple of Juno, calls it  $\tau\upsilon\mu\beta\omicron\varsigma$ . So Virgil uses the expression, "Tumulum antiquæ Cereris." There was, however, another proverb or saying, just the reverse of the last, and used both in Gaelic and Welsh as a curse, viz., "To wish one under a cairn," *i.e.*, not merely to wish their enemy dead, but buried in dishonour. It is to this that Sir Walter Scott alludes in his tale, *The Heart of Midlothian*.

The Gaelic term for "outlaw" is still "Fear air charn," the man in the cairn. Compare this with Josh. vii. 25, 26, "All Israel stoned him with stones, and they raised over him a great heap of stones to this day;" and 2 Sam. xviii. 17, "They cast Absalom into a great pit in a wood, and laid a very great heap of stones upon him."

It is important to keep this in mind, as the two monuments are so repeatedly connected, that each affords to the other a strong confirmation of similarity of customs and religious belief.

From the statements in Scripture and other sources, there can be no doubt, I think, but that these menhirs, in their original intention, were representatives of Deity; not idols, in the usual acceptation of this term, as they were designedly without form or figure, but embodiments or symbols of Deity. Potter, in his *Antiquities of Greece*, states that the first idol was a rude stock, and says that Pausanias tells us "that in Achaia there were kept 30 square stones, on which

were engraven the names of so many gods, but without pictures or effigies. No sort of idol was more common than that of oblong stones erected, and thence called *κίονες*, pillars." In the East countries they were exceedingly frequent, and were called in Phenicia, *βαιτυλια*, "Beetyli." This name is very remarkable, as being a Grecised form of "Bethel," the "House of God," which was the name given by Jacob to the pillar that he set up and anointed, showing that the stone, in its first intention, was really an emblem or symbol of divinity.

In Arabia, according to Maximus Tyrius, Mercury was worshipped under the symbol of a square stone. Venus of Paphos, and Alitta in Arabia, were worshipped with impure rites, under the form of a white pyramid. It was a black conical stone that was brought to Rome by the Emperor Heliogabalus, as the statue, or, rather, the Bethel of the sun.

The most sacred oath among the Romans was "Per Jovem Lapidem."

So also Bacchus (or, as he is often called, "Iacchus") is mentioned by Clemens Alexandrinus as being figured among the Thebans by a pillar only. Bacchus or Dionysus was probably the autumnal personification of the sun, "*Ἥλιος ὃν Διονυσον επικλησιν καλεουσιν*" (Manob. Satur.) Thebes was the city to which (according to the Greek legends) the Tyrian Cadmus came, bringing from Phenicia the Cadmean alphabet, and with it probably Phenician customs and ideas.

The very name "Iacchus" being a Grecised form of *ΙΑΩ*, "the greatest of the gods," shows some connection with that land, where the great name was known; and we know that Mount Carmel had a great reputation, even in Greece, as Pythagoras studied there for some time.

That upright stones were objects of worship in Britain, is proved by various edicts against their being worshipped.

Stone worship was condemned by Theodore, Archbishop

of Canterbury, in the 7th century; by Edgar, in the 10th; by Cnut, in the 11th.

In Armorica, in the 5th and 6th centuries, it was condemned at Arles and Tours, and all doors were ordered to be closed against worshippers of certain upright stones. Brand, in his *Pop. Antiq.*, mentions, that in every district in Skye there was a rude stone consecrated to Gruagach or Apollo; and the Rev. Mr. McQueen states that in Skye the sun, called Gruagach or "fair-haired," was represented by a rude stone. And to this day, in the Dekhan, the ancient ceremonies are still practised, generally coupled with impurity, and certain stones are anointed with oil.

So in Ireland, a stone pillar, surrounded by twelve others, received worship. (Todd's *Patrick*.)

The question, then, would be, "What god or divinity did these stones represent?" Certain proverbs and superstitious customs and names still existing in Scotland, but much more frequent 100 years ago, point most clearly to Baal and sun worship. The worship of the sun seemed to be interwoven in most of their customs, both domestic and religious; and so intimately, that it is by no means extinct, even in these days of enlightenment and progress.

There can be no doubt, also, that Baal was of old the god of Britain—even as Scripture tells us that he was the god of the countries around Israel. The superstitions, legends, and proverbs still remaining, prove most clearly that such was the case. Baal, however, is not to be understood as some particular deity—such as Mars or Apollo—but as the name of the invisible, eternal God, just as "the Great Spirit" is now the name by which some uncivilized nations speak of Deity. The Gaelic form of this name, "Beil," is said to be derived from Bea-uil, "the life or source of all things;" even as in Ceylon "Bali" is "planetary worship;" "Bhala," "light."



Though the sun was adopted as a representation of Deity, as being the most direct and evident manifestation of Divine power, and the visible source of heat, life, vitality, and generation, still, as shown by the word for sun, "grian," or "Gri'ine," the "nature of fire," they did not regard the sun as the Deity himself, but as a manifestation of his power: they believed in one invisible, omnipotent, eternal Being—Beil, the source of all things—in common with Egyptians, Hindoos, Persians, Greeks, Phenicians, and Israel.

Baal, Bel, or Beil, seems to have been a general name for God, and probably each people would select some one attribute as the prominent feature in divinity, according to their own peculiar habit of mind. Thus the Baal of North and South Syria differed greatly. The one was a stern, harsh, and bloody worship—even that of Moloch—offering sons and daughters to Baal; the other, a soft, effeminate, and impure worship—such as that of Baal Peor, and in other countries the worship of Venus, and of which such fearful accounts are given us by Herodotus. After the time of Moses, the name of the Baal of Israel was Jehovah; what it was before that time we are not told, only we are told in Ex. vi. 3 that it was not "Jehovah;" and the frequent use of Baal in names, shows that at one period there was no disgrace, no semblance of idolatry in its use. Thus in the same chapter of Judges, the 18th, the same place is called Baal-berith (4), and El-berith (36), as though no difference existed between El and Baal. Saul and Jonathan had sons, whose names were compounded with "Baal." Several of David's officers had the same, as though even in their lifetime the name Baal implied no sin or disgrace, as it did in after times; nay, we have a more direct proof that "Baal," in itself, did not always imply idolatry, in Hosea ii. 16, Thou shalt call me Ishi, "my husband," and shalt call me no more "Baali," *i.e.*, "my lord." Thus Baal was the deity of Canaan and Syria,

so also of Babylon, where the great temple was dedicated to Jupiter Belus. So also we find the word in Africa along the route where menhirs and cairns existed, as in Hannibal, Asdrubal. The word was also used in Britain, as, *e.g.*, "Cassibelan," "Cunobeline," both of whom are called simply "Belinus," by two authors, Dio and Nennius.

Belik is the Breton word for priest, as also in old Cornish, "Belini ædituus Stirpe satus Druidum, Gentis Armorice" (Ausonius).

Besides the name Baal and worship of the sun, which were common to Britain and Palestine, there are certain other customs and circumstances common to both countries, which show that at one time the same ideas existed in both countries; in other words, that the inhabitants of Britain long retained, and in some respects still retain, the customs and feelings with which they originally left the parent tribe in the East. These tell us that we must look to the East for an explanation of the original worship and creed of the Celtic nations, both in Britain and elsewhere. Thus nothing is more common than to find flint-knives and other stone implements in the cists and burial-places, as well as in other situations. The same custom existed in Israel. In Joshua v. 2 of the Septuagint and Vulgate translations, the command was, "Make for yourselves stone-knives and circumcise the children of Israel." Although our version reads "sharp knives," the margin gives "knives of flint." So at the burial of Joshua, xxiv. 30 (Septuagint), "there they buried with him in the tomb, in which they buried him, the stone-knives with which he circumcised the children of Israel in Gilgal." It was probably from the same custom that Zipporah used a "sharp stone" to circumcise her son.

The similarity, too, between the old Irish alphabet and the Hebrew is very striking. The present square Hebrew character is comparatively modern. The Jewish coins, till

some time after our era, bear inscriptions in the Phenician character, which probably was the character used by the Hebrews. The names of some of the letters in the Irish alphabet are almost identical with those of the Hebrew, *e.g.*, Aleph, Ailm; Beth, Beth; Iod, Iodha; Mem, Muin; Nun, Nuin; Pe, Pieth; Resh, Ruis. And as the Irish letters are named after trees (among which is the vine, not a native of Ireland), it is, to say the least, a very strange coincidence. The number also of the Irish letters corresponds with the original alphabet of Phenicia and with the Greek, before new letters were added, which, some say, was about the time of the Trojan war; thus apparently throwing the connection between Ireland and Phenicia to a period very far distant.

We might add a threefold ministry—Druids, Bards, and Eubates (or Vates), supposed to be students, literally “promising youths”—corresponding with priests, Levites, and schools of the prophets.

So also the use of the cross, as a sacred emblem. This was common to the Egyptians, Hindoos, and Phenicians; and though now adapted to Christian worship, and become the emblem of a high and purer mystery, was nevertheless in use before our era. In Ezekiel ix. 4 and 6, where the Almighty commanded the man clothed in linen to go through the city and mark certain of the people in the forehead, the Hebrew and Vulgate read, “Mark with the mark *Tau* ;” and the Phenician Tau, the last letter of their alphabet, was a cross.

The Egyptian Tau is too well known, as a sign or emblem of life, to require more than a passing allusion. The globe and cross was carried by the representation of the Ibis. Saturn’s monogram was a cross and ram’s horn. Jupiter often bore a cross with a horn. Venus a circle and cross.

It is used in India. Two, at least, of the principal

pagodas are built in the form of crosses. In a description of an ancient city of Mexico, published in 1822, it is stated that there are many examples of the cross among other hieroglyphics. One is very remarkable, and on the top is placed an idol, in the likeness of a hen—the hen of Ceres, to which the devotee is offering an infant. The cross was sacred to the Druids. Schedius de Mor. Germ. 24, as quoted by Godfrey Higgins, states “that the Druids seek carefully for an oak, with two principal arms, growing horizontally, in form of a cross.” If they cannot find this, they fasten a cross beam to it, and they cut the name of God, “Tau,” upon this. Now Maximus Tyrius says that the Celtæ adored Jupiter, and the Celtic statue of Jupiter is a lofty oak, thus connecting Tau and the cross with God.

It is necessary to keep in mind how remarkably the customs and religious belief of Britain and Ireland agree with those of countries mentioned in Scripture and in other records, as it is by these means that we can form any conception of the origin and use of the menhirs, or pillar stones. There can be no doubt of the worship of Baal and the sun among Israel and the nations around them, and there is sufficient evidence that such was also the early worship of the Celtæ.

The custom of observing the course of the sun is still very prevalent. When going out to fish, the sailors in many places will not proceed, unless they first turn their boat round with the sun; if it should go against the sun, they will not go out that day. A clergyman in Appin has informed me, that even to this day, when the coffin has left the church, the bearers and mourners march round the grave “sunwise” before they will deposit it in the grave. A similar custom exists also among the Esquimaux.

This custom has given rise to a saying, though the origin of it is not always known, viz. :—

Deas-iul, "Way of South," *Lucky*.

Tua-iul, "Way of North," *Unlucky*.

These two words are in constant use, and are derived from sun-worship, even as the old custom of passing the bottle "the way of the sun" has a similar origin.

The old statistical account of Scotland (A.D. 1794) is full of the remains of this worship.

Sick people were carried "sunwise" round cairns. Water taken from sacred wells, for the recovery of a sick person, was carefully watched. If, in being moved, it turned deas-iul, "sunwise," the patient would recover; if tua-iul, "against the sun," he would die. We may add that the latter prediction was often fulfilled, as the friends would take no care of the sick man, and would not choose to counteract the sun's prophecy.

The Gaelic word for "miracle" is mior-Bheil, "the finger of Baal;" hence, perhaps, our word "marvel."

So, again, Gabha-Bheil, "the jeopardy of Baal," is still the word used to express an escape from serious danger, and is taken from one of the most solemn and awful ordeals of old time, to which reference will be made hereafter. In both these words the Highlanders are exceedingly shocked if they are told that they are acknowledging Baal.

May-day is still called Beil-tin, or Beltane, "the fire of Baal;" and the custom of lighting fires on May-day, and other days connected with the seasons, or solstices, is not yet extinct. On the first Monday of the year (O.S.), called Handsell Monday, there is a custom of lighting a fire at the Cross Well, at West Linton, Peebles-shire, immediately after the Sunday has passed. This is evidently a rejoicing that Adonis is alive again; in other words, that the sun having reached his lowest declivity is again commencing his upward course. So strong is the feeling, that no fine, which is annually imposed, will deter the men from their custom.

By way of evidence, I may refer to the Sheriff's Court at Peebles, year by year. Probably the rustic ceremony of Plough Monday may be referred to the same source, as it occurs in January, between the autumn and spring ploughings, and cannot therefore be referred to agricultural usage. The old English custom of Christmas, or Yule (or Yeul) "logs," was derived from the same origin, especially as the orthodox plan was to save a portion of each year's log to light the log of the following year.

So also a custom, now almost lost, of Christmas candles, *i.e.*, each member of a family lighted a candle for himself on Christmas eve.

The very name "Yeul" seems to be derived from the sun. In Sanscrit, "Heli;" Greek, "Helios;" Welsh, "Haul;" Armorican, "Haul" and "Heol;" Cornish, "Houl" and "Heul."

The most remarkable remains of Baal worship are the Baalfires which a few years ago were very generally lighted on May-day, or May-eve; and from this circumstance May-day is still called Bheall-tainn, the "fire of Baal." It is a common saying "o' Bheall-tainn gu Samh-uinn," *i.e.*, "from Whitsuntide to Hallow-een;" referring to the two grand Druidical feasts, *viz.*, Baal's fire and the fire of peace. The latter of these was on Hallow-een, when the Druids went round on circuit, as Samuel did, to judge the people. Every fire was extinguished and rekindled by holy fire, kindled and consecrated by the Druids. No excommunicate person was allowed to have it, and no friend or neighbour dared to supply him. He was thus doomed to cold and misery till he made peace with the Druids. Hence it was that the Druidical tenet of "Hell" was diametrically opposite to our own, *viz.*, instead of everlasting *fire* it was everlasting *cold*, fogs, and damp morasses. It is strange that the Gaelic word for hell, even now, bears witness to this notion, being

“Ifurin,” or “the island of the land of cold;” although, when the word is now used, the Highlanders mean by it the place of everlasting fire.

In the old statistical account of Callander, in Perthshire, a singular custom is mentioned as existing at that time, and founded upon the old feast of Samh-uinn. Baal fires were lighted on rising grounds and in villages. When the fire was burnt down, the ashes were carefully collected in a circle; a stone was then placed in the circumference of glowing ashes, for every person or family interested in the ceremony. If any stone was injured, or moved from its place in the morning, the person whose stone it was, was considered to be doomed, and supposed to die before twelve months. Here is a clear allusion to the excommunicate person being deprived of fire, and left to perish. The festivities of Hallow-eeen still bear some resemblance to this custom. Nuts are placed in the fire by the lads and lasses; if they burn evenly together, a marriage is supposed to be the inevitable result. If one should jump out of the fire, no marriage can take place; but probably single misery will be the doom.

The ceremonies at Beltane were equally conclusive of a Baal origin. In the old statistical account of Callander the writer records a custom that was then wearing out in all the Highlands, and which, therefore, he very wisely thought, ought to be taken notice of. “On the first of May, called Beltan, or Beil-tein day, all the boys in a township or hamlet meet in the moors. They cut a table in the green sod of a round figure, by casting a trench in the ground; they kindle a fire, and dress a repast of eggs and milk in the consistence of a custard; they knead a cake of oatmeal, which is toasted at the embers against a stone. After the custard is eaten up, they divide the cake into so many portions, as similar as possible to one another in size and shape, as there are persons

in the company; they daub one of these portions all over with charcoal till it be perfectly black; they put all the bits of cake into a bonnet; every one, blindfold, draws out a portion. He who holds the bonnet is entitled to the last bit. Whoever draws the black bit is the devoted person to be sacrificed to Baal, whose favour they mean to implore in rendering the year productive of the sustenance of man and beast. There is little doubt of these inhuman sacrifices having been once offered in this country as well as in the East, although they now pass from the act of sacrificing, and only compel the devoted person to leap three times through the flames."

It is singular to observe in connection with this oat-cake lottery, and a somewhat similar one to be noticed immediately, that though the only idea of sacrifice now entertained by the Highlanders is one drawn from Scripture and classic authors, viz., that of bulls, and goats, and rams, &c., &c., their word for sacrifice is "Iob-oirt," from iob or uib, "a raw cake" or "lump of dough," and thoirt, to "offer" (the "th" being quiescent), thus retaining the old word for Baal offerings.

There are many other notices of Baal fires existing at that time; and a short time ago a sum of money was left in Aberdeenshire to keep up the Beltane fire.\*

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\* The following paragraph appeared in the *Leeds Mercury* of June 29th, 1867. "A letter from Dublin says:—The old Pagan fire-worship still survives in Ireland, though nominally in honour of St. John. On Sunday night bonfires were observed throughout nearly every county in the province of Leinster. In Kilkenny fires blazed on every hill side at intervals of about a mile. There were very many in the Queen's County, also in Kildare and Wexford. The effect in the rich sunset appeared to travellers very grand. The people assemble and dance round the fires, children jump through the flames, and in former times live coals were carried into the cornfields to prevent blight. Of course the people are not conscious that this midsummer celebration is a remnant of the worship of Baal. It is believed by many that the round towers were intended for signal fires in connection with this worship."—[H. D.]



Another ceremony is mentioned by Pennant. "On the first of May the herdsmen of every village hold their Beltein, a rural sacrifice. They cut a square trench in the ground, leaving the turf in the middle. On that they make a fire of wood, on which they dress a large caudle of eggs, butter, oatmeal, and milk. The rites begin with spilling some of the caudle on the ground by way of libation. On that, every one takes a cake of oatmeal, on which are raised nine square knobs, each dedicated to some particular being, the supposed preserver of their flocks and herds, or to some particular animal, the real destroyer of them. Each person then turns his face to the fire, breaks off a knob, and flinging it over his shoulders, says, 'This I give to thee, preserve thou my horses; this to thee, preserve thou my sheep; this I give to thee, O fox, spare thou my lambs,' &c., &c. When all is over they dine on the caudle."—*Tour in Scotland*, 1769.

The writer of the article "Baal," in Calmet's *Dictionary of the Bible*, states that he has witnessed the Beltein on Midsummer eve in public streets of towns in the diocese of Durham. Another writer, Hayman Rook, states that summer fires were lighted at Brimham in 1786. In North Wales, though for some cause the day got altered, the fires were kept up with great spirit, and certain ceremonies, among which was running through the fire and smoke, and casting a stone into the fire. On the following morning the stones were searched for in the fire; if any were missing, their owners had to make up their minds to encounter mischief. There is a town in Perthshire called "Tillie," or Tullie-beltane, *i.e.*, the "eminence of the fire of Baal." On Beltane morning, people went to a sacred well in the locality, and walked in procession round it nine times. The reverend writer adds that "many who reckoned themselves good Protestants would not neglect this, even when Beltane

fell on a Sabbath!" Truly their old custom must have taken deep root indeed. There is a proverb still in use among the Highlanders, though its real meaning is lost, implying a position of danger, or rather an awkward dilemma, viz., "Ittir dhu theine Bheil," "between Bel's two fires."

Toland mentions that there was in the Isle of St. Kilda a hill called "Otter Veaul," or "Belen's height." One writer states that though the name Beltein is not known in Sweden, the custom of fires on April 30th (the eve of Beltane day) was very common. The people were wont to light great fires on the hills, and spend the night in shooting.

So also in Norway, as late as 1807; though, owing to the clear bright light of the sun, the fire itself was all but invisible.

Allusion has been made above to the "Gabha Bheil," or "jeopardy of Baal." There seems to have been two species of this ordeal, one in the case of a criminal, and the other an usual ceremony, either on the Beil-tin or Samh, in festivals. Toland, who wrote at the commencement of the 18th century, and was well read in the old literature of Ireland, and acquainted with all its old customs, tells us "that on May-eve prodigious fires were made on the numerous cairns which existed on the tops of mountains and high places in Ireland. They were made in honour of Baal, or Beil, latinized by the Romans into Belenus, by "which name the Gauls and their colonies understood 'the sun.'" One hill in Toland's memory was never known by any other name than "Baulteine." He seems to infer that fires were thus lighted on May-eve (and the Gaelic name for May is even now "ceitean or ceud-uin," the *First* month); also on Midsummer eve, when corn begins to ripen; on November 1st, after harvest; and on New Year's eve, the commencement of the sun's upward course.

When the flames of the fire had ceased, "the lord of the place, or his son, walked barefoot over the ashes, carrying the entrails of the victims to the Druid; if he escaped injury, it was regarded as an omen of good to himself and people, but if not, it was a presage of evil." This old custom was not forgotten in Ireland at the close of the 17th century. The people would eagerly jump through the St. John's fires, not by way of sport, but because they thought that by so doing they obtained some blessing. Is it not possible that the English custom of jumping through bonfires may also be a remains of old forgotten ceremonies, and not merely a rash feat of agility? It is strange to compare with this the words of Silius Italicus, v. 175:—

"Exta ter innocuos late portare per ignes," &c.

"Then seeing Equanus, near Soracte born,  
Whose country manner is, when the archer keen,  
Divine Apollo, joys in burning heaps,  
The sacred entrails thro' the fire unhurt  
To carry thrice: so may you always tread  
With unscorched feet the consecrated coals,  
And o'er the heat victorious swiftly bear  
The solemn gifts to pleased Apollo's altar."

Why was Apollo surnamed "Carnus" by the Greeks? Why, too, was May called "the Carnean month"? Most probably the word was derived from the Celtic tribes, and "Carnus" became Apollo's name, from the heap or cairn on which he was worshipped. It is not too much to suppose this, nor is it ascribing too great a notoriety to the Celtic race; for, setting aside the question of "Who the Celts were," Iamblichus, in his life of Pythagoras, distinctly states that Pythagoras having studied in Egypt, among the Chaldeans and Magi, in Eleusis, Samothrace, and Delos, and also for a long time in the temple on Mount Carmel, learned much from the *Celts*. And if Abaris, the priest of the

Hyperborean Apollo, were a *British* Celt, Britain must have contributed much to the learning of Pythagoras; for Abaris was rather a master than a pupil to his splendid friend.

The other ordeal took place on the Samh-in, "Fire of Peace," or Hallow-een. When an easy decision could not be obtained, the accused was obliged to clear himself, by walking thrice, barefooted, through the ashes of the sacred fire. If he escaped unhurt, heaven attested his innocence: if not, it was the "judgment of heaven" that he was guilty. This ordeal was the "Gabha-Beil," "jeopardy of Baal." It is, however, stated that the Druids knew of some oil, with which they bathed the feet of the accused, if they wished him to escape, for any reason. May not this be alluded to in St. Paul's words, 1 Cor. iii. 15, some shall be saved "yet so as by fire"? literally, "*through* the fire." Again, compare with this the words of Virgil:—

"O patron of Soracte's high abodes,  
Phœbus, the ruling power amongst the gods,  
Whom first we serve—whole woods of unctuous pine  
Burn on thy heap, and to thy glory shine:  
By thee protected, with our naked soles  
Thro' flames unsinged we pass, and tread the kindled coals:  
Give me, propitious power, to wash away  
The stains of this dishonourable day."—DRYDEN.

This is by no means the only allusion in *Virgil* to Celtic customs and feelings—or, rather, to feelings that the Celts had in common with the greater portion of the world. We may witness the sacred mistletoe, and the writing of oracles in leaves, from which custom our own words folio, and leaf of a book, may probably derive their origin.

If there is any truth in the assertion, that the hills and rivers of Scotland, or other lands, have retained the names given to them in pre-historic times, and that, therefore, these names are a record of ages long past and gone, can we doubt

that these singular customs and names, which have no connection with Scotland of historic times, and are in many respects opposed to the prejudices and feelings of the present race, point to very early ages—even to a time when Bel or Baal had a meaning, and found a response in the hearts of the people? There can be no doubt that sun or Baal worship prevailed to a great extent in Israel, and in most, if not in all, the nations of the world. The city of On or Aun (*i.e.*, the self-existing eternal Being) was called Heliopolis (city of the sun) by the Greeks. Baalbec in the East was also considered synonymous with city of the sun. In India, in Persia, in China too, so also in Greece and Rome, and even to the north of Europe, and probably in the wilds of Siberia, there seems to have been one universal feeling on this subject, viz., the existence of one great eternal being—Bel or Bramah, or Oromasdes, or Phthah; and the sun, as being the most direct and visible manifestation of his power. Connected with this, it is singular to find that some notion of a Triad or Trinity was almost as universal. Bramah, Vishnu, and Shiva, in India. Phtha, Amoun, and Osiris, in Egypt. Oromasdes, Mithra, Arimanius, in Persia. Bel, Samham, and Abhiester, in Britain. All having similar functions, and a similar, though not identical, connection. It is remarkable, that though the ordinary word for “devil” in Gaelic is one taken from the Scriptures, viz., some form of Satan or Diabolus, implying “accuser,” the real old word is *abheister*, which means “destroyer,” which is the office of Arimanius and Shiva with the Persians and Hindoos.

This wonderful similarity in feeling and religious belief among nations far removed from each other, and varying in habits, in climate, and disposition, cannot be the effect of chance, or the natural offspring of the human intellect, but is rather the remains of some primeval belief, and points to

a time of the infancy of the human race, when as yet no swarms had left the parent hive, and when afterwards they took their departure to seek new situations and more ample room for their increased numbers, they took with them the original religious belief, which afterwards got corrupted and changed according to each tribe's peculiar habits; and yet, strange to say, among all the variety of idols and strange systems of mythology, the truth was still known to the initiated, who in some instances have recorded that their idols and theogony were for the sake of the multitude, lest they should altogether forget God, while they themselves regarded them but as fables and emblems. (*Max. Tyrius*, Sallust on *Gods*, and *Aristot. Metaph.*)

We must turn then to the present use of pillar stones in India, and to the frequent mention of them in Scripture, as being the earliest authentic record that we possess, if we wish to form any conjecture as to their use and origin. It appears from Scripture that these pillars were used for various purposes, even as crosses have been among Christians; and, like the cross, were an emblem of Deity.

In Gen. xxviii. 18, we read, "Jacob rose up early in the morning, and took the stone that he had put for his pillow, and set it up for a pillar, and poured oil on the top of it, and called the name of that place 'Bethel,' *i.e.*, 'house of God:' but the name of that city was called Luz at first;" v. 22, "And this stone that I have set up for a pillar shall be God's house." On his return from Padan-aram he built an altar there, and called the place El-beth-el, *i.e.*, "The God of the house of God" (Gen. xxxv. 7).

So again, after God had appeared to him, and changed his name to "Israel," Jacob set up a pillar in the place where he talked with him, even a pillar of stone, and he poured a drink-offering thereon, and he poured oil thereon, and called the name of the place "Bethel," Gen. xxxv. 14, 15. 'Com-

paring this with the command given in Deut. xii. 3, "Ye shall overthrow their altars, and break their pillars, and burn their groves with fire," it seems clear enough that, however innocent in their first intention, these pillars became idolatrous and sinful, when the holy name had been once revealed to Israel. It is evident that they were not simple memorial stones, and their form would not have permitted them to be altars. It is a strange coincidence, to say the least, or rather an evidence of uniformity in idea and design, that besides "Bætyli" being the Phœnician name for pillars, Dr. Borlase states that these pillars were called by the ancient Irish "Bothal," "house of God." There was also another name applied to them, viz., "Crom-leach," which was derived, either from "Crom," to adore, and "leach," a stone; or else, as Toland says, from "leach," a stone, and "Crom," an old Irish name for "God." A priest was called "Cromar," or "Cruim-thear," a servant of Crom.

The word "clachan," "stones," is often used for "church." The word is still in use for this purpose; but about eighty years ago the Highlanders more frequently said, "Will you go to the stones?" than "Will you go to church?" In this instance, as in some others already mentioned, the old word remains, though a very different meaning is attached to it.

A stone circle in Aberdeenshire was still called the "Auld Kirk of Tough;" another at Alford was called the "Auld Kirk."

That the erection of menhirs, or pillar stones, was not originally sinful, is shewn by Moses' conduct at Mount Sinai (Exod. xxiv. 4): "Moses builded an altar under the hill, and twelve stones, according to the twelve tribes of Israel." The same thing was ordered to be done when the people had passed over Jordan, Deut. xxvii. 2, "It shall be, that thou shalt set thee up great stones, and plaister them with plaister: (5) And there shalt thou build an altar unto

the Lord thy God, (6) of whole stones: and offer burnt offerings, and peace offerings," &c. This was fulfilled by Joshua iv. vers. 5, 19, 20, "These stones did Joshua pitch in Gilgal." This Gilgal became a holy place, till in after days it became idolatrous; even as Bethel did (Hosea iv. 15), "Come not ye unto Gilgal, neither go ye up to Beth-aven." Thus it was at Gilgal that Samuel offered burnt offerings and peace offerings (1 Sam. x. 8); so, also, Saul offered a burnt offering there (xiii. 8). At Mizpeh (where was a pillar and a heap raised, by Jacob, as a witness), Samuel prayed for the people (1 Sam. vii. 15). There he judged them (6); there, also, he offered a suckling lamb for a burnt offering (9). Close to Mizpeh, also, he took a stone and set it up, and called it "Eben-ezer," *i.e.*, "stone of help."

So, also, the king (Josiah) stood by a pillar, and made a covenant before the Lord, 2 Kings xxiii. 3; and this pillar is called, in 2 Chron. xxxiv. 31, "His place." Colonel Forbes Leslie, in his *Early Races of Scotland*, vol. i., p. 250, writes "that in India, not only among the aboriginal tribes, but also professed Hindus, unhewn stones are still used as representations of the invisible powers, which are the object of native worship. Not only in India, but in Central Asia, in Cafirstan, and among tribes on the eastern frontier of Hindostan, stones are placed as representatives of deities. In many parts of the Indian peninsula, rude stones mark, or have marked, consecrated places; and nothing is more common than to see a Hindu god receiving vicarious worship when, under the form of a stone, he is anointed with gee or oil by some pious villager or passing traveller. Being smeared and dirty, with perhaps a broken earthenware lamp lying near, is often the only mark which distinguishes these sacred stones from others, apparently equally eligible representatives of supernatural power. Such objects were worshipped prior to the era of Gautama Buddha, who



condemns those who worship gods, and address themselves to trees and rocks, stocks and stones."

Again, these pillars were used as places of justice. Thus Samuel went from year to year in circuit to Bethel, and Gilgal, and Mizpeh, and judged Israel in all those places, 1 Sam. vii. 16. This custom was not forgotten in Scotland in A.D. 1349. In that year a court was held "apud stantes lapides de Rane."

Again, in 1380, a court was held "apud le standand stanys de la Rath de Kynquey Estir," and the Bishop of Moray, as a vassal, stood "extra circum." It was to this use of stone circles that Homer probably referred, when he spoke of the chiefs taking counsel, "ἴερω ἐνὶ κυκλω." Probably the Tynwald Hill, in the Isle of Man, is from the same origin; and there are several hills in Scotland of which the legend is, that chiefs were wont to promulgate their laws upon them; and on some are the remains of stones, but in what position they stood I am unable to say.

Again, these pillars were used for sepulchral purposes. Thus Jacob placed a pillar upon Rachel's grave (Gen. xxxv. 20). So a pillar was placed on the tumulus of Ilus, son of Dardanus, king of Troy. So Plutarch relates that Alexander anointed with oil the pillar on Patroclus' cairn. Indeed, the whole account of the burial of Patroclus, as given by Homer, is so just an account of the cairns and tumuli of Scotland, that it is perfectly evident that one and the same idea in this matter pervaded Greeks and Celts. It was thus, also, that Sarpedon was buried, *τυμβῶ τε σελῆ τε*. There are many stones standing in various parts of Scotland of which the legend is, that they mark the burial place of kings or great heroes of historic times. This may be only legend, still it shews that such a feeling has existed, and does still exist.

Again, these pillars were "inaugural." Saul was made

king in Gilgal, 1 Sam. xi. 15. Abimelech was made king by the plain of the pillar in Shemesh (margin "by the oak of the pillar"), *i. e.*, the pillar that Joshua set up under an oak, "that was by the sanctuary of the Lord," Josh. xxiv. 26. So "the king (Joash) stood by a pillar, as the manner was," 2 Kings xi. 14. Do not our thoughts at once revert to the "Coronation Stone" in Westminster Abbey? It is very interesting, but at the same time very singular, to find that a remnant of ancient superstition of pre-historic times occupies so important a place in one of our most solemn ceremonies. A sovereign might as well be crowned without a crown as without the old "Lia Fail," the "Stone of Destiny." This stone was certainly brought from Scotland, where it had long been the inaugural stone for the kings of Scotland at Scone. The legend is, that upon it the destiny of Scotland hangs. It was brought from Ireland by the Scoti when they took possession of Argyll, &c. It was brought from Spain to Ireland, and from Africa into Spain, thus following one of the supposed routes of Celtic immigration. Wherever it originally came from, it is at least a very ancient inaugural stone, and still remains so.

The pillars seem also to have been used as memorials or witnesses. Thus, when Jacob and Laban made a covenant, and raised a heap or cairn as a witness, Jacob took a stone and set it up for a pillar, even as he had done at Bethel; unless, indeed, the heap alone was the witness, and the pillar the representative of the Lord, who was to watch between them (Gen. xxxi. 35). So, also, Saul set him up a pillar after his victory over Amalek; for the Septuagint and Vulgate translations both read "pillar," instead of "place." Absalom had raised up for himself a pillar in his lifetime; for he said, "I have no son to keep my name in remembrance; and he called the pillar after his own name," 2 Sam. xviii. 18. If any reliance can be placed on the legends of

the country, several pillars now standing, unhewn and unsculptured, have been erected in modern Christian times as a memorial of some great victory. In a similar manner, there are several stones with a large round hole in them, vulgarly called "Odin stones." These were used in later times for contracts, and especially for marriage vows. An oath made, while the parties joined hands in the hole of the stone, was considered most inviolable.

There is another use to which these pillars were applied, viz., as "boundary stones." We read in Josh. xv. 6, "The border went up to the stone of Bohan, the son of Reuben." So in Josh. xviii. 17; and in Deut. xix. 14; and Proverbs xxii. 28, a plain command was given not to remove a neighbour's landmark, "the ancient landmark, that thy fathers have set." That these stones (as well as cairns) were in after ages used for this purpose is shewn by the Register of the Bishops of Aberdeen: "Thir are the Boundis own my Lord of Atholles syde the Stannande Staine, merkit like a horse-sho." We remember that Numa Pompilius introduced the *god* Terminus, the keeper of landmarks, into the infant kingdom of Rome. And he who moved a landmark was accused. Terminus thus became one of the deities of Rome; and the annual festival in his honour was celebrated by the country people, by crowning the landmarks with garlands and flowers, and making libations of milk and wine, and, in after times, by offering a lamb or young pig.

These terminalia had their representatives in Britain, viz., the Beating Bounds, in Rogation Week. Rogation Week falls the very end of April, or the beginning of May, about the time of the old beltane. In many parts of England there still remain venerable oaks, called gospel oaks, at which a portion of the gospel was wont to be read on these days of beating bounds.

Can we doubt that this is a Christianized form of the old

terminalia, or rather of the old pillar stones, the emblem or representation of the god of the country, or of that sacred oak, which was the "Celtic statue of Jupiter"?

Though used for various purposes, there can be little doubt that the original intention was a representation or symbol of Deity. The statements in classic authors make this almost certain, as the symbol was adopted by the Greeks, &c., to represent several of their gods. Thus the Thespians had a stone as a statue of "Love,"—the three graces and the seven planets were thus symbolized; by the Megareans, "Apollo Carinus;" by the Sicyonians, "Jupiter Meilichius," and "Diana Patroa," were thus represented. The Paphian "Venus" was a cone or pyramid; the Cadmean "Bacchus" was a wooden pole or stock; the Samian "Juno," and Icarian "Diana," were worshipped by a statue made of unfashioned wood.

As some persons suppose them to have been simply monumental, from the fact of sepulchral remains being so frequently found close to them, it will be necessary to bear in mind, what has been mentioned before, that the temples themselves, even among the Greeks, were often founded upon the tomb of some celebrated person. No one would for a moment maintain that the Christian cross was in its first intention merely sepulchral, from the fact of its being used as a tombstone; nor would he assert that our cathedrals and churches were simply monumental, from the fact of so many bodies lying interred within and around them. Neither can any objection be made on the ground of their occurring in groups, for, as Colonel Forbes Leslie observes, in India they occur in groups, and that in these groups there are some one or more still anointed with oil. "Their altars were as furrows in the field."

We may learn something of the origin of the emblem itself from its present use, or rather appearance, in India,

from the account of this in the Purans, from the use of the emblems, in the idolatrous times, by the kings of Israel or Judah, and the sad degradation that it underwent in later times, in Greece, Rome, Pompeii, &c., as also from the remains of customs that until late years (if, indeed, it is yet extinct) existed in Scotland and in Brittany.

It is possible that the symbol may have originated from the worship of a tree itself. A learned Rabbi makes a curious suggestion, viz., that when Adam and Eve were driven from Paradise, in which was the "Tree of Life," they sought for a similar place in which they might worship God, on which account they considered trees to be worthy of veneration, as being the seat and habitation of God, and the instruments of life, even if they did not actually worship them. Accordingly, in every country certain trees have been regarded as sacred, and as emblems, or rather the dwelling-place of their deities. The constant mention of "oaks" in Scripture, and these often connected with "pillars," shews that the idea was not strange to the patriarchs. The tree, however, soon became idolatrous. Whether or no the pillar was thus derived from the trunk of the trees, it became an idol, or statue, or symbol, from the earliest times, and very soon acquired a new signification.

There can be no doubt at all as to the meaning of the Indian "Lingham," and its corresponding emblem the "Yoni." Its present use, and the impure ceremonies often attending it, make this a matter of no doubt; and the Purans state that such was its signification at the time that they were written, whenever that was.

The emblems were φαλλος ἄρσεν και θῆλυ, "Simulacrum Priapi," not erected at first with any impure or obscene intention, but as representing life, vigour, reproductive power, and thus eternal life, and as such it readily became

an emblem of the material sun, in days when the mind of people could regard it without pollution or injury. Artemidorus and Phurnatus mention the phallus as an emblem of "education and sound discourse," as being *productive* of benefit; hence Pausanius states that it was an emblem of Mercury, the god of eloquence.

Macrobius (*Sat.*) says that square figures, with head and phallus, were emblems of the sun, as being "mundi caput, et rerum sator." Both Herodotus and Diodorus Siculus give unmistakable evidence that in Egypt and in Greece this emblem was held in especial reverence. Osiris in Egypt, and Dionysus in Greece, were honoured with this symbol; so was Shiva in India. "Bhavani" Venus Generatrix was represented of both sexes, and also by a conical figure of marble. The reason appears too plainly in the temples and paintings of Hindustán (Sir W. Jones, *As. Res.*). St. Jerome, in Hosea, accuses the Jewish women of worshipping "Baal Peor,"—"Ob obsceni magnitudinem membri, quem nos priapum possumus appellare." The use of this emblem in the days of the kings of Israel and Judah confirms this supposition. We read repeatedly of the "Groves," as the English version calls them, that were made by their kings, and at times placed even in the temple (2 Kings xvii. 7—17). Manasseh built up high places for Baal, reared up altars for Baal, and made a grove. He set up a graven image in the grove that he had made in the house of the Lord (2 Kings xxi. 3—7). Women wove hangings for the "grove," even as among the Greeks and Romans, and other nations, altars and statues were consecrated by anointing them, and by placing chaplets, &c., upon them. Josiah brought the "grove" from the house of the Lord (2 Kings xxiii. 6). In Judges ii. 13, we read: "The people forsook the Lord, and served Baal and Ashtaroth;" and in iii. 7, "They served Baalim and the groves,"

as though Ashtaroth and the groves were convertible terms. We cannot suppose that all this has reference to mere groves of trees, even though trees were often sacred, and the Hebrew word for "grove," viz., "ashera," militates against such an interpretation. It signifies "erect," and is now generally interpreted to be either synonymous with Astarte, or the trunk of a tree, as a symbol of her, or of Baal.

The Septuagint and Vulgate translations bear out this interpretation, as *e.g.*, 1 Kings xv. ; v. 13; and its parallel passage, 2 Chron. xv. 16, where Queen Maachah is deposed from being queen because she had made an idol in her grove. No great offence, one would think, in the eyes of most of the kings of Israel and Judah. In the Septuagint the passage from Chronicles is thus translated: Τὸν μὴ εἶναι, τῇ Ἀζάρετῃ λειτουργοῦσαν; and the Vulgate, "Eo quod fecisset in luco 'Simulacrum Priapi.'" The passage in Kings is καδῶς ἐποίησε Σύνοδον ἐν τῷ ἄλσει, words capable of implying a grievous sin, and perhaps similar to the union of the Lingam and Yoni in India. The Vulgate reads: "Ne esset princeps in sacris Priapi, et in luco ejus, et confregit simulacrum turpissimum." The Hebrew for "idol" in this passage implies an "object of shame." St. Jerome, too, similarly translates the passage. Thus Phallic Worship—the worship of Baal Peor—is clearly pointed out, especially when we read of Sodomites (literally "consecrated ones") in connection with the groves. What the "turpissimum simulacrum" was is not told; most probably that which Herodotus (ii. 102) states that he saw on certain pillars. It is sad to reflect upon; but, from the history of Israel's sin with Moab, at the suggestion of Balaam, it is quite evident that sensuality and impurity were as much a part of religious worship in the nations of Canaan as among the Lydians and Babylonians. It was probably from the very general practice among the heathen of associating impurity and sensuality with

their idolatrous worship, that the Council of Jerusalem connected impurity with idol offerings as things to be avoided. The emblem became of a far more gross form and character in after ages, and such as could admit of no doubt as to its meaning. It was the guardian of the Roman gardens; and though perhaps at that time a mere scarecrow, it retained its name "Priapus," and, with its name, a remembrance of its origin, peculiarly fitted for gardens, viz., the sun, the author of life, and heat, and vegetative power. There are several examples of this among Roman remains in Britain, as, for instance, on an old Roman arch, near Newcastle; and, again, on a stone found at Adel, near Leeds, not far from an old Roman pottery manufactory. The numerous examples found in Pompeii, for almost every conceivable purpose, for charms, for personal ornaments, for lamps, &c., shew how general its use was; and, though gross in its form, it evidently was not a mere emblem of sensuality, as was shewn by its appearance as the tutelary deity of an oven, where bread, the staff of life, is prepared; but it was a remnant of the old worship of their fathers, and signified "Life," creative and supporting power.

From certain customs, attached to menhirs or pillar stones, especially to the Obelisk of Kerloaz, in Brittany, it is evident that some remains of impure worship, or rather superstition, are still lingering among a people who call themselves "not the least civilized in the world."

There is one more coincidence, or similarity of religious habit, between Britain and Egypt, India and Canaan, and connected with Baal worship, that may be worth observing, viz., the worship of the "Bull," or "Heifer." The Egyptian Apis is too well known to require more than a passing allusion; so also the Sacred Cow of India. The frequent mention of calves, &c., in the Old Testament, shews that the idea was a common one in Canaan. We must have



been struck with Aaron's conduct in making a golden calf in the wilderness, and saying, "These be thy gods, O Israel, which brought thee up out of the land of Egypt." We cannot suppose that, after all that he had seen, he could so readily fall into abject idolatry, and provoke the God of Israel; he was not leading them back to the darkness of Egyptian superstition; but, as the people were amazed at the absence of Moses, saying, "We know not what is become of him," and wanted a visible leader, he made for them an emblem of Deity, which both they and their fathers, in Egypt and in Canaan, had acknowledged and worshipped. So with the golden calves at Dan and Bethel. And it is to be observed that when Jehu destroyed the worship of Baal, which Ahab had introduced to please Jezebel (and this Baal was a new one to Israel—the Baal of Tyre—"Moloch," with his bloody ritual), he spared the calves at Dan and Bethel, as representing an idea, not strange to Israel, and, perhaps, in its original acceptation, not objectionable. Baal of Tyre was represented as a man with a calf's head; the Syrian Baal as a golden calf. Tobit. (i. 5) supports this notion, as his words in the Septuagint are, "ἡ βααλ ἡ δαμαλις," "Baal the heifer," thus unmistakably connecting the two. With respect to Britain, it is not so clear; but in the cairns, or rather the cists within the cairns, the teeth of cows, *unburnt*, are very frequently found among the burnt bone and charcoal. They are more common than urns or implements of flint. In several cists that the writer of this paper has examined in Argyleshire, cows' teeth were always present.

In Persia, however, the ram's head seems to have been the religious emblem, instead of the bull's head, and in some old Tyrian coins the ram's horn is impressed upon them, together with the pillars of Hercules. The "horns of the altar" was a common expression. The most ancient altars

were adorned with horns. Roman altars, or coins, are scarcely ever without them. Moses' altar had four horns. Pictures of ancient gods and heroes were commonly adorned with horns. In fact, horns were an ensign or mark of power and dignity. Medals of Serapis, Isis, Jupiter Ammon, and Bacchus have horns. Clem. Alex. states that Alexander wore horns as a token of Divine extraction. Eusebius states that Astarte wore bull's horns as an ensign of royalty. There can be no doubt from this, that the bull or heifer, and, in after times, the ram, were emblems of deity—most probably of the sun. The origin of this is not difficult to conceive. The words of Virgil supply a cue, viz., "Aperit cum cornibus annum Taurus." We have already stated that the Gaelic for May is "first month," that the first of May was the Bealtane, and that the other great festival was on the first of November. These were, of old, the vernal and autumnal equinoxes. Years gone by (which must be calculated by the precession of the equinoxes), the sun entered the sign Taurus, at the vernal equinox: hence the bull became an emblem of the sun. So again, when the equinox ceased to be in Taurus, and took place in Aries, the equinoctial festival was changed from May to April—hence the ram also became a symbol of the sun. We have remains of these festivals in Britain. The May-pole (perhaps originally a grove or phallus), with its garlands and ribbons (the hangings for the grove); the May queen (originally the queen of heaven), with the dances and rejoicings—these are remains of bull-worship. So also the sport of making "April fools" is the remains of the ram. And these are by no means confined to Britain. The Rev. Mr. Maurice, in his *Antiquities of India*, has shown that the May festival was an ancient one in India, Egypt, and Phenicia. In India it is now celebrated in honour of Bhavani, "Venus Generatrix," a personification of vernal nature. A May-pole is erected, decorated with

garlands, and the young people dance round it. Mr. Maurice adds that it is a "Phallic festival, to celebrate the generative powers of nature," and in this is an evidence of its real origin and connection with the pillar stones. A remark of Mr. Maurice is well worth noticing in these days, when the origin and unity of the human race are called in question: "I could not avoid considering the circumstance as a strong additional proof, that mankind originally descended from one family, and proceeded to the several regions in which they finally settled, from one common and central spot. That the Apis, or sacred bull of Egypt, was only the symbol of the sun, in the vigour of vernal youth; and that the bull of Japan, breaking with his horn the mundane egg, was evidently connected with the same bovine species of superstition, founded on the mixture of astronomy and mythology," vol. vi., p. 93. In India, April 1st is observed as a grand festival, in addition to the amusement of "April fools." It is called the Huli Festival, and celebrated on the day when the Persian year began—when the sun entered the sign Aries. The festival is celebrated in Persia with similar ceremonies. On the first day of the year (April 1st), the moment the astrologer announced the sun's reaching the equator, the new year is celebrated by the firing of guns, and the sound of all kinds of instruments. As our year begins in January, instead of in spring, the festivities of April are transferred to New Year's day. It is needless to say how general is the festivity, so much so as almost to have superseded the Christian festival of the circumcision. But not many years ago, mumming, and other rejoicings akin to April fooling, were not uncommon.

Surely it is not by chance that these coincidences occur. That the bull and ram and horns have been used as emblems of power, royalty, and divine extraction, is in itself a proof that in the minds of men of old time, "horns" had a far

more honourable signification than they have at the present day, though it is not improbable that even these are derived from some of the impure ceremonies of Phallic worship.

Whether this be the original meaning of the pillar stones or no, they at least take us back to a very distant period, and form a very interesting portion of the few objects of antiquity that have survived to our day; and, as such, they should be carefully protected: at the very least, they were connected with the religion of Ancient Britain, and of nearly the whole world. But if the above account be true, what a tale do they tell! a woful tale of sorrow and little hope, of savage cruelty, or gross immorality. They tell of a time, when the first-born was given for the sin of the soul; or when the degradation of the body was thought to be a sacrifice well-pleasing to the Deity. They tell of a time, when all was unhallowed and gloomy, when natural affection was overpowered by superstition, and chastity was abomination in the eyes of their god. We may regard them as among the last survivors of a superstition, now almost vanished; and, while looking upon them, we should be filled with humility and thankfulness, that not for anything that we have done, but through God's infinite mercy, the Christian cross has taken the place of the Ashera.

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FOOTPRINTS OF ROMAN OCCUPATION IN THE SOUTHERN PARTS OF NORTH HUMBER LAND. BY REV. SCOTT F. SURTEES.

Not far from the line of the Great Northern Railway, about one mile south of the Askern station, about two miles east of the Roman "Rig" from Robin Hood's Well, in Barnsdale, screened by a rein or belt of trees from the observation of railway passengers, lies, yet untouched by drainage or the plough, a morass called Sutton Common.

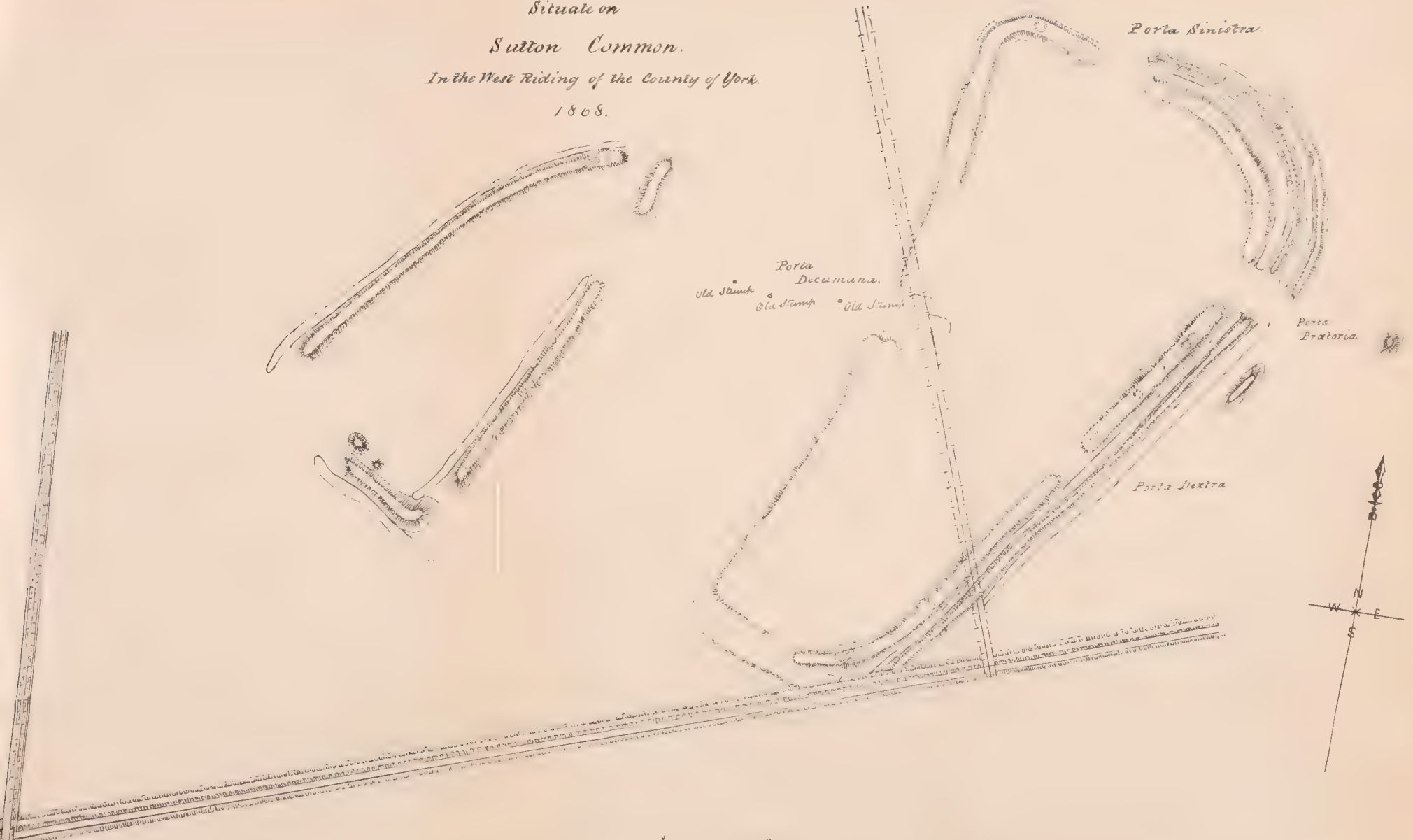
PLAN OF ROMAN CAMP,

*Situate on*

*Sutton Common.*

*In the West Riding of the County of York.*

1868.





On and about this common are what seem to the casual observer raised banks and ditches. On these banks, or raised terraces, are found, at regular intervals, elevated, oblong, or oval mounds, with a small trench around them, about a foot in width. These banks and ditches will be noted, on a more careful survey, to be part of an oblong enclosure; and, at the hinder part, will be found a second enclosure, smaller, and having only a single entrenchment; this also has, upon the elevated ground, in a few places, raised mounds,—some oblong, some round. It is, I believe, very rare that a Roman camp, for temporary purposes, has been found in existence. I have had it photographed for the purpose of this Society's meeting; and although, from there being little or no difference in the colour of the herbage or the soil, it is difficult to represent the variation of surface on a photograph, yet, by careful observation, some of the salient features will be found to be portrayed on this picture.

But I am also able, through the liberality of Mr. Philip Davies Cooke, of Owston,\* who has during the last week had this camp carefully laid down on scale, by Mr. Brundell, of Doncaster, to present to your notice this beautifully-executed plan.† It is all we could wish; and the two will give you a very fair idea of the camp as it now exists.

There are four gates shown upon the plan. The Prætorian, the Decumana (*ab tergo*), and the Sinistra—Porta Dextra appears to have been set out, as usual, by the pioneers (*metatores*) of the force, and then afterwards by some higher authority; or, on reconsideration, closed up, and the fosse and external vallum extended across the entrance.

The earth has sunk down, and the fosse filled in, during

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\* It was Mr. P. Cooke who first called my attention to this camp.

† See PLATE.

the lapse of centuries, so that it is difficult to arrive at any accurate measurement of the ditch and vallum. I calculated, in a rough way, that the inner rampart would be twenty-four feet wide; the fosse, or ditch surrounding it, twelve feet; the next rampart, or vallum, eighteen feet wide; then a second ditch, twelve feet in width; and, last, at the outside, a narrower and lower vallum. All these ramparts appear to rise on a graduated scale. The outer of less height than the second; and the second lower than the inner.

In front of the principal gate—the *Porta Prætoria*—at the distance of about 100 feet, is a raised mound, as if it were an advanced post to protect the gate.\* The distance from north to south is, speaking generally, about 700 feet; from east to west, a mean of 240 feet.

In the rear of the first camp is a second similar enclosure, distant about 300 feet from the *Porta Decumana*. The mean average appears to be 400 feet by 200 feet. It has only a single vallum and ditch. This I suppose to have been the quarters of a second legion. *Agricola*, in his expedition against the *Caledonians*, was surprised by a night attack, and the camp of the ninth legion, which was the weakest, nearly overwhelmed, when he came to their assistance.

The remarkable point to be noticed is, how singularly perfect and distinct are the raised elevations, or mounds,

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\* "If four legions, or two consular armies, were united and enclosed by the same ramparts, their two camps then formed an oblong rectangle, the back of each single camp being turned towards the other. . . . The camp had four gates, one at the top and bottom. The back gate, '*ab tergo*,' was called the *Decumana*; the front gate, the *Prætoria*; the gates at the side, *Dextra* and *Sinistra*. Camps were made square, round, or triangular, to suit the nature of the ground. The most approved form was the oblong; length one-third greater than the breadth. A distinction was also made between those for a night, on a march, and those built more strongly, for stationary purposes."—*Smith's Dictionary of Roman Antiquities*—"CASTRA."



upon which the tents were pitched; showing us how the Romans utilised the vallum as dry ground on which to fix their tents; and also how they dug out the earth round each tent, to allow an outfall for the rain water. The majority appear to me to be of an oblong shape, with rounded corners; but some are circular, and others almost a perfect oblong. But the depression of the soil, and the working down of the mounds, in the lapse of centuries, leaves, as I said before, these dimensions difficult to calculate.

You will note, also, that three stumps are marked out on the plan. They are of old black oak; and appear, by the direction they take, as if a bridge of planks had been erected over the marsh,—which is here peculiarly wet,—between the rearward gate and nether camp. There appears to have been, on the right hand of the *Porta Decumana*, a tent for the general; and also one for the reception of the eagles. On the left hand, close to the entrance, I noted some large stones. They must have been brought from a distance; and appear to have the marks of fire upon them. This may have been the place for cooking.\* The round tent, on the left hand, may have been the *Quæstorium*, where they kept the stores, and which Livy tells us was near the back gate of the camp.

These mounds I have spoken of vary in size. The general run appears to be 12 by 9, others 12 by 6, and a few certainly of larger dimensions. If this camp shows us nothing else,—and I know of no other camp that teaches this so manifestly,—it shows us how the Romans went to work when they camped in these marshy sites, which they were so fond of occupying, as they were safe from surprise;

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\* In plate iii., *Atlas* to vol. 2 of the *Emperor's "Julius Cæsar,"* in Cæsar's Camp at Mount St. Pierre, the cooking places are marked to the left of the *Porta Decumana*,

and how they raised a wide inner vallum, and upon that pitched their tents, in order to raise them above the wet and damp of the surrounding subsoil, instead of, as in drier situations, fixing them in the centre of their camp. There is one observation I wish to make, which I have never seen alluded to elsewhere, and this is, that it appears to me as if all their measurements were a multiple of 3.

You will notice that near the gateways the mounds for the tents of the guard are peculiarly distinct. These are always, as near as I can determine, 12 by 9 feet. Last year, in Germany, I paid a visit to Drusus's camp, on the Taunus; and having the notes of the Sutton camp in my pocket-book, I was surprised to find that the guardrooms there, on each side the gate,—which are singularly perfect, being built of stone,—are also 12 by 9. There also, after the inner rampart, as here, a fosse; then a second rampart, on which the Romans oftentimes placed stakes; then, as here, a second fosse; and, outside, a smaller rampart. It was to me most satisfactory to be able to test, on a large scale, the similarity of measurements, and arrangement of ramparts and fosse, in two camps at so great a distance one from the other; one in a morass in South Yorkshire, and the other on a mountain in the Taunus.

This most remarkable camp, called the Saalburgh, is on a spur of the Taunus.\* I have never heard mention made of it in England, nor have I seen any account of it in archæological journals. The existence of this camp shows how near we may be to the largest and most important Roman remains, and yet not happen to light upon the spot. It is only a few years since that a new roadway cut into and laid open the camp. The excavations were followed up, to a certain extent, and the

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\* "Germanus led himself as many legions (four), with double the number of allies, and erected a fort on Mount Taunus, upon the site of one raised by his father."—*Tacitus*, b. i., c. 56.

forum cleared. There we find everything as at Pompeii, the same as the day the Romans left. The barbarians appear to have broken in upon them, and destroyed and devastated the whole. The pillars of the forum,—the bases of the statues of their deities,—can still be pointed out. The building where the ensigns of the legions were kept,—the remnants of the bronze statues of their gods, broken in pieces and flung down,—the apartments for the general and the staff, around the forum,—are there; and these also a multiple of 3! The passage round the forum was twelve feet wide; the rooms 18 by 18, or 12 by 12. The burial-places, of which there are many on the road leading to the camp, 12 by 18 inches, and about twelve inches in depth. The roadway leading up to the camp, fifteen feet, with raised footway on each side. The apartments for the soldiers are solidly built of stone and sod. It appears clear, from the *débris*, that the camp had been more than once destroyed and re-edified. After the last of these irruptions, the earth had closed completely over it, and a forest grown upon it; and it was only by chance that this most perfect camp has been opened out, in the nineteenth century, to our view. It gives a good idea of the size of an important “*castra stativa*,” occupying about twenty-two acres. It affords information, also, as to the extent and situation of their colonies. Outside the camp, and under the protection of their walls, there has been a settlement, or colony; its area about 160 acres. Some of the apartments of the camp have been warmed by flues; but so much remains as yet uncovered, that it is difficult to trace the course of the flues. I give you a sketch of one. Not so in the colony. Here the Roman, or hot-air bath, has been thoroughly opened out. The furnace for heating, the cistern for cold water, the reservoir for hot water, the pillars of brick upon which it was raised, creating a hollow

chamber, beneath which the hot air circulated, are all laid bare. With my walking-stick I unearthed several sorts of scored bricks and pavement, and a remarkably fine specimen of a flange tile. We learn, then, from this "castra stativa" of Drusus, that they had all the appliances of a town: their forum, their baths, their heating apparatus for their apartments; that they burnt their dead; that they buried their ashes near the highway, at the entrance of their camp; that they placed within these burial-places an urn with ashes, a pot for food, two small vessels, called lachrymæ, and broken bits of glass and pottery. Mr. Greenwell, in the last number of this Society's Report, states that this was common to the British race; and the "pitcher broken" is used, you will remember, as a simile for death, by the writer of *Ecclesiastes*. The burial-places were enclosed with brick or stone; and, as I said before, about 18 by 12 inches in diameter. We learn, also, the strength of their inner wall, or stone rampart—six feet thick; of their paved road and raised pathway together—twenty-four feet. They were also particular about their water supply. I counted seven or eight wells of great depth; they were cased with stone. So much for Drusus' camp.

Now, how came this Yorkshire camp of ours in this situation? Why was it located here? It is but a few miles from Danum, a most important "castra stativa," and the station of the Crispinian horse. It is not far from the track of the old Roman road, or rig (ridge), as it is called in the every-day parlance of the country. Another important permanent camp—Castel-ford, or Legiolium—is near at hand. Why, on the line of the Roman road, and within a short march of *two* Roman camps, did the Roman legions expend this labour and trouble on an entrenchment in a morass? Does it not suggest that it was still earlier than the road and the camps themselves? It is within a few miles

of the borders of the Brigantes. Who, then, first conquered these people? Does it not point to Claudius? He had determined to obtain a triumph, and had fixed upon Britain for the scene. His general, Aulus Plautius, had prepared all for a campaign against the Britons. What would be his course thitherward? We are told by Suetonius that he set sail from Ostia; was shipwrecked on his voyage to Marseilles; and went from thence to Gessoriacum, and crossed over to Britain. Where, then, was Gessoriacum? Let us recollect that he was about to undertake an expedition against a people, of whom the little that was known had taught the Romans they were an enemy not to be despised. Julius Cæsar had invaded them; and no one who studies the history of his campaigns, but must feel sure that his expeditions were failures. None had cared to repeat the invasion. A century had elapsed, and Britain, its harbours, and its country, were better known. An important trade had sprung up, and was carried on so vigorously, that it produced a satisfactory revenue. If, then, Claudius meant to attack the Brigantes, is it not probable that he would plan to have his fleet as near as may be, and depend for his supplies mainly upon that source? We know, from our campaigns in the Crimea and Abyssinia, how impossible it is to strike forward into an enemy's country, some hundred miles, without keeping open the communication with the seaboard. If Claudius had landed in the south, he would have had three parts of Britain to walk through, and to provision his army on their march, whilst passing through tribes, if not hostile, at least but doubtful friends. In Abyssinia, with all our modern advantages, we managed to accomplish a short ten miles a day. Now Claudius' campaign was over in sixteen days!

Must he not have landed somewhere nearer his work, on the eastern coast? If he had the choice of sailing from

Northern Gaul to Eastern Britain, would he be likely to prefer a passage from Southernmost Gaul to Southernmost Britain? In the one case, he would have had his fleet close at hand to victual his army; in the other, he would have had weary miles of march, from Kent or Sussex up to Yorkshire. Aulus Plautius, who preceded him, I think we may safely say did not do so; for we are told by Dion that his army objected to the voyage, mutinied, and were with difficulty persuaded to embark; that, when partly over, they deliberated about returning; but were encouraged to persevere by a meteor flashing "from east to west." What does that mean? How can you explain that statement away? Their course was clearly from *east to west*; and the voyage was sufficiently long to allow them to entertain the idea of returning. Whence, then, did Claudius set sail? The name of the port at least is known. Suetonius has told us it was Gessoriacum. Pomponius Mela tells us it was "the best-known port of the Morini." It was near the Rhine; for Strabo says, "To such as set sail from the parts about the Rhine, the passage is not exactly from its mouth, but from the Morini, which border on the Menapii." Caesar says the latter dwelt on "both" sides the Rhine. Æthicus Ister, "The nearest shore of Britain is over against the country of the Morini, and Menapii, and Batavi." Pliny places next the Scheldt, "Toxandri, then the Morini and Menapii," and states they are joined by the place or district (*pago*) Gessoriacum. Orosius states that "the Morini, Menapii, and Batavi dwelt together opposite Britain." Florus tells us that "Drusus joined by bridges (*pontibus*) *Bonnam et Gessoriacum*." Tacitus fixes this causeway, joined by three long bridges, at near the outlets of the Rhine. Virgil speaks of the Morini as being the extreme borders of the empire, near where the Rhine branches into two channels—

"Extremique hominum Morini Rhenusque bicornis."—*Æneid*, viii.

Tacitus, lib. ii., c. 6, says, "The Rhine at the commencement of Batavia is broken as it were into two rivers." Tacitus again, *Hist.* iv., 28, in his account of the famous rising of the Germans against the Romans under Claudius Civilis, informs us that orders were given to "lay waste the country of the Ubians and Treveri, and to pass the Mosa and harass the Menapii and Morini and frontiers of Gaul." Ptolemy places "*Gessoriacum statio Morinorum*" next the Scheldt. Sigbert's *Chronicle*, A.D. 881, says that "the Northmen and Danes laid waste with fire and sword the county of Morini, Menapii, and all the country round the Scheldt."

Eumenius describes Gessoriacum as a place "with the sea and tide flowing up to its very gates, and how Constantine blocks up the harbour with piles and stones, and yet Carausius is able to get away by another exit, and that whilst his fleet was preparing for the British expedition he cleared *Batavia* of the Franks." Gratius Faliscus states that the place where they cross to Britain is on "the Morinian shores whose ebbing waves oft leave the ocean doubtful." Are all these authorities, Strabo, Pliny, Ptolemy, Tacitus, Dion, Florus, &c., to be accounted of the number of know-nothings. Are D'Anville, and the Emperor of the French, and Mr. Freeman, more likely to be right than Tacitus and Pliny, who knew well Germany and Northern Gaul? Many more quotations might be given to show that the port of the Morini was between the old mouths of the Rhine and the Scheldt.\* No wonder every modern writer blunders over

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\* Antoninus Iter makes Gessoriacum a port of the Germans, and places it near Treves, Cologne, Cassel, Tarvenna, and the Scheldt. Gessoriacum or Portus Morinorum, we are told by Strabo and Appian, was twelve hours passage from Britain—Cæsar's troop-ships never took less time, and sailed always over-night, so as to make land in the morning!—See *Julius Cæsar—did he cross the Channel? with Appendix, showing that he sailed from Zealand and landed in Norfolk*, by Rev. Scott Surtees: Russell Smith, London.

Gessoriacum, when they choose, contrary to every authority worth speaking of, to transfer its site from the vicinity of the Rhine and Scheldt to Boulogne! It is so hard to root up and overturn a fixed prejudice, it is such uphill work to argue against "everybody says so!" It is so difficult to "educate" the party of progress in Archæology, so few care to seek truth for itself, and to follow it out regardless of consequences and what Mrs. Grundy may say!

Now that Claudius' short campaign was in the north, that it was against the Brigantes, that it was their capital he took possession of, is clear from the evidence of history. Claudius and his generals, as well as their successors, ever found that the Brigantes were foremost to rebel, and bore with impatience the yoke of servitude. We can have no stronger testimony than that of Seneca, who states in express words that it was the Brigantes whom Claudius conquered.

"Ille Britannos,  
Litora ponti,  
Scuta Brigantas  
Colla catenis  
Nova Romanæ  
Tremere oceanum," &c.

Tacitus tells us that Claudius took Cunobelin's royal city Camulodunum. Ptolemy expressly states that this was a city of the Brigantes, and places it southernmost on the borders of the Parisii. In 1858, Hector Boece's *Chronicles of Scotland* was edited by the late William Turnbull. He was selected, and deservedly, as the fittest person to superintend the publication of Public Records by the Master of the Rolls. This publication he thought of so much value, that he edited it himself, and it is important to my subject that he, the first authority of the age, in vol. iii., p. 630, places "Camulodunum" in Yorkshire, within a few miles of this



very camp, and names Doncaster as its site.\* The after campaigns of Claudius' generals and their successors are still amongst the Brigantes. Ostorius (see *Tacitus*, b. xii., 33 c.) on his arrival marches against the Silures. He had advanced nearly as far as the Irish Sea, when a sedition amongst the Brigantes compels him to return, "as he wished to make no new conquests until he had secured the old." He comes back, quiets the Brigantes, by making an example of some and pardoning the others, and establishes a colony at Camulodunum. He then re-enters on his campaign, defeats Caractacus, takes his wife and daughter prisoners, and Caractacus himself is delivered up to the Romans by Cartismandua, whose protection he had sought; he is taken to Rome; graces a triumph; quiet, cool, and self-possessed as a North-countryman of the present day would be, he makes his well-known speech; he is pardoned by Claudius and restored to his country.

"Ostorius syne did till him restoire,  
Brigantia quilk was his before."

He lived a firm friend to the Romans, and died at York. Aulus Didius comes next. Didius sends word to King Corbreid to leave Brigantia (Hector Boece, vol. i., 273).

"Do and him weill that tyme to understand  
Brigantia should be the Roman's land,  
Quilk Cæsar gaif to Caratac his brother."

Then—

"Ane Roman, callit Ceciis Nausica,  
With great power came into Brigantia."

Aulus Didius was at Camelidone when King Corbreid proposes a conference, with ten on each side, at a famous stone.

"Neir by the bounds of Brigantia thair stude  
Ane end fast stane."

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\* Polydore Virgil. "Puto Cambodunum Doncaster on Pomfria."

They make peace; Didius dies at Trynovant. Veranius succeeds; visits the fortresses; comes "to Camelidone to the temple of Claudius." Claudius dies; Nero's lieutenant Paulinus Suetonius invades Mona, and destroys the Druids. Taking advantage of his absence, the British, as in Ostorius' time, revolt, burn the colony of Camulodunum, destroy the temple of Claudius, cut to pieces the infantry of the ninth legion, which was coming to succour the detachment which had been sent to protect the colony; Petilius Cerealis, with the horse, retreats with difficulty, and manages to defend himself within fortifications. Now it is just possible that it was he who flung up these earthworks; if he had been coming from Legiolum to succour Don-Castra, and had to retreat, it is just possible it might have been to this morass he fled for safety. I hazard this conjecture as a second thought upon the subject. Boadicæa, or Bonduca, as she is called in best MSS., is the head of this confederacy against the Romans, who were "killed, hanged, burned, crucified." Suetonius Paulinus marches back in haste, defeats the confederacy, and saves the Roman power from complete destruction.

Now, lastly, I have a most important and interesting subject to bring before you. In the accounts of that uprising of the Britons against the Romans,\* there has been a persistent effort to oust the Brigantes from their share in the conflict, and to remove the colony of Camulodunum, spite of the clear and positive statements of Seneca,† and

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\* "Commotis ad rebellionem Trinobantibus, et qui ALII (Q. Brigantes) nondum servitio facti resumere libertatem occultis conjurationibus pepigerant, acerrimo in veteranos odio. Quippe in Coloniam Camulodunum recens deducti pellebant domibus, extorbabant agris, 'captivos servos' appellando. . . . Ad hæc templum D. Claudio constitum, quod arx æternæ dominationis aspiciebatur."—*Tacitus*, xiv., c. 29.

† Xiphiline, lxii., p. 701, states that this very revolt was partly owing to Seneca's requiring repayment of large sums advanced at usurious interest, and the confiscations exacted from the Britons.

Ptolemy, and Tacitus, from Yorkshire and the North of England, where the campaigns of the Romans at this portion of their occupation clearly were fought out, to other places south of North Humber Land. There has been, to bring this about, an habitual, and I might almost call it a wilful, alteration in modern English editions of Tacitus; so common and widespread is the error, that Tennyson himself has fallen into the mistake; and whilst he so eloquently describes the gathering of the Britons under Boadicæa, and their fierce hour of triumphant vengeance, leaves out all mention of those amongst whom that hated temple stood, "where Claudius was worshipped as a god," and where they were goaded by their own personal wrongs (*Tacitus*, xiv., c. 29) to assist in her deeds of retribution.

Seneca and Ptolemy have surely some right to be heard upon the subject, and Tacitus—why Tacitus was son-in-law to Agricola, and in that magnificent speech—has its eloquence ever been surpassed?—(the heads of which he must have treasured up from his father-in-law's stories or written notes, it may be), with which Galgacus warmed his tribes for the coming fight, lets us know that it was the *Brigantes* who were the principals in that famous confederacy under Boadicæa, who had all but flung off the Roman yoke and freed the island of its invaders. These are the words: "*Brigantes femina duce exurere coloniam expugnare castra,*" &c. The modern English editions, however, of Tacitus, give, instead of Brigantes, "Trinobantes." I have consulted three foreign editions of the highest authority, Brotier, Paris, M.DCC.LXXI; Jacob Gronovius, Dutch; and the Delphin, M.DC.LXXXVI: all of these have the word "Brigantes." It is strange how in the names of places and people connected with the history of a country one follows another like a flock of sheep, and how few have the carefulness to search for themselves, and see whether all they meet

with in print is to be taken for gospel. If ever I am in doubt upon a subject of British or English history, I have recurrence to the old foreign editions; the editors have no prejudice one way or other, or semi-local knowledge to lead them wrong. No one can study the earlier history of our country without feeling confident that *Maxima Cæsarensis* was the principal province and centre of the Roman Empire in Britain, and was of such importance, that seven Roman Emperors visited it in person; and that the country of the Brigantes, with Eboracum, its capital, was the earlier as well as the later stronghold of its dominion. We learn from the *Notitia Imperii*, that under the Dux Britanniae along the wall and in its vicinity were quartered, garrisons and cohorts, 11,800 men. That the other garrisons in the North, in the rear of the wall, were 12,900 men; including in this Northern part of ours a total of more than 24,000 men! It was here that Bede, a North-countryman himself, locates them, b. i., c. 11. "They (*i.e.*, the Romans) resided within the rampart which, as we have mentioned, Severus made across the island, on the south side of it; as the cities, temples, bridges, and paved roads there made testify to this day." There is also another circumstance strongly corroborative of my suggestion that Claudius, following the course of Aulus Plautius, who came from east to west, crossed from the Pays Bas, and landed on the eastern coast of Britain. In all British histories, related in different ways, with slight variations of spelling in the name, there is an account of Lælius Hamo or Hamond, a Briton brought up at Rome, and present with Claudius' army, by his knowledge of their language, and putting on their clothes, deceiving the Britons, and by treachery slaying their king; that the king's brother follows hard upon him through the woods unto a haven near, and, as he was getting on board ship, overtaking and slaying him; and that the part of the coast bears the name of

Hamond until this day. Now this has been set down as happening at "Suth-ham-ton," and "Southampton" being clearly Saxon, has flung discredit on the whole story. But if we take the ordnance map of Norfolk (sheet 68), off the coast there we find a bank, near Hasbrough sands, marked as "Hammond's Knoll." Thus Grafton's *Chronicle* (part 7, p. 45) describes Arviragus, the youngest son of Kymbelin: "This man did well and knightly behave himself against the Romaines, and slue the afore named Hamo near unto a hauen or part of the sea; and when he was slayne he threw him gobbet meale into the same sea, and for this cause that hauen was long time after called Hamo Hauen, which is at this day called Suthhampton." Geoffrey, also: "There was at the same place a convenient haven for ships, and some merchant ships at anchor, and just as Hamo was attempting to get on board them, Arviragus came upon him unawares, and forthwith killed him; and ever since the haven has been called Hamon's port;" so that the story which has been thought to bring discredit upon British historians, proves at once their veracity and my theory to be right, which brings Claudius from east to west. I think this is a strong undesigned evidence as to the whereabouts of his landing; in that case he might have marched to the Brigantes and Camulodunum, received the submission of the people, and, if his fleet coasted north with him (as was the case afterwards with Agricola), he might have sailed back from the Humber mouth to Gessoriacum within sixteen days.\* Ptolemy places "Ocelum" at Spurn Head; and Ocelum means "principal passage." Hector Boece tells us that he did sail from that part of the coast.

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\* "Claudius. He was the only one, either before or after Julius Cæsar, who dared to land upon the island; yet within a few days, without any fight or bloodshed, the greatest part of the island was surrendered into his hands."—*Bede*, b. i, c. 3.

“Soon efter this, the Emprioure Claudeus  
 And Vespacion, as my autha tellis thus,  
 Come forth of *Flanderis* with ane greit armie  
 On to Britain quhair that tyme landed he,  
 And the Britons made peace,” &c.\*

There is also another argument in favour of Northern Gaul being the point of embarkation, and that is, that Claudius placed a NAVAL crown on his Palatium, in token of his having passed, and, as it were, conquered the ocean! Suetonius, c. 17. Now if he had crossed from Boulogne to Dover, could this have been construed into having “conquered the ocean”? Why, the voyage from Ostia to Marseilles was twice as dangerous! So Gibbon, whenever he comes to this transit from Gessoriacum, gets puzzled with it. Speaking of Constantine’s visit to Britain—“But we may form some estimate of his achievements by the language of panegyric, which celebrates only his triumphs over the elements, or, in other words, the good fortune of a safe and easy passage from the port of Boulogne to the harbour of Sandwich!” and, again, in writing of Constantine’s visit to Britain, he expresses himself as unable to comprehend why they made so much of the voyage, and draws the conclusion what poor sailors the Romans must have been! But to return to our camp on Sutton Common. If these were the troops of Claudius first entering the country of the Brigantes, there would be a reason for thus encamping in a spot where they could not be taken by surprise. They were in the immediate vicinity of the Britons. Not far from that camp is still in existence a large pit village or British town. It is situate in the woods at Cusworth. These pits or dwellings are from twelve to fifteen feet in diameter; some are in

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\* “On les distingue très souvent par le nom de Flandres en prenant une partie pour le tout.”—*Description Géographique et Historique des XVII. Provinces Bel-giques* (vol. i., p. 2). Liege, M.DCC.LXIX.

clusters, some have communication one with the other. They have a causeway running through the middle, and stone ramparts to protect them. At the eastern end is a lofty hill fort, called "Castle Hill." It is surrounded by terraces and platforms of levelled earth, one above the other, and with a fosse between; it contains within its circuit several acres of ground. A little further on is a second lofty tumulus or barrow, called also "Castle Hill;" this has only a fosse. These British pits are lined with stone about three or four feet in depth, and were covered over with a roof of poles and turf. I could point you out a charcoal burner's hut in the woods close by, of the same pattern and build and material, no doubt, as those of older days. Water has been brought from a considerable distance, and flows under Castle Hill, within the entrenchments. It is wonderful that these footprints of British and Roman occupation should have survived the lapse of ages, and that so many centuries should have passed by, and the plough and the draining tool alike left them as they were, to teach us in the nineteenth century how our ancestors (no, not our ancestors, for I believe it is the Norse blood that predominates in this old North Humber kingdom), to show us how the former inhabitants of this Yorkshire of ours, were housed and dwelt. Singular that the camp of the invaders and the stronghold of the invaded should both in such near vicinity be here.

One or two other footprints of Roman occupation I will just touch upon, as being familiar to you all in your own immediate neighbourhood. One is the use of the word "Corves." The measurement for coal at the pit's mouth, and the basket in which it comes up, still bear the Roman name of *corvus*, or basket, and testify that the Romans worked here the mines. Aldwark, also a Saxon word, speaks of an older work of pre-Saxon days; and the next

parish, Rawmarsh, so abundant in coal, is written Romeys, and Romaries (see *Kirkby Inquest*, Ed. I.), in olden times.

Now, it is true that we have not so many substantial remains of Roman occupation in these Southern parts of North Humber Land as we might expect, from the importance of its position; but William of Malmesbury, who lived soon after the Conquest, accounts for this. The Conqueror was at first inclined to treat with friendship the Great Northern Jarls; but found that they would brook no second master. From the Humber to the Tees all was laid waste; and the vengeance, or policy, of the Conqueror suffered scarcely a single homestead to escape. "Vasta," "Vasta," "Vasta," occurs in township after township, in every Yorkshire wapentake. These are the words of Malmesbury:—"Thus the resources of a province, once flourishing, and the nurse of tyrants, were cut off by fire and slaughter and devastation; the ground, for more than sixty miles totally uncultivated and unproductive, remains bare even to the present day. Should any stranger now see it, he laments over the magnificent cities, the towns threatening heaven itself with their loftiness, the fields abundant in pasturage and watered with rivers; and if any ancient inhabitant remains he knows it no longer." My lord, I hope your blood does not run chill at the thought of the part your maternal and paternal ancestors, Fulk and Thorald de Lizours, and the father of Albreda de Lacy, may have taken in these transactions.\* They, no doubt, had their full share in polishing off the face of this southern part of North Humbria the inhabitants whose lands they retained possession of; but, my lord, I believe that yourself, as being in the loins of your ancestors, need not be conscience-stricken for the deeds which they have done. We get a clue to the reason of what seems, at first

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\* The Earl Fitzwilliam was in the chair,



sight, such cold-blooded, wholesale vengeance. It was at York that "the English and *Danes*, with Edwin, Morcar and Waltheof," hatched rebellion; it was after a severe battle, in which he lost "many of his people," that "he then ordered both the towns and fields of the whole district to be laid waste; the fruits and grain to be destroyed by fire and water, more especially on the coast, as well on account of his recent displeasure, as because a rumour had gone abroad that Cnut, King of Denmark, the son of Sweyn, was approaching with his forces;" and here local nomenclature bears witness to the truthfulness of the historian. The numerous names of towns and parishes with the ending of "by," a sure sign of Danish location, show how thoroughly these Danes had colonised and settled down in this North Humber Land. Denaby, Cadeby, Barnby, Keadby, Selby, Firsby, Ravenfield (the raven, the national ensign of the Danes), in our neighbourhood, and many more *everywhere* in Yorkshire, at once occur. It was stern policy which necessitated this course to William; and, it may be, in no other way could the strong hold of the Danish interest in the North be stamped out. The hard lines which were meted out to them, were the same they had meted out to others; and the tenure of their lands was the same as that of William's followers, viz., the might of the strong arm and the right of conquest. It was better for us the Norman, with his higher type of civilisation, should replace the descendants of the Danish Vikings, and the rule of a more refined nature succeed to the lawlessness and wild habits of Godwin's sons. It was best for us in South Yorkshire that this Danish supremacy was cut short, and that other lords inherited their lands. But I must conclude. I have brought together, into this hour's reading, a work of no little magnitude. I think few are aware of the amount of labour incurred in the preparation of, and putting into

“ship-shape,” a paper such as this. I have had to look into, and make extracts from, at least a hundred authors, of all nations and languages. In no way else, save by this painful process, can discrepancies be found out, and the truth elicited. At any rate, in calling your attention to these footprints of Roman occupation, I have not gone over trodden ground. I have brought under your notice one of the most remarkable camps remaining, either in Britain, and, as far as I know, elsewhere; unique in its clear tracings of the footprints which yet are there to give us an idea of the position and size of the Roman tents, as they fixed them on their march through an enemy’s country; and remember that I am treating of a time when the crucifixion of Jesus Christ was a recent event, and the year when his followers were first called Christians at Antioch. I have, I hope, done somewhat towards the settlement of that much-disputed point,\* the whereabouts of Gessoriacum, and the port of the departure of Claudius; and have also attempted to show there are good reasons why he should have landed on the Eastern Coast; to clear up the mystery hanging over Hamond’s Port; and to point out how Claudius could have marched from *thence*, which he could hardly have done from the South Coast, on a campaign against the Brigantes, and yet not have consumed more than the sixteen days which history allows him. I have shown how wilfully English authors have altered history, in order to bring Southward Camulodunum, to favour their own preconceived views and prejudices. I have given you extracts to prove that every ancient authority worth speaking of fixes Clau-

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\* “Malgré la solution complète de ce problème embarrassant, et contre lequel avaient échoué les efforts de tant d’hommes savans il restait encore une difficulté qui paraissait insurmontable pour accorder ensemble tous les auteurs anciens qui ont parlé de Gessoriacum,” &c. &c.—*Géographie Ancienne des Gaules, par M. Le Baron Walckreder. A Paris. Vol. i., p. 452.*

dius's campaign in Brigantia; and that the first archæologist of the present day has left on record his belief, which is borne out by history, that Camulodunum was situate in South Yorkshire, near Don-castra, or Dun-castra, within a few miles of this very camp I have brought face to face with the light of the nineteenth century. I have told how, within a few miles where now we are, and not far from this ancient camp, there are not a few habitations existing of the Ancient Britons, with their earthworks and fortifications still existing. I have told you of a visit to, and produced relics from, the camp of Drusus, on the Taunus, unearthed, like another Pompeii, to let us know exactly how these ancient Romans settled themselves, and secured themselves, when away from their fellows, in strongholds and central camps, amongst a hostile population. I have done, although much remains which might be of interest, and which may, perhaps, be reserved for a future occasion.

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ON THE COAL-MEASURES OF THE NEIGHBOURHOOD OF  
ROTHERHAM. BY A. H. GREEN, M.A., F.G.S. OF THE GEO-  
LOGICAL SURVEY OF ENGLAND AND WALES.

In a paper read before this Society last year, at Barnsley, I gave a general sketch of the geology of the Carboniferous rocks of the North of England. I propose to-day to describe, rather more in detail, that portion of the Carboniferous group which contains the thick workable coals and is known as the Middle Coal-measures, as it is found over the country lying between this town and Flockton. With this tract I have had opportunities of making myself tolerably familiar; of the remainder of the Yorkshire Coal-field my knowledge is as yet too meagre to allow of my attempting its description; but when I shall have pushed on my work

further northwards, I shall have great pleasure in laying the results of further observations before the Society.

I again gladly take this opportunity of making my acknowledgments to the coal-owners, landed proprietors, and all others in the district, who have placed information in my hands, and of thanking them for the liberality with which they have, without exception, given me all the assistance in their power: without such help, the best endeavours on my part must often have been labour in vain.

I would, at the same time, even at the risk of seeming ungracious, ask leave to urge still greater care and exactness in the keeping of mining records. I have often had occasion to examine the plan of a large colliery with the assistance of the underground steward; and, on asking, may be, about a fault marked on the plan, what was the amount and direction of its throw, the answer has been: "Oh, those workings were before my time; and there is nothing known about them, except what you will find on the plan." In fact, details, such as I have mentioned, are generally carried by the manager in his head; and when he dies, or leaves the country, all record of them is lost. If every fault had marked beside it, *on the plan*, the amount and direction of its throw, as is often, but by no means always, done, information, which will some day be of priceless value, would not be thus lost. In like manner, the position of every shaft or boring, with the depths and thicknesses of the principal coals passed through, ought to be marked on every colliery plan.

Again, it has sometimes, but not often, happened that on asking for a section of the measures passed through in a sinking, the answer has been: "It is not worth while keeping sections, when we know all the measures; but we can give you something far better;" and then there has been produced one of those "General Sections," which are the horror

of every geologist and scientific engineer; a thing compiled from sinkings here and borings there, possibly tolerably correct for a very limited district, but representing as fairly the measures of the whole coal-field, as the single brick represented the house out of which it was taken. For instance, take the coal known as the High Hazles or Kent's Thick; about Sheffield it is a good coal, four feet thick; utterly worthless about Barnsley; and again workable, but only 2' 6", at Mapplewell. How can a "General Section" show this? The history of almost every other bed of coal in the field will prove in the same way the worthlessness of "General Sections."

All that I complain of is easily explained; the information is not likely to be of value for many a long day, at least we hope so; and posterity is left to take care of itself. But I would venture to suggest that coal, to which England owes her great commercial prosperity, and which when once gone can never be replaced, is being used by us at an enormous rate; in short, that we are living on our capital: and this being the case, the barest justice demands that we should hand down to those who come after us the records of our experience, to enable them to turn to the best account the comparatively trifling remnant that we have left unconsumed.

These few remarks, I hope, will be taken in good part, and will not be held to argue any want of gratitude on my part for the favours and kind attentions which I have everywhere received, and for which any thanks that I can offer must be a most inadequate return.

But I am not here to lecture on the ethics of coal-mining, and will at once turn to my subject.

The lowest of the thick workable coals in this part of the field is the Silkstone, Sheffield, or Black Shale Coal, a "soft" or bituminous bed of great purity, yielding excellent house-coal, and well suited for coking. It consists of two beds,

with a dirt parting. The latter, though here and there swelling out to a thickness of seven or eight yards, rarely exceeds a foot, and is very often only a few inches, in thickness, anywhere between Sheffield and Silkstone; the thickness of workable coal over the same district ranges from four feet to five feet six inches. Between Silkstone and Cawthorne the parting increases very rapidly in thickness, and on the north of the latter village the two beds are separated by a mass of shale and stone of eight or nine yards, while the coal itself is much reduced in thickness. Between Cawthorne and West Clayton is a tract of unproved ground, over which some thin coals, perhaps the still further attenuated representatives of the Silkstone, have been worked to a small extent in bygone times. To the north-west of West Clayton, a coal known as the Blocking Bed is largely gotten: it holds the same relative position in the measures as the Silkstone Coal, of which it must be looked upon as in some measure the equivalent. It is of good quality, and ranges from eighteen inches to two feet in thickness.

We shall come across changes like those just described in the thickness and character of other coal seams, and I hope some day to be able to explain to you how they were brought about.

We may now turn to the hundred yards of measures between the Silkstone and Park Gate Coals.

A thick bed of sandstone, known as the Silkstone or Sheffield Rock, is often found above the Silkstone Coal: it forms a ridge ranging from Dropping Well, through Winco-bank Wood, down to Sheffield; and is also well shown at Banks Hall, near Cawthorne. Like all the Coal-measure sandstones, however, it very frequently dies away altogether, and is replaced by shale.

About ten or fifteen yards above the Silkstone Coal is the

Claywood or Black Shale Ironstone. This bed is worth the notice of local geologists, as it contains many fossils, plants, a little crustacean (*Cypris*), and *Anthracosia*.

The Silkstone Four-foot Coal, which seems to be the same as the Wheatley Lime of the Flockton district, lies about forty yards above the Silkstone. Traces of this bed can generally be found everywhere over the district we are now concerned with, but its thickness is most changeable. About Sheffield there is often on this horizon a six-inch coal: the bed seems to grow thicker northwards, till at Silkstone it has been found four feet, but its average in the Barnsley district is about two feet six inches. The coal has probably been worked about the outcrop, but I have not been able to learn anything of its quality.

The Swilley Coal or Accidental Bed behaves somewhat in the same way as that last described; under one form or another, varying from a few inches to two feet, it may be pretty generally traced: at one colliery, however, it turned out most unexpectedly to be a most valuable seam, 5' 8" thick, consisting of three beds, and of most excellent quality.

The New Hards or Cromwell of the Flockton district corresponds in position with this bed: it is a good coal, averaging about eighteen inches in thickness.

About eighty yards above the Silkstone is Walker's or the Thorncliffe Thin Coal, with ironstone-measures, known as the White Mine, above it. The coal varies between Sheffield and Barnsley from 2' 6" to 1' 6" in thickness; it is worked for house-coal at some of the collieries. The ironstone-measures have been largely gotten, but are, I believe, nowhere worked at present. About Silkstone the coal is found sometimes in two beds thick enough to be worth working, but is sometimes so split up with dirt as to be unworkable; it goes thereabouts by the name of the Thorn-

cliffe Muck. The Green Lane of Flockton agrees with this bed: it is a thin coal of poor quality.

The Park Gate Coal, lying one hundred yards above the Silkstone, is one of the important seams of the district. It is made up of several beds, some "soft" or bituminous, and some "hard" or semi-anthracitic; and the number and thickness of these beds and their partings vary very much from place to place. In the neighbourhood of Sheffield the whole thickness is from five to six feet, with from four to five feet of workable coal; about Barnsley the seam takes pretty regularly the form of two beds, with from four to six feet of coal, and from eighteen inches to nine feet of measures between them; towards Kexborough and High Hoyland it becomes very much split up, and does not yield more than three feet of coal; and about Flockton it is represented by the single bed of the Old Hards, averaging a foot and a half in thickness.

Above the Park Gate Coal there lies a sandstone, the Bradgate Rock of William Smith, reaching in some places the thickness of fifty yards; it forms a well-marked ridge from Pitsmoor, by Grimesthorpe and Wincobanks Wood, where it is quarried, up to Kimberworth. Northwards from this point it dies away, and is replaced by shale, setting in again for a space here and there, but never reaching the great thickness it has in this immediate neighbourhood.

In the measures between the Park Gate and Flockton Coals, to which I shall next call your attention, there occurs a change in thickness so large and sudden as to deserve especial notice. About Sheffield the distance between these coals is some eighty yards, and about Barnsley not more than forty; and this thinning out has been proved by sinkings to take place within the space of little more than a mile. The change happens about the village of Dodworth; and while to the south-east of this point the coals are regularly



found about eighty yards apart, to the north-west the distance between them is as regularly only half, or a little more than half, that amount.

From twenty to thirty yards above the Park Gate, over the district where this coal and the Flockton are furthest apart, lies a group of coals called Fenton's Seam, and a valuable ironstone known as the Black Mine. Where the Park Gate and Flockton come closer together, these strata disappear. The coals are very variable, but sometimes amount in the aggregate to six or seven feet; this has led to attempts being made to work them, but all have, I believe, been given up, on account of the bad quality of the mineral. The ironstone is happily named; it consists of beds and nodules of a dark colour and deep black outside, embedded in black shale: the latter is crowded with *Anthracosia*, and the shells are also found, but less plentifully, in the ironstone itself.

The Flockton Thin Coal cannot be recognised in the neighbourhood of Sheffield: about Flockton it is some fifteen inches in thickness, but of so pure a quality that it is largely worked as a house-coal: it lies there about thirty yards above the Old Hards.

The Flockton Coal can be traced over the whole of the district we are describing: it consists of two beds, with a parting of very variable thickness. Hereabouts it is known as the Heward, and is of no value. About Barnsley the upper bed averages two feet, the lower fifteen inches, and the parting varies up to four feet: the top bed yields excellent house-coal. Further north this seam falls off in quality, and, in spite of its greater thickness, it cannot compete with the purer Flockton Thin bed.

At from six to twelve yards above the Flockton Coal, lie the strongly-marked and very valuable ironstone measures known as the Tankersley or Mussel-bed Stone. The seams

of ore are a perfect mash of fossil shells of the genus *Anthracosia*, and the peculiar character thus given to the stone makes it easily recognisable. The alteration in character, change of name, and variable distance from the Park Gate of the Flockton Coal, would have made the tracing of the latter, over long distances, a matter of much uncertainty, but the constant presence above it of this marked stone enables us safely to identify at different parts of the field the coal beneath.

At about twenty yards above the Flockton, is the Joan Coal, a very regular bed about two feet thick.

About a hundred yards above the Flockton, lies a coal, or group of coals, about the identification of which in different parts of the field there is some uncertainty. Hereabouts we find a distinctly recognisable bed, called the Swallow Wood, with a dirt parting, altogether about 4' 6" thick. Though our information is very meagre, the bed seems to keep this character up to Tankersley, where it is worked for local purposes, and is about three feet thick. Hence as far as Barnsley we learn nothing definite about this coal, but about that town it seems to be the custom to bore down below the Barnsley Coal, and call the first bed that could by any possibility be supposed workable by the name of the Swallow Wood. Great confusion has thus crept in; but I believe that, though several different beds bear this name, a coal can pretty fairly be fixed upon as the equivalent of the true Swallow Wood of the Sheffield district; it has, however, fallen off very much in quality, and is so split up by dirt partings as to be little worth. Further north, between Darton and Netherton, there are two poor beds of coal, called the Netherton Thick and Thin, which hold about the same position in the measures as the Swallow Wood; and still further on these seem to run together and form the valuable seam of the Haigh Moor; but I am here getting beyond the present range of my knowledge.

At a distance of about seventy yards above the Swallow Wood, we come to the great seam of this part of the coal-field, the Barnsley or Nine-foot Coal. This seam is in the neighbourhood of Sheffield about 4' 6" in thickness; it increases about Rotherham to seven or eight feet, and around Barnsley reaches nine or ten feet, and here and there a still greater thickness; about Haigh and Crigglestone it is much split up by dirt partings, and of inferior quality, and further north becomes so much divided as to be unworkable. Over the district where it is best developed, it may be divided into three parts, the uppermost and lowest being "soft," or bituminous coal, and the middle "hard," "steam," or semi-anthracitic coal. The following table shows the thickness of these sub-divisions:—

	Top Softs.	Hards.	Bottom Softs.
Sheffield district .....	1' 0" to 1' 8"	1' 6" to 2' 0"	0' 2" to 1' 0"
Rotherham to Elsecar	1' 6" to 3' 0"	3' 0" to 4' 6"	1' 4" to 2' 0"

About Barnsley a parting of clay and bad coal comes in between the Top Softs and the Hards. The following table shows the sub-divisions:—

Top Softs in several beds.	Clay and bad coal.	Hards.	Bottom Softs.
2' 2" to 4' 0"	0' 4" to 1' 8"	1' 9" to 3' 6"	1' 1" to 2' 8"

The following section, measured in the cutting by Crigglestone Station, shows the splitting up northwards of this bed.

Coal .....	1' 7"	
Grey shale.....		0' 7"
Coal .....	0' 2"	
Grey shale.....		4' 6"
Ironstone nodules .....		0' 1"
Dark shale.....		1' 0"
Coal .....	0' 1"	
Grey clay .....		0' 2"
Coal .....	1' 6"	
Black shale and coal .....		1' 3"
Coal .....	2' 10"	
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	6' 2"	7' 7"

The further history of this bed I must defer till I have made acquaintance with the country north of this spot.

Above the Barnsley Coal there is sometimes found a thick bed of sandstone. It is best seen about Rawmarsh, whence its outcrop runs in a bold ridge through Nether Haugh, and contributes not a little to the beauty of Wentworth Park. Like the rest of the Coal-measure sandstones, it is very often replaced by shale.

In the one hundred and eighty yards of measures above the Barnsley Bed is a group of coals, little worked as yet, but which will no doubt be fallen back upon when the thick seam begins to be exhausted. Unluckily all are more or less changeable, and, though several reach a fair thickness, they have none of them sufficient persistency of character to allow us to look forward to them as likely to furnish an equivalent for the supplies we are now drawing at such an enormous rate from the beds which are the present main-stays of the trade.

Of these, the High Hazles, seventy yards above the Barnsley, is a good coal, four to five feet thick in the neighbourhood of Sheffield; becomes worthless around Barnsley; and is again workable, but only 2' 6" thick, around Mapplewell. Kent's Thin, a two-foot bed, twenty yards higher up, seems a fair coal, of more constant quality. The Beamshaw Beds, a group of two or three coals, are so excessively changeable, that they are never found alike either in number, thickness, or position, in any two sinkings.

The Winter, or Abdy, is less inconstant, and should it turn out as regular in quality as in thickness, it will furnish a large supply of house-coal.

The Half-yard, Two-foot, or Riding Coal, is very regularly present, but varies very much in thickness; I do not know that it has ever been worked.

Lastly, we have the Melton Field, Wath-wood, Wood-moor, or Summer Bed, which has been, and is, pretty extensively gotten. Where at its best, it is said to yield an

excellent house-coal, but in many places it is so mixed up with dirt as to be worthless. The only specimens that I have had the means of testing were from a day hole near the outcrop, and were therefore not a fair sample; they were very tender, highly bituminous, very fierce and swift in the fire, and made a large quantity of light white ash.

In the two hundred and fifty yards of measures above the Wathwood Coal, there is little to interest anyone but the geologist pure and simple. A few coals, thin, irregular, and of the poorest quality are found, but the main features are several thick and massive sandstone rocks. Even these, however, have their use, for they can be traced with more or less certainty by the ridges which their outcrops form, and when these are laid down on a map, it will be possible to determine within moderate limits the depth at which the Barnsley Coal will be found, when the present bassett workings are exhausted, and deep winnings undertaken over the eastern portion of the coal-field; and in some cases approximations may be made to the positions of the lines of the larger faults, before the latter have been proved in actual workings.

The most striking of these sandstones is the Woolley Edge Rock, a coarse, thickly-bedded gritstone, sometimes thirty or forty yards thick, which ranges with a fine escarpment from New Miller Dam, along Woolley Edge, east of Barnsley, along Darley Dale, as far as Hemingfield: here the bed begins to be split up into several divisions, and in place of the striking cliff, which has hitherto served us so admirably as a guide in tracing the rock, we have a few faint ridges, step by step dying away altogether; the rock soon afterwards tails out, and its place is taken by shale.

The four rocks above this, the Oaks Rock and the Bottom, Middle, and Upper Chevet Rocks, have a common character: they are light brown or buff in colour, finely grained, thickly

bedded, and as a rule soft and crumbly: the lowest and uppermost are the only two that have any claim to persistency; the two middle ones, though here and there thick and striking, are quite as often wanting as not.

The Oaks Rock ranges from Chevet Park, through Monk Bretton, Hoyle Mill, Wombwell, and Brampton, to Kilnhurst Station, south of which point it dies away. The Lowest and Middle Chevet Rocks are found at Ardsley, whence the latter runs to Cudworth Station. The Upper Chevet Rock may be traced from Upper Cudworth, by Ardsley and Darfield, to Bolton-upon-Dearne; after having been shifted by faults, it reappears at Denaby, and thence its outcrop makes a bold ridge along the east side of the valley of the Don, down to Thryberg Park. This sandstone again appears at Wickersley.

Like the Woolley Edge Rock, these sandstones die away to the south; I am as yet unable to say how they behave going northwards.

Above the Upper Chevet Rock, is a four-foot coal, which has been worked at Shafton and Billingley; at the first place it is said to have been of fair quality, at the latter the lower part at least was very "druggy." I have traced the outcrop of this seam from Shafton to Thryberg, and at the few spots where evidence was forthcoming, it seemed to keep pretty much the same thickness.

I have now pretty well exhausted my stock of information, for my knowledge of the measures above the Shafton Coal is so small as not to be worth giving; but, before leaving off, a word ought to be said about the striking rock so well shown in the neighbourhood of this town, and known as The Red Rock of Rotherham. This bed, which is a thick mass of coarse, red, purple, or salmon-coloured grit, has proved a sore stumbling-block to geologists, and I fear that I can as yet do no more than state the various

opinions held about it, without hoping either to reconcile them or say which ought to be adopted. The rock is found in force over the country between Rotherham, Whiston, Aston, South Anston, and Harthill, and patches of a sandstone exactly like it in character occur at other spots. It was referred by Professor Sedgwick to the marls and sandstones beneath the Magnesian Limestone, generally known as the Rothliegende division of the Permian formation. Its character, however, is so utterly unlike that which these beds bear in the neighbourhood, that I do not think this view can be upheld. Farey, Thorpe, and other local geologists looked upon it as a regularly interbedded sandstone of the Coal-measures, of limited local extent; in fact, a bed just like the Woolley Edge Rock. In this case it ought to keep about the same distance from the Barnsley Seam; actual sinkings have now proved that this is not the case; and if all the patches of Red Rock that we know of are to be referred to the same bed, it will at one spot rest upon measures at least one hundred yards higher in the series than at Shireoaks Colliery, the shaft of which went through it. The notion, therefore, that it is a conformable Coal-measure sandstone, must, I think, be given up. Still, it seems to belong to the Coal-measures, for coal and shales exactly like those of that formation lie above it: such were sunk through at Shireoaks, and may be seen in the cutting of the Midland Railway, about two miles south of Masborough Station. If, then, we must have an opinion, the facts at present known seem to show that it belongs to an upper unconformable part of the Coal-measures, and that after the main mass of that formation had been deposited, upheaved, and denuded, the Red Rock, and the beds overlying it, were laid down upon the upturned and truncated edges of the previously formed strata, so that these later rocks rest sometimes on one member, and sometimes on

another, of the older Carboniferous beds. Somewhat similar rocks, to which a like explanation is applicable, occur in the Leicestershire Coal-field;\* and a similar unconformity has been detected and described by Mr. Marcus Scott in the Coal-measures of Shropshire.† The problem of the age of the Red Rock of Rotherham is, however, by no means solved, and it is one to which local observers will do well to turn their attention.‡

I have now laid before you a catalogue of bare facts; time will not allow of my going into the question of the method of formation of the beds we have reviewed; but this subject I hope to be allowed to discuss with the Society at some future day.

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\* *The Geology of the Leicestershire Coal-field (Memoirs of the Geological Survey of Great Britain)*, p. 56.

† *Quarterly Journal of the Geological Society of London*, vol. xvii., p. 457.

‡ The reader may also consult *Horizontal Section of the Geological Survey of Great Britain*, sheet 69; and the pamphlet explaining it.











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