THE TROGLODYTES OF THE VEZERE*

II.

WE have now examined the succession of prehistoric periods, from the beginning of the quaternary epoch, under the threefold aspect of stratification, palæontology, and archæology. We have thus obtained three series of dates, which do not always agree very strictly. They coincide only in the latest date, which marks the commencement of the modern epoch, and only approximate in the more ancient dates; but that is sufficient to enable us to arrange the following table, as a summary:—

	Stratigraphical Dates.	Palæontological Dates.	Archæological Dates.
Quaternary Epoch	Low level of the valleys undisturbed	Mammoth Age	Hatchet of St. Acheul
	Middle level	Intermediate Age	Moustier point
	Upper level	Reindeer Age	Solutré point
Modern Epoch	Recent soil	Present Fauna	Polished hatchet

II.—*Successive Stations of the Troglodytes of the Vézère*

We now possess the facts necessary to enable us to assign a place in chronology to the Troglodytes of the valley of the Vézère. There is not one polished hatchet to be found in their numerous stations; all their industry belongs to the epoch of hewn stone. They were therefore anterior to the modern epoch. They were acquainted with the mammoth; they fought him; they ate him; they even sketched him; they also knew the gigantic cave lion, and the cave hyena. Nevertheless, in their most ancient station—at least, the oldest with which we are acquainted, that of Moustier—the extinct species are already very rare. Our Troglodytes, therefore, do not date from the first quaternary period or Mammoth Age; but their station at Moustier belongs incontestably to the age which we have called intermediate, and which preceded the Reindeer Age.

Their other stations range from epoch to epoch until the end of the Reindeer Age; they therefore helped to destroy the ancient fauna. They did not, it is true, witness the disappearance of the last survivor, the mammoth, for some few rare vestiges of that animal are met with in the most recent caves of the Vézère, but at some leagues distance, at Excideuil, where MM. Jules and Phillippe Parrott have discovered a palæolithic cave in which was no trace of the extinct species, and in which even the reindeer was becoming rare.

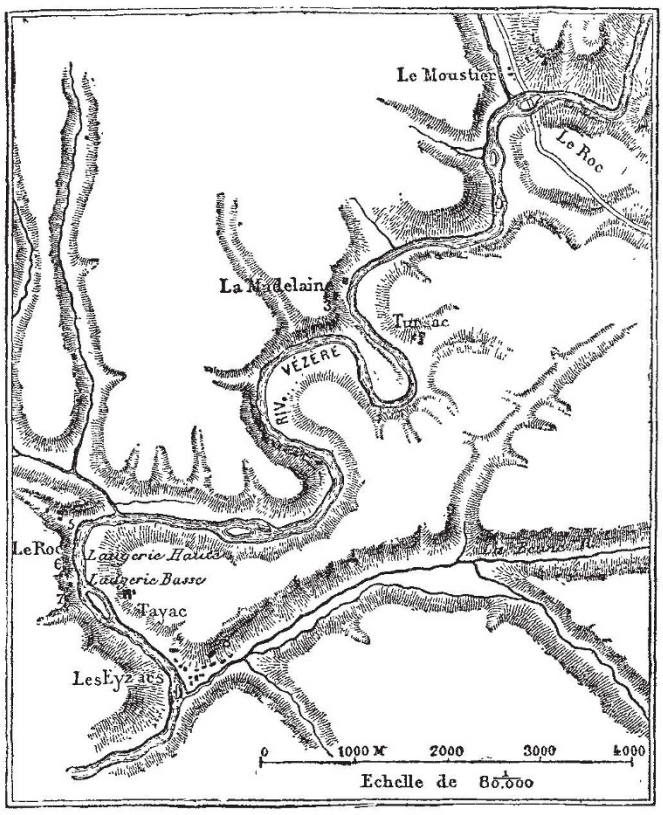

FIG. 8.—Map of the quaternary stations of the Vezère.
1.—Moustier cave. 2.—Moustier shelter. 3.—Shelter of the Madelaine. 4.—Shelter and burying-place of Cromagnon. 5.—Shelter of Upper Laugerie. 6.—Shelter of Lower Laugerie. 7.—Cave of the Gorge d'Enfer. 8.—Cave of the Eyzies.

Thus the Troglodytes of Perigord have existed in the two last periods of the quaternary epoch, from the decadence of the mammoth to the disappearance of the reindeer. It is impossible for us to measure the immense number of ages in which they lived, but we can have some idea of it by studying their stations in connection with the level of the Vézère.

Since the Moustier Cave has ceased to be inhabited it has so often been flooded by the Vézère that it has been entirely filled with alluvial earth. This layer of earth, nearly two metres in thickness, does not contain either bones or flint. It has covered the layer which was formerly the inhabited soil, in which man has left the tokens of his industry and the remnants of his feasts. This proves that the mouth of the cave was within reach of frequent floodings, and that consequently it was at a level hardly above that of the river. Now, at the present day, it is situated twenty-seven metres above the lowest water-mark; the depth of the valley is therefore considerably increased since the epoch of the Moustier Troglodytes. On the other side, the station of La Madelaine, which is one of the most recent, perhaps *the* most recent of the valley, is very slightly above the level of the largest present floodings. We may hence conclude that the valley of the Vézère was very much then what it is now, and that since the epoch of La Madelaine the level has become lowered to the extent of a few metres only.

Thus this depression of twenty-seven metres, due to the action of the waters, was effected almost entirely under the eyes of our Troglodytes, and from that time, during the whole length of the modern epoch, that is in hundreds of centuries, it has made very little progress. Judge from this how many human generations must have come and gone between the epochs of Moustier and La Madelaine.

It is easy to see that in such an immense lapse of time the manners and industry of this people must have undergone notable changes. We shall have no trouble in proving this by the study of their different stations in succession.

All those of the stations that are known up to the present time are grouped on both banks of the Vézère in a very circumscribed space. From Moustier, which is up the river, to Eyzies, which is down, the distance is but eight kilometres as the crow flies; it is nearly double when you follow the windings of the valley. Between these extreme stations we see succeeding each other, on the right bank, those of the Madelaine, Upper Laugerie,

* Continued from p. 272.

Lower Laugerie, the Gorge d'Enfer, then, on the left bank that of Cromagnon, very near the Eyzies (see the map).

Some are really habitable caves, others are simply shelters under the rocks, with large openings towards the valleys. But these distinctions have no chronological importance. It is not by the nature of the habitations, but by the nature of the *debris* they contain that we can estimate their relative antiquity. The stations at Moustier are evidently the oldest, that of Cromagnon is less ancient, but evidently belongs, like the preceding, to the intermediate age. Upper Laugerie, the Gorge d'Enfer, belong to the Reindeer Age; and finally Lower Laugerie, the Eyzies, the Madelaine, form a last group, and bring us to the end of the quaternary epoch.

The Moustier Troglodytes were quite uncivilised. They did not know how to fashion bones and horns; they only understood working in stone. Carved flints abound in their stations, but, with the exception of an arrow-point, rather carefully cut, all these flints are of very rough workmanship. The distinguishing weapon of the Moustier Troglodytes, that which characterises this station and epoch, is the lance or spear-point which we have already described (see above, Figs. 3, 4, and 5).

This powerful flint, with an arched point, sharp at both edges, wide enough to make large wounds, thin enough to penetrate easily into the flesh, constituted a much more terrible weapon than the hatchet of Saint Acheul. Fastened to the end of a spear, it could put to death the most gigantic mammalia. Vestiges of the mammoth, of the huge cave lion, and of the cave hyena have been picked up at Moustier. But the principal human food at that time was first the horse, then the aurochs; the reindeer came third. The weapons of the chase were more suited to attack the enemy that resisted than the game that fled. They neglected those lighter shafts that bring down birds and smaller quadrupeds. Fishing was also neglected and probably not known. There is not a single fish-bone or bird-bone in the Moustier stations.

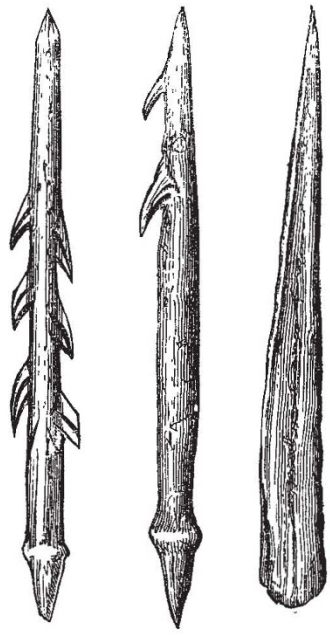

FIG. 9. FIG. 10. FIG. 11.

Fig. 11.—Point in deer horn, without barbs (Gorge d'Enfer). Fig. 9.—Arrow with bilateral barbs. Fig. 10.—Harpoon with unilateral barbs.

The men of Cromagnon, less ancient than those of Moustier, had considerably advanced. Their implements were less massive, more numerous, more varied, and, above all, better finished. They had not the Moustier point, but they had a kind of flint poignard. They wore shell ornaments, and their numerous scrapers seem to indicate that they prepared skins for clothing. Their principal food was still the horse, but they had a great variety. We find in the *débris* of their repasts, besides the reindeer, which was beginning to be plentiful, bones and teeth of aurochs, wild boar, stag, wild goat, wolf, fox, spermopile, hare, and even of a bird belonging to the Crane genera. They consequently hunted small game as well as large animals; but they were still ignorant of fishing.

FIG. 12.—The Mammoth, carved on ivory. (Engraving from the Madelaine.

Among these remains of animals we still find the mammoth and the great cave lion; likewise a large bear, which might well be the *Ursus Spelœus*. We must likewise remember that the reindeer had not begun to multiply rapidly, that it was less plentiful than the horse; we are therefore still in the intermediate age. But, on arriving at the following stations, we enter definitely the Reindeer Age; henceforward the vestiges of this animal

will be more abundant than those of all the others put together.

The finest works in flint of the Valley of the Vézère are those of Upper Laugerie. All the implements, all the weapons of that station are in flint. They are innumerable; their shapes and dimensions are very varied. Side by side with imperfectly fashioned objects we find others whose elegant form and delicately finished contours reveal accomplished workmen.

These beautiful flints of Upper Laugerie belong to the Solutré type. Their shape is lanceolated; they are not thick; their graduated edges, jagged with little notches, are regular and symmetrical; their base is often fashioned so as to facilitate putting on a handle. They are evidently destined to be adapted to the extremity of a piece of wood. Their dimensions vary considerably; the shape is much the same. It is easy to see that the small ones are arrow-points; the medium size doubtless furnished the darts which were hurled from the hand. The largest are lance-points, but their want of width shows that those lances were rather light.

These carefully-wrought points, so common at Upper Laugerie, are not to be found in the later stations of the valley of the Vézère. It was surmised, from this circumstance, that the workmanship of flints, after having progressed till the time of Upper Laugerie, had then declined. This caused surprise, and justly; for it would be astonishing if such an intelligent people, as were evidently the Troglodytes of the Reindeer Age, had allowed their main branch of industry to decay. But many objects found in their more recent stations prove that they had not lost the secret of fine carving; and that, if they no longer wrought the points of Upper Laugerie, they no longer needed them.

A great progressive stride had been accomplished. They had learned how to shape the deers' horns, and the bones of animals. It was with those substances, more pliable than flint, less hard, no doubt, but quite solid enough to fabricate darts and arrows of a longer flight and a greater precision. Then, when these modes of workmanship were once known, the bones and horns of deer were used to manufacture a vast number of tools and utensils of every description.

But, for all that, the reign of flint was not over. On the contrary, the varied assortment of cut flints was greater than ever; to those which served as weapons and implements were now added a multitude of small tools destined to use for working the deer-horn.

We have here arrived at an important evolution of industry. Up to that time there had only been simple industry, or as it were primitive, utilising the original substance direct. Now we come to progressive industry. Tools were manufactured whose sole use was to fabricate others.

In all ages flint had been employed as an instrument of workmanship. From the commencement of the Stone Age it had been used to cut the horn, to make pikes, clubs, handles of lances or darts. The idea of making use in the same manner of the bones of animals was not new either, for in the ancient station of Cromagnon were found some dart-points of deer-horn, and even some pieces of ivory. But the characteristic feature of the epoch on which we are entering was the creation of special tools which were not necessary for the wants of life, and which were destined to facilitate and perfect the fabrication of useful implements. From that time commenced that division of labour which, in a future day, was to increase a hundredfold the power of man and subject all nature to his sway.

The workmanship in deer-horn was already pretty far advanced in the station of Gorge d'Enfer. We find there a complete assortment of objects in this substance—lances, darts, arrows, bodkins, needles, hunting marks, account registers, &c. These articles are pretty well wrought, but without ornaments, and the darts are of the simplest shape. They are conical points, without any barbs. (See Fig. 11.)

The invention of barbs is worthy of attention. These recurring points no doubt rendered the blow more dangerous; the projectile remained fixed in the flesh, and the wounded animal could not get rid of it as he fled through the bushes. But this was probably not the principal object of the barbs. Placed in a regular series on both sides of the arrow (see Fig. 9), they sustained it in the air like wings; they increased the flight and the precision of the aim, and this innovation suggests a certain knowledge of experimental physics. The barbs are generally provided on one side with one or more openings, which are supposed to be destined for the reception of poison. The barb of the arrows and the ornamentation, more or less artistic, are the two distinguishing marks of the stations of the latest epoch. These are three in number—the Eyzies, Lower Laugerie, and the Madelaine. They resemble each other closely, and it is probable that they were nearly contemporary.

III. *The Society of the Troglodytes*

The caves of the Troglodytes were situated near the Vézère, without any special aspect, excepting perhaps that they were never open to the north.

They lived in them the whole year round. This is proved by the remains of their food, for they ate the reindeer fawn of every age. An examination of the teeth of these young animals, of their bones, of their horns in different stages of growth, enables us to determine the number of months they had lived, and consequently the season of the year in which they were killed. Hence we may aver that our Troglodytes had a fixed residence, in other words, that they were not nomads.

When they went out fishing or hunting they closed the mouth of their caves to prevent the entrance of carnivora. A single bone, found at the Madelaine, has the trace of a hyena's teeth. This animal may have once by accident gained an entrance. The hyena was rare at that epoch, but wolves and foxes were numerous, and if they did not come and gnaw the bones scattered all over the floor of the cave, it was because the latter was carefully closed. As there is no vestige of a stone door at the approach to our caves, the Troglodytes, doubtless, closed their doors with palisades.

There have certainly been found, in the three stations of the latest epoch, a certain number of stones in granite, sandstone, or quartz, rounded and polished nearly smooth with friction, presenting on side a very regular depression in the form of a little cup, and resembling little mortars. From this has arisen the supposition that the Troglodytes ground corn for food; but all concur in proving that they did not understand agriculture. It is much more probable that they used their mortars to triturate poisons or colours.

Hunting was their chief resource and occupation. The remnants of bones accumulated on the floor of their caves prove that they hunted animals of every size, from the small bird to the mammoth. This old giant of the early quaternary age still survived, but he was becoming very rare.

Here is the representation of a piece of ivory discovered in 1864, at the Madelaine, by MM. Ed. Lartet, de Verneuil, and Falconer. On this surface, an engraved drawing represents the mammoth, with his head erect, his brow concave, his great tusks bent, his small eye, his long trunk, his tail elevated, and his long mane. In a word, precisely like the mammoths in flesh and bones, which a perpetual frost has preserved to our own days on the banks of the Lena. (See Fig. 12.)

The Troglodytes of the Reindeer Age had rarely an opportunity of encountering the mammoth. They more frequently hunted the aurochs, the horse, the ox; and it was doubtless for hunting these large animals that they still

had some large spears, armed with flint, differing little from those of Moustier. But nearly all their weapons were light, and the deer-horn points replaced the flint points of an earlier epoch.

The bow had become the predominant weapon, for henceforth nothing resisted man; all fled before him, and hunting was no longer a struggle but a chase. There were two kinds of arrows: the little pointed arrow, not barbed, for small animals and birds, and the large dart with two sets of barbs, which was principally used in hunting the reindeer. Light spears, terminating in a flattened point, darts with conical points, and long sharp poignards, which gave, when necessary, the finishing blow, completed the hunting equipment. I was nearly forgetting the rallying whistle. It was a reindeer's phalange, pierced near one end, with an oblique hole which did not go right through, and only penetrated to the medullary canal. By blowing on this hole as on a drilled key, one can, even to this day, extract shrill sounds.

(*To be continued.*)

THE NEW HYDROCARBON GAS

THE new hydrocarbon gas produced by Mr. Ruck's process certainly promises to realise the conception that has long floated in the minds of scientific men of turning the exhaustless store of heating power to account that lies ready to hand in water. Mr. Ruck appears literally, by the successful development of his invention, to have set the Thames on fire. At this present time, at the Battersea water-works, on the banks of the old river, near to Battersea Park, both light and heat may be seen and felt in the process of evolution from the decomposition of the water of its stream, and further light is added to the gas first produced by a very simple and uncostly extension of the process, until the illuminating power is raised to the intensity requisite for artificial lighting during the dark hours of the night. The Battersea water-works are now lit experimentally by this new form of gas, an apparatus having been erected there to test and prove the efficiency and value of the method.

Mr. Ruck's hydrocarbon gas, it should be at once understood, differs entirely from the so-called "air gases" that consist mainly of air impregnated with the vapour of some form of naphtha or petroleum, in the fact that its base is essentially a gas. The heating gas, which is the form first generated, is true honest hydrogen mingled with a little taint of carbonic oxide, and a small and practically unimportant percentage of carbonic acid; and the apparatus by which this heating gas is produced is remarkably ingenious and simple. Ordinary steam is brought through a pipe from one of the boilers of the engine house, and this steam is poured through a horse-shoe-shaped tube that passes through the red heat of a fierce coke furnace. In this tube it is superheated, or raised to a temperature which disposes its constituents, the oxygen and hydrogen, to dissolve their intimate alliance, and in that state it is passed on into retorts, also contained in a lower region of the same furnace, which are packed full of coke and fragments of iron. The steam is discharged into the interior of these retorts out of its own conducting pipe, so that it has to traverse their entire length amidst the masses of heated metal and coke, and during its journey it ceases to be steam. The oxygen attaches itself to the iron, and forms scales of black rust, and the hydrogen passes on free, with only a commingling with carbonic oxide and carbonic acid formed by the action of the disengaging oxygen upon the coke packing of the retort, and with certain sulphurous vapours that also issue from the coke. In this impure state the gas issues from the retort, and is carried to a purifying chamber containing oxide of iron, which at once clears it from all the sulphur compounds, and it is then stored in a gas reservoir of ordinary form. In this state it is the "heating gas;" that is, gas supereminently suited for all purposes where heat, without light, is required, as, for instance, for gas stoves of whatever kind, or for boiling water, and generating steam. When the gas is taken from this reservoir, and discharged through an ordinary burner, it burns with the pale colourless hydrogen flame, streaked with a few lines, of yellow scintillations, and of the characteristic pale green colour of incandescent carbonic oxide.

At the present time, with coals quoted in the London markets at 52*s.* per ton, this part of the affair, the production of a heating gas out of water, at the cost of a very simple apparatus, a very small consumption of fuel, and with a demand for an incredibly small application of manual labour, seems to be the one that is most deserving of thought and attention. In the practice of the manufacture at the Battersea water-works, by the expenditure of one ton of coke for the interior of the retorts, and of two tons of coke for the support of the heat of the furnace, 133,000 cubic feet of gas are produced, that, to say the least of it, is quite equal for all purposes of heating to coal gas in ordinary use, and that is as chemically enduring and perfect for storing in gasometers and for transmission to unlimited distances through pipes. In a direct experiment with the gas, tried by the writer, one quart of cold water was boiled in four minutes and a half by a jet of flame issuing from an orifice one-eighth of an inch in diameter, and under a pressure of three inches of water, without any arrangement for the concentration and protection of the flame from chill and draughts. There was no provision on hand to measure the exact consumption of the gas, but the man who was engaged in the Laboratory estimated it at about five cubic feet per hour. Now the cost of this gas at the works is found to be 7*d.* per 1,000 cubic feet. In this experiment, therefore, the result was something like converting seven gallons of water at a temperature of 38° Fahrenheit, into boiling water for 1*d.* One thousand cubic feet at a cost of 7*d.* would boil about 50 gallons of cold water. At the works at the present time the steam is supplied independently from the boiler of the engine room. But this does not need to be taken into consideration, because the waste heat of the retort furnace is more than enough for the production of the steam, and in ordinary circumstances will be used, as a matter of course, for the purpose.

When it is desired to use the gas for lighting purposes, it has to be further prepared and manipulated. The "heating gas" from the gasometer is made to bubble through a reservoir containing rectified petroleum at a specific gravity of about 0·680. It then passes at once into the pipes for circulation and consumption, and issues from these burners a very excellent gas, equal in illuminating power to 16½ candles with a consumption of 5 cubic feet an hour in an Argand burner. The cost of the gas in this form is a trifle less than 1*s.* 8*d.* per 1,000 cubic feet, and the saving in the manufacture over ordinary coal gas with coals costing 26*s.* per ton, is estimated to be 40 per cent.—in exact figures 1*s.* 8*d.* per 1,000 cubic feet against 2*s.* 4*d.* per 1,000 cubic feet. One thousand cubic feet of the heating gas require a gallon and a half of the petroleum to convert them into illuminating gas, but they are considerably increased in volume by the conversion—133,000 cubic feet of "heating gas" become 165,000 cubic feet of "illuminating gas" after it has been passed through the petroleum. Arrangements have been made for the purchase of several millions of tons of crude petroleum at a price which will represent a cost of 6*d.* a gallon after rectification.

Some rather severe experiments have been already tried to test the power of the illuminating gas to retain its full charge of carbon after travelling through long distances of delivery at low temperatures, and the report of the testing engineers is that so far the experiment was