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ART. XVI.—*On the Ancient Lake Habitations of Switzerland*; by
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[The interest attached to the subject of Mr. Lubbock's memoir warrants its republication, as but few American readers have access to the original. M. Morlot, whose researches are alluded to in this article, will be well remembered by the readers of this Journal from his paper entitled 'General views on Archæology,' published in vol. xxix.]

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

* From the Natural History Review for January, 1862, p. 26.
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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 the two of our most eminent contemporaries, M. Morlot points out that as Lyell, the reformer of Zoology, 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. Thomson, by collecting the implements and recording the habits of the existing savages, has thrown much light upon the manners and customs of ancient times. Fully recognizing the imperfection of the record in the one case as well as in the other, we must guard ourselves against any hasty conclusions and generalizations 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, as was mentioned in our last number, that the Stone period will require much sub-division. In all classifications we are apt, at first, to take the apparent, for the real dimensions of the more distant portions, and it is only as we obtain a closer acquaintance with them, that we discover their real proportions. Thus, it would appear, that the Stone age 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

* In a grave at Mare Hill in Staffordshire, Mr. Carrington found "a piece of lead," having the appearance of wire, which subsequent researches prove to have "been accidentally fused from metalliferous gravel present upon the spot." May not copper have been first obtained from some bright piece of ore, used as an ornament, and burnt with its wearer? The coincidence of a knowledge of metal with the practice of burning the dead is at least significant.

The copper of North American tumuli is plainly traced to the deposits of native copper near Lake Superior.—Ebs.

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 unfavorable 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 ridge.

This method of construction, indications of which are found in various parts of Europe, was especially mentioned by Herodotus,* who describes the Pæonians 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 Swiss "*Pfahlbauten*," or lake habitations, have been described by M. Keller, in three memoirs presented to the Antiquarian Society of Zurich, in 1854, 1858, and 1860, and by M. Troyon, in a special work, "*Sur les Habitation Lacustres*," 1860, in which the author gives a general account of what has been done in Switzerland, and compares the result obtained in his native land, with the lake dwellings of other countries and times. The discoveries in Lake Moosseedorf have been described in a special paper by MM. Jahn and Uhlmann (*Die Pfahlbaualterthümer von Moosseedorf*. Bern, 1857); and we owe to M.

* Her. Book V, ch. 16.

Rüttimeyer to works on the animal remains from the Pfahlbauten the first "Untersuchung der Thierreste aus den Pfahlbauten der Schweiz," published by the Antiquarian Society of Zurich, in 1860; and still more recently a larger work*—Collections of objects from these localities have also been made by many Swiss Archæologists.

The Flora has been studied by M. Heer, whose results are contained in the last memoir published by M. Keller. Nor must we omit to mention M. Morlot's short paper in the "Bulletin de la Societe Vaudoise," and his more recent "Leçon d'Ouverture d'un cours sur la haute Antiquité fait à l'Académie de Lausanne." From the conclusion of this lecture, indeed, I must express my dissent: not that I would undervalue what M. Morlot calls the Practical Utility of Geology, nor that I am less sanguine as to the future advantages of Archæology. Science, however, is like virtue, its own reward, and the improvement of the mind must be regarded as the highest object of study. However this may be, M. Morlot is, to use his own metaphor, laboring earnestly in the vineyard, and is improving the soil, though, as in the old fable, it may be in the false hopes of finding a concealed treasure. The Swiss Archæologists have, indeed, made the most of a golden opportunity, Not only in Lake Zurich, but also in Lakes Constance, Geneva, Neufchatel, Bienne, Morat, Sempach, in fact in most of the large Swiss lakes, as well as in several of the smaller ones (Inkwyl, Pfaffikon, Moosseedorf, Luissel), similar lake habitations have been discovered. In the larger lakes, indeed, not one, but many of these settlements existed; thus, M. Keller mentions, in Lake Bienne, eleven; in Lake Neufchatel, twenty-six; in the Lake of Geneva, twenty-four; in that of Constance, sixteen; and many more, doubtless, remain to be discovered.

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, 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 the Swiss Archæologists feel justified in concluding that the cabins were circular, and from ten to fifteen feet in diameter. Though, therefore, the architecture of this period was

* Die Fauna der Pfahlbauten in der Schweiz. Untersuchungen über die Geschichte der wilden und der Haus Säugthiere von Mittel Europe von Dr. L. Rüttimeyer. This work contains a full resumé of the subject up to the present time.

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 labor,* 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 Neuchâtel, 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 uncivilized should have constructed their dwellings with immense labor on the water, when it would have been so much more easy to have built them on dry land. The first settlers in 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 Dunshuglin, 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. Thus, according to Shirely, "One Thomas Phelliplace, in his answer to an inquiry from the Government, as to what castles or forts O'Neil hath, and of what strength they be, states (May

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

† See Wilde's *Catalogue*, vol. i, p. 220.

18, 1567): 'For castles, I think it be not unknown unto your honors, he trusteth no point thereunto for his safety, as appeareth by the raising of the strongest castles of all his countreys, and that fortification that he only dependeth upon is *in sartin ffresh-water loghes* in his country, which from the sea there come neither ship nor boat to approach them: it is thought that there in the said fortified islands lyeth all his plate, which is much, and money, prisoners and gages: which islands hath in wars to fore been attempted, and now of late again by the Lord Deputy there, Sir Harry Sydney, which for want of means for safe conducts upon the water it hath not prevailed.'

Again, the map of the escheated territories, made for the Government, A. D. 1591, by Francis Jobson, or the "Platt of the County of Monaghan," preserved in the State Paper Office, contains rough sketches of the dwellings of the petty chiefs of Monaghan, which "are in all cases surrounded by water."* In the "Annals of the Four Masters," and other records of early Irish history, we meet with numerous instances in which the Crannoges are mentioned, and some in which their position has not preserved them from robbery and destruction; so that we need not be surprised to find that most of the Swiss Lake habitations appear to have been destroyed by fire. Though, however, these latter resemble the Irish Crannoges in their position and use, they differ considerably from them in their construction. In one or two places, indeed, as for instance at the Steinberg, in the Lake of Bienne, it is possible that an island may have been formed, the bottom of the lake having been artificially raised. It is curious that a canoe laden with stones, was actually found near this spot, it having, apparently, sunk with its load, at the time when the Steinberg was in process of construction. After all, however, it seems probable that even in this case, the object was only to obtain a firmer foundation for the piles. At the present time the highest part is eight feet below the surface of the water, and nothing justifies us in looking back to any such alteration of level. Moreover, even now the piles project two or three feet above the surface, upon which, therefore, the cabins cannot have been intended to stand. A small island in Lake Inkwyl, however, reproduces almost exactly the Irish Crannoge.

After having chosen a favorable 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

* Ibid. p. 231.

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 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. Draging the piles to the lake, and fixing them firmly, must have required much labor, 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. The structure of the Pileworks at Wauwyl, in the Canton of Lucerne, certainly seems to favor this view. It was composed of four rectangular divisions, separated by narrow channels, over which, no doubt, bridges were thrown, and through which canoes might pass. The piles were less numerous than usual, and were grouped principally around the outer edge of the platforms. In this case they have been preserved by peat; they are from three to four and a half inches in diameter, all rounded, and not formed of split timber. In order to ascertain their length, M. Suter dug up two of them; the longest penetrated four feet through the peat, and ten feet six inches into the ancient bed of the lake; the other, also four feet through the peat, but only four feet six inches lower. M. Suter examined the piles carefully, but fruitlessly, to ascertain any manner in which the platform can have been attached to them.

The platform itself consisted of five layers of trees, curiously and carefully fastened together by clay and interlaced branches of trees, but like the perpendicular piles they were examined in vain for any traces of notches, mortises, holes, ligatures, bolts, or any contrivance, by which the upright piles and the platforms could have been fastened together.

Not only were the debris of their repast, 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 Robenhausen, 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 skillfully 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. One or two bits, however, consisted of Oriental nephrite, which is green, transparent, and of remarkable hardness, and if these really belonged to the Stone age, the fact is very remarkable, as this substance, according to Swiss mineralogists, does not naturally occur in Switzerland, and must have been brought from Egypt or Asia. On this point, however, it would be desirable to have more information; since, if we are to suppose that any such extended commerce existed, it is difficult to understand why bronze and iron were not also introduced. Weapons of nephrite have also been found at one or two other places, belonging to the Bronze age, and where therefore its presence is less inexplicable. The stone implements found in the settlements belonging to this earliest period consists of ham-

mers, 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 preëminently *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 Neufchatel). 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 process of manufacture is thus described by M. Troyon. After having chosen a stone, the first step was to reduce it by blows with a hammer to a suitable size. Then grooves were made artificially, which must have been a very tedious and difficult operation, when flint knives, sand, a little water, and an unlimited amount of patience, were the only available instruments. Having carried the gooves to the required depths, the projecting portions were removed by a skillful blow with a hammer, and the implement was then sharpened and polished on blocks of sandstone.

Sometimes the hatchet thus obtained was simply fixed in a handle of horn or wood. Generally, however, the whole instrument consisted of three parts. A piece of horn, two or three inches in length, received the stone at one end and was squared at the other, so as to fit into a longer handle either of wood or horn. These intermediate pieces present several variations, some are simply squared, others have a projecting wing which rested against the handle, some few are forked as if to receive a wedge, and one had a small transverse hole apparently for the insertion of a peg.

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. The first sort had a diamond shape, the posterior half of which was, in some specimens, shorter and rounded off. The second sort had the posterior margin more or less excavated, so that the angles being produced, as it were, into wings, clasped the shaft and enabled the arrow head to be more firmly fixed. In the third sort, the middle part of the posterior side had a projection which sunk into the shaft. 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 javaline 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. (*Mittheilungen des Antiq. Gesellschaft in Zurich*, Bd. xiii, Abth. 2, 1860; and, more recently, a separate work, *Die Fauna des Pfahlbauten in der Schweiz*, 1861). 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,

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

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.

Two species, the one wild, the other domestic, are especially numerous,—the Stag and the Ox. The remains of these two indeed equal those of all others together. It is, however, interesting, that in the older settlements, as Moosseedorf, Wauwyl, and Robenhausen, (Lake Pfeffikon,) the Stag exceeds the Ox in number of specimens indicated, while the reverse is the case in the more modern settlements of the western lakes, as, for instance, those at Wangen and Meilen.

Next to those in order of abundance is the Hog. More sparing again, and generally represented by single specimens where the preceding occur by dozens, are the Roe, the Goat, and the Sheep, which is most numerous in the latter settlements. With these rank the Fox and the Martens. The Fox indeed, appears, whether from choice or necessity, to have been eaten during the Stone period. This conclusion is derived from the fact that the bones often present the marks of knives, and have been opened for the sake of the marrow. While, however, it is very frequent in the Pileworks of the Stone epoch, it has not yet been found in any settlement belonging to the bronze period. Oddly enough the Dog is, at least in the lake dwellings of the Stone period, rarer than the Fox, though more common than the Horse or the Ass; and of other species but few specimens have been met with, though, in some localities, the Beaver, the Badger, and Hedgehog appear in some numbers.

The Bear and Wolf, as well as the Urus, the Bison, and the Elk seem only to have occasionally been captured; it is probable that the latter species were taken in concealed pits.

From the small lake at Moosseedorf, M. Rüttimeyer has identified the following list:—Of the Dog, 3 specimens; Fox, 4 specimens; Beaver, 5 specimens; Roe, 6 specimens; Goat and Sheep, 10 specimens; Cow, 16 specimens; Hog, 20 specimens; Stag, 20 specimens.

It is certainly very striking to find two wild species represented by the greatest number of specimens, and particularly so, since this is no exceptional case; but the whole sum of the wild, exceeds that of the domesticated individuals, a result moreover which is confirmed by the other settlements of this epoch. Not only does this indicate a great antiquity but it also proves that the population must have been sometimes subjected to great privations, not only from the necessary uncertainty of supplies so obtained, but also because we cannot suppose that foxes would have been eaten except under the pressure of hunger.

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In his first memoir, Prof. Rüttimeyer gives an interesting table which I here subjoin, premising that 1 denotes a single individual; 2, several individuals; 3, the species which are common; 4, those which are very common; and 5, those which are present in great numbers. An x indicates a trace, and I have inserted a + in those cases in which the species have occurred since the table was constructed. I may also repeat that Moosseedorf, Wauwyl, Robenhausen, and Wangen belong to the Stone period while Meilen, and Concise were also inhabited during that of the Bronze, and Auvernier and Steinberg have even produced a few weapons of iron.

		STONE.				BRONZE.			IRON.
		Moosseedorf.	Wauwyl.	Robenhausen.	Wangen.	Meilen.	Biene.	Concise.	Auvernier.
1	The Brown Bear	Ursus Arctos	2		2	+		(x)	
2	The Badger	Meles vulgaris	2	2	1	x		+	
3	The Martin	Mustela Foina	2	3				(x)	
4	The Pine Martin	" Martes	2	3		1		(x)	
5	The Polecat	" Putorius	2		+				
6	The Ermine	" Erminea	2		2				
7	The Otter	Lutra vulgaris	1		+				
8	The Wolf	Canis Lupus		1	+	(x)	x		+
9	The Fox	" Vulpes	3	3	1	1	(x)		
10	The Dog	" familiaris	2	2	2	2	3	3	(2) x
11	The Wild Cat	Felis Catus	2	2	2	2			
12	The Hedgehog	Erinaceus europæus.	1	+	+				
13	The Beaver	Castor fiber	3	2				(x)	
14	The Squirrel	Sciurus europæus	2	2		1			
15	The Marsh Boar	Sus Scrofa palustris	5	5	5	5	5	2	(x)
16	The Wild Boar	" " ferus	2		2				
17	The Domestic Hog	" " domesticus		?	1			3	+
18	The Horse	Equus Caballus	? 1	2		1	2	3	
19	The Elk	Cervus Alces	1	1	2		2	1	(x)
20	The Stag	" Elaphus	5	5	5	5	5	5	(x)
21	The Roe	" Capreolus	4	2	2	2	2		(x)
22	The Fallow Deer	" Dama					x?	x	
23	The Ibex	Capra Ibex					1		
24	The Goat	" Hircus	2	2	2			3-4	(x) x
25	The Sheep	Ovis Aries	2	1	2		(x)	3-4	(x) x
26	The Urus	Bos primigenius	1	+	2				+
27	The European Bison	" Bison		1					
28	The Ox	" Taurus domesticus	5	5	5	5	5	5	(x) x
29	The Kite	Falco milvus			1				
30	The Goshawk	" palumbarius	2	1					
31	The Sparrow hawk	" nisus	2						
32	The Ringdove	Columba palumbus	1						
33	The Wild Duck	Anas boschas	3	1					
34	The Garganey	" querquedula?	2						
35	The Heron	Ardea cinerea	2		1				
36	The freshwater Tortoise	Cistudo europæa	1						
37	The edible Frog	Rana esculenta	3	2	+				
38	The Salmon	Salmo salar	1						
39	The Pike	Esox lucius	3						
40	The Carp	Cyprinus carpio	2		+				
41	The Bleak	" leuciscus	1						

The additional species added since this table was published are:—

42. The Mouse, *M. sylvaticus*. A single specimen, from Robenhausen. Our common house-mice and rats seem to have been unknown, and even this species is at present represented by but a single specimen.

43. The Hare, *Lepus timidus*. Of this species only a single bone has yet occurred. It was found at Moosseedorf. It is very remarkable that any nation should have eaten the Fox and spared the Hare, and nothing but a feeling of superstition can account for such an anomaly, which, however, accords well with the entire absence of the Hare from the Kjökkenmöddings of Denmark.

44. The Chamois, *Antilope rupicapra*. This species is represented by a piece of skull from Robenhausen.

45. A second race of domestic Oxen.

46. The Ass.

The additional birds which have been discovered are:—

Aquila fulva, Meyer. The Golden Eagle. At Robenhausen.

Aquila haliaëtus. A single bone found at Moosseedorf is rather doubtfully referred to this species by M. Rüttimeyer.

Strix alves. From Concise.

Sturnus vulgaris. " Robenhausen.

Cinclus aquatinus " "

Tetrao bonasia " "

Ciconia alba. Not unfrequent at Moosseedorf and Robenhausen.

Fulica atra. Robenhausen.

Larus. Sp. in " "

Cygnus musicus " "

Anser segetum " "

The additional species of fish are:—

Perca fluviatilis. Robenhausen.

Scardinius erythrophthalmus. " "

Chondrostoma nasus. " "

Lota vulgaris. " "

And one or two species belonging to the genus *Squalius*.

The common Mouse and our two House rats, as well as the domestic Cat and the Barndoor fowl are absent from the Lake habitations of Switzerland as from Kjökkenmöddings of Denmark; at least Prof. Rüttimeyer attributes to a later period a single bone of the latter which was found at Morges, a settlement belonging to the Bronze period.

The bones of the Stag and the Wild Boar often indicate animals of an unusual magnitude, while on the other hand the Fox appears to have been somewhat smaller than at present.

The Dogs varied less than at present, in fact they belong to one variety, which was of middle size, and appears to have resembled our present Beagles. (M. Rüttimeyer describes it as "resembling the Jagdhund" and the "Wachtelhund.")

The Sheep of the Stone period differed from the ordinary form, in its small size, fine legs, and short, goat-like horns: particulars, in which it is nearly resembled by some northern, and mountain varieties at the present day, as for instance by the small sheep of Shetlands, Orkneys, Welsh hills, and parts of the Alps. At Wauwyl, however, M. Rüttimeyer found traces of an individual with large horns.

The number of Wild species of Sheep is so great, and our knowledge of them is so deficient, that M. Rüttimeyer does not venture to express any opinion concerning the origin of our domestic varieties except that he is inclined to trace them up to several wild races.

It is singular, that though remains of the Horse have yet been found in all the Pileworks, they are so rare that their presence may almost be considered accidental: thus Wangen has only produced a single tooth, Moosseedorf, a metatarsal bone, which has been polished on one side, Robenhausen, a single os naviculare tarsi and Wauwyl, only a few bones, which may all have belonged to a single specimen. On the other hand, when we come to the Bronze period, we find at Steinberg, numerous remains of this species, so that, as far as these slight indications go, the Horse though undoubtedly present in the Stone age, seems to have been rarer than it became at subsequent periods. All the remains of the Horse belonged undoubtedly to the domestic species.

Though he refers some bones to the Wild Boar, and others to the Domestic Hog, yet he considers that the greatest numbers of the remains of this genus belong to a different race, which he calls *Sus scrofa palustris*. This variety was, in his opinion, less powerful and dangerous than the Wild Boar, the tusks being much smaller in proportion; in fact he describes it as having with the molar teeth of an ordinary full grown Wild Boar, the premolars, canines, and incisives of a young Domestic Hog. He considers that all the bones of this variety from Moosseedorf, belonged to wild individuals, while of those from Nidau-Steinberg, Robenhausen, Wauwyl, and Concise, some bore in his opinion evidences of domestication. It has been supposed by some naturalists that this variety was founded only on female specimens, but in his last work, M. Rüttimeyer combats this opinion at some length, and gives copious descriptions and measurements of different parts. He also points out numerous sexual differences in the *S. palustris*, of the same nature, but not so well marked, as those of the Wild Boar. Relying also on its well defined geographical and historical range, he denies that it can be considered as a cross between the Wild Boar and Domestic Hog, or that the differences which separate it from the former, can be looked upon as mere individual peculiarities. He considers, indeed, that as a wild animal it became extinct at a very early period, though the tame

Swine of India which agree closely with this race may perhaps have been descended from it.

Our Domestic Hog first makes its appearance in the later Pileworks, as for instance at Concise. M. Rüttimeyer does not, however, consider that it can have been derived from the Wild Boar (*Sus scrofa*), nor does he think that it was tamed by the inhabitants of Switzerland, but is rather disposed to look upon it as having been introduced, and the more so, as he finds at Concise traces of an Ox (*B. trochoceros*) which does not occur in the earlier Pileworks. In considering whether a given animal was wild or domesticated, we must be guided by the following considerations; the number of individuals represented; the relative proportions of young and old; the absence or presence of very old individuals, at least of species that served for food; the traces of long, though indirect, selection, in diminishing the size of any natural weapons which might be injurious to man; the direct action of man during the life of the animal; and finally the texture and condition of the bones.

Applying these considerations to the *Sus palustris* from Moosseedorf, it is evident, firstly, that the argument derivable from the number of young specimens loses much of its force on account of the great fertility of the Sow, and the ease with which the young can be found and destroyed; secondly, in the number of individuals represented, it is equalled by the Stag, which certainly was never domesticated; thirdly, some bones of very old individuals have been found and some of very young, even of unborn pigs; the smallness of the tusks is, according to M. Rüttimeyer, a characteristic of the race and not an evidence of domestication; the bones are of a firm and close texture, and the only cases of decay have arisen from an extreme degradation of the teeth, which would certainly be unlikely to occur in a domestic animal. Finally, none of the teeth show traces of any filing or other preparation, except such as may have taken place after the death of the animal, from all of which reasons M. Rüttimeyer infers that the inhabitants of Moosseedorf had not yet succeeded in taming either the *Sus scrofa palustris* or the *Sus scrofa ferus*.

M. Rüttimeyer has paid great attention to the texture and condition of the bones themselves, and in many cases can from these alone distinguish the species, and even determine whether the bone belonged to a wild or a domesticated animal.

In wild animals the bones are of a firmer and closer texture, there is an indiscrivable, but to the accustomed eye very characteristic, sculpturing of the external surface, produced by the sharper and more numerous impressions of vessels and the greater roughness of the surfaces for the attachment of muscles. There is also an exaggeration of all projections and ridges, and a diminution of all indifferent surfaces. In the consideration of the

remains of Oxen, these distinctions have proved of the greatest importance. By their assistance, and this is in some respects the most interesting part of the work, M. Rüttimeyer has convinced himself that besides the two wild species of Bos, namely the Urus (*B. primigenius*) and the Aurochs (*B. bison* or *bison Europeanus*), three domestic races of Oxen occur in Pileworks.

The first of these is allied to, and in his opinion descended from, the Urus, and he therefore calls it the Primigenius race. This variety occurs in all the Pileworks of the Stone period. The second or Trochoceros race, he correlates with a fossil species described under this name by F. von Meyer, from the Diluvium of Arezzo and Siena. This variety has hitherto only been found at Concise.

The third, or Longifrons race, is by far the most common of the three. It occurs in all the Pileworks, and at Moosseedorf and Wangen—that is to say, in the settlements which are supposed to be the oldest, almost to the exclusion of the Primigenius race. M. Rüttimeyer considers that it is the domesticated form of *B. longifrons* of Owen, but as the word “longifrons” seems to him to be inappropriate and incorrect, he uses the name “brachyceros,” which was originally proposed in manuscript by Owen for this species, but which has also been used by Gray for an African species, and ought not therefore to be adopted.

A subsequent portion of the work is devoted to the examination of the existing races of European Oxen. The old Trochoceros race he considers to be extinct, but he sees in the great Oxen of Friesland, Jutland, and Holstein, the descendants of the *Bos primigenius*. This race does not now occur in Switzerland, but he considers that there are at present in that country two distinct varieties of Domestic Oxen. The one of various shades between light grey and dark brown, but without spots, and prevailing in Schwyz, Uri, Wallis, &c., in fact, in the whole country south of a line drawn from the Lake of Constance to Wallis, agrees in its general osteological characters with the *Bos longifrons* of Owen. The other or spotted variety, which is generally of smaller size, and prevails in Northern Switzerland, is considered by M. Rüttimeyer to be descended from the *B. frontosus*, a species found fossil in Sweden and described by Nillson.

I will not express any opinion of my own as to these conclusions. The subject is one no less difficult than important, and our space does not permit us to lay before our readers the details given by M. Rüttimeyer, to whose work therefore we must refer all those who wish for more information on the subject. All naturalists must feel much indebted to M. Rüttimeyer for the labor he spent, and the light he has thrown upon the subject, whether we eventually adopt his conclusions or not.

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 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, 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. M. Troyon, quotes the following passage from a work published by André Thévét, in 1575; "Quand donc (speaking of the Brazilian aborigines), leurs parents sont morts, ils les courbent dans un bloc et monceau dans la lit où ils sont décédés, tout ainsi que les enfants sont au ventre de la mère, puis ainsi enveloppés, liés et garrottés de cordes, ils les mettent dans une grande vase de terre." M. Troyon adds, "Chez certains Indiens, les mères, après avoir donné à l'homme, avant de l'inhumer l'attitude qu'il avait dans le sein maternel, épanchent

* See for Denmark, Worsaae's *Antiquities*, Eng. Edit. p. 89. To judge from Mr. Bateman's excellent volume just published, "Ten years diggings in Celtic and Saxon Gravehills," the same position was, to say the least of it, very common in early British Tombs, in which also the corpse was generally deposited on its left side. It would be very interesting if some archæologist would tabulate all the accounts of ancient graves, showing the ornaments and weapons which have been found with different methods of interment.

leur lait sur la tombe. Cet usage des mères, qui assimile l'homme après sa mort au petit enfant qu'elles nourrissent de leur lait, s'est conservé, sauf l'attitude, il est vrai, jusqu'au commencement de ce siècle, dans le centre de l'Europe, dans la vallée alpestre des Ormonts ;" making this last statement on the authority of M. Terrieux, who was himself an eye witness of this extraordinary custom.

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 characterizes 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 latter 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 monarch 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 Urus, or great fossil Ox is now altogether extinct. It was mentioned by Cæsar, who describes it as being little smaller than an elephant. (Hi sunt magnitudine paulo infra elephantos, specie et colore et figura tauri.) According to Herberstein, it still existed in Switzerland during the sixteenth century, soon after which, however, it must have become extinct.

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. In Switzerland we cannot trace it later than the tenth century, but it is mentioned in the "Niebelungen Lied," of the twelfth century, as occurring in the Forest of Worms, and in Prussia the last was killed in the year 1775. At one period indeed, it appears to have inhabited almost the whole of Europe, much of Asia, and part even of America, but at present it is confined in Europe, to the imperial forests in Lithuania, where it is preserved by the Emperor of Russia, while, according to Nordmann and von Baer, it still exists in some parts of Western Asia.

We have no notice of the existence of the Elk in Switzerland during the historical period, but it is mentioned by Cæsar as existing in the great Hercynian forest; and even in the twelfth century it was to be met with in Sclavonia and Hungary, according to Albertus Magnus and Gesner. In Saxony, the death of the last is recorded as having occurred in 1746. At present it inhabits Prussia and Lithuania, Finland and Russia, Scandinavia and Siberia, to the shores of the Amoor.

* Whether the Drift race of men were really the aboriginal inhabitants of Europe, still remains to be ascertained. M. Rüttimeyer hints, that our geographical distribution indicates a still greater antiquity for the human race.

The Ibex disappeared from most of the Swiss Alps, perhaps not much later than the Elk. It lingered longest in the West. In Glarus the last one perished in 1550, though near Chiavenna it existed until the commencement of the 17th century, and in the Tyrol until the second half of the 18th, while it still maintains itself in the mountains surrounding Mont Iséran.

The extermination of the Bear, like that of the Ibex, seems to have begun in the East, and not yet to be complete, since this animal still occurs in the Jura, in Wallis, and in the South Eastern parts of Switzerland.

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. It has long been very rare in Switzerland, but a few survived until the beginning of the present century, in Lucerne and Wallis. Red deer were abundant in the Jura and Black Forest in the twelfth and thirteenth centuries, though they do not appear to have been so large as those which lived in earlier times. The last was shot in Basle, at the close of the eighteenth century, while in Western Switzerland and Wallis they lingered somewhat longer. 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 characterize 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 hyena. These extinct species appear to have coëxisted 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 had 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 pres-

ent 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 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 Hyena.

M. Rüttimeyer, however, thinks that we may carry this division farther, and he considers that some of the Pileworks presenting a more archaic character than others, they may be arranged as follows:—

1stly, Moosseedorf.

2ndly, As being somewhat more recent, Wauwyl, Robenhausen, Wangen, and Meilen.

3dly, The Lake habitations of Western Switzerland.

It is of course unnecessary to point out the interest and importance of such a distinction, which accords so well with that indicated by the study of the weapons and the state of preservation of the piles. Thus, the Urus has only occurred at Moosseedorf and Robenhausen; the Aurochs only at Wauwyl; the Bear only at Moosseedorf and Meilen. A glance at the table given at page 172, will show that several other species have as yet only occurred at Moosseedorf and Robenhausen, a fact however which indicates rather the richness than the antiquity of these localities. Possibly indeed we may consider the presence of these larger species as an indication of their greater abundance in the oldest period; but we must not forget that not only the Bear and the Elk, but also the Aurochs and Urus come down to a much later period. On the other hand, the abundance of wild animals, and the fact that at Moosseedorf and Wauwyl the Fox was more abundant than the Dog, while elsewhere the reverse is the case, certainly speaks in favor of the greater antiquity of these two settlements.

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 provision 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 carbonized 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 and shorter 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.

Carbonized Apples and Pears have also been found at Wangen, sometimes whole, sometimes cut in 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 list of plants found in the Pileworks stand as follows:—

Pinus abies.	Corylus avellana.
“ picea.	Prunus spinosa.
“ sylvestris.	“ padus.
Quercus Robur.	Rubus idæus.
Fagus sylvaticus.	“ fruticosus.
Populus tremula.	Wheat.
Betula alba.	Hordeum distichum.
Alnus glutinosa.	“ hexastichon.

Trapa natans.—This species was supposed to be extinct in Switzerland; but, as M. Troyon informs me by letter, it has recently been discovered in a living condition. It has, however, become very rare.

Flax, Hemp, Juncus, Arundo.

Neither Oats nor Rye have yet been found. Small pieces of twine and bits of matting made of hemp and flax may have been parts of some article of clothing. For the latter purpose also there can be little doubt that the skins of animals were used, and some of the stone implements seem well adapted to assist in their preparation, while the bone pins, and the needles made from the teeth of boars, may have served to fasten them together.

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 a 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. The rings of pottery, which at a later epoch were used as stands, for these earthen *tumblers* are not found in the Lake habitations of the Stone period, but some of the vessels had small projections which were pierced in such a manner that strings might be passed through them, and the vessels might in this manner be suspended. Some of them were also pierced by small holes at different levels. Professor Heer suggests that these may have been used in the preparation of curds, the small holes being intended to permit the escape of the milk.

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 neighboring civilization 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 the 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; 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 characterized, 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 skillfully made than that of the Stone age, and the potter's wheel was already in use. Rings of earthenware are common, and appear to have been used as supports for the round bottomed vases. 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 Bienne 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 skillfully made and is ornamented with various colors; the personal ornaments are also more varied, and glass for the first time makes its appearance.

Col. Schwab has found at the Steinberg more than twenty crescents, made of earthenware, and with the convex side flattened, to serve as a foot. They are compressed at the sides, sometimes plain, sometimes ornamented, from eight to twelve inches from one horn to the other, and from six to eight inches in height. They are considered by Dr. Keller to be religious emblems, and are taken as evidence of moon-worship. He refers to Pliny, xvi. 95; "*Est autum id (viscum) rarum admodum inventu et reperiunt magna religione petitur et ante omnia sexta luna, quæ principia mensum annorumque his facit, et sæculi post tricesimum annum quia jam virium abunde habeat nec sit sui dimidia; omnia sanantem appelantes suo vocabulo.*" This passage he translates as follows: "The mistletoe is however very rare, but when it is found it is gathered with great religious ceremony, especially on the sixth day of the moon, at which epoch begin their months, years, and divisions of thirty years, because it has then sufficient force, and yet is not in the middle of its course; calling it Heal-all in their language." This name has generally been referred to the mistletoe. (See *The Celt, Roman and Saxon*, p. 48.) But the Swiss archæologists consider that this is a mistake, and that it properly refers to the moon.

A field of battle at Tiefenau, near Berne, is remarkable for the great number of iron weapons and implements which have been found on it. Pieces of chariots, about a hundred swords, pieces of coat of mail, lance heads, rings, fibulæ, ornaments, utensils, pieces of pottery and of glass, accompanied by more

than thirty pieces of Gaulish and Massaliot money anterior to our era, enable us to refer this battle field to the Roman era.

After this period we find no more evidences of Lake habitations on a larger 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 civilization, 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.

The torrent of the Tinière* at the point where it falls into the Lake of Geneva, near Villeneuve, has gradually built up a cone of gravel and alluvium. In the formation of the railway this cone has been bisected for a length of one thousand feet, and to a depth in the central part, of about thirty-two feet six inches above the level of the rails. The section of the cone thus obtained shows a very regular structure, which proves that its formation was gradual. It is composed of the same materials (sand, gravel, and larger blocks) as are even now brought down by the stream. The detritus does indeed differ slightly from year to year, but in the long run the differences compensate for one another, so that when considering long periods and the structure of the whole mass, the influences of these temporary variations, which arise from meteorological causes, altogether disappear, and

* See Morlot, *Leçon d'Ouverture*, &c.

need not therefore be taken into account. Documents preserved in the archives of Villeneuve show that in the year 1710 the stream was dammed up and its course a little altered, which makes the present cone slightly irregular. That the change was not of any great antiquity is also shown by the fact that on the side where the cone was protected by the dykes, the vegetable soil, where it has been affected by cultivation, does not exceed two to three inches in thickness. On this side, thus protected by the dykes, the railway cutting has exposed three layers of vegetable soil, each of which must, at one time, have formed the surface of the cone. They are regularly intercalated among the gravel, and exactly parallel to one another, as well as to the present surface of the cone, which itself follows a very regular curve. The first of these ancient surfaces was followed on the south side of the cone, over a surface of 15,000 square feet; it had a thickness of four to six inches, and occurred at a depth of about four feet (1.14 metre measured to the base of the layer) below the present surface of the cone. This layer belonged to the Roman period, and contained Roman tiles, and also a coin.

The second layer was followed over a surface of 25,000 square feet; it was six inches in thickness and lay at a depth of 10 feet (2.97 metres, also measured to the bottom of the layer). In it have been found several fragments of unvarnished pottery, and a pair of tweezers in bronze, which to judge from the style belonged to the Bronze epoch. The third layer has been followed for 3500 square feet; it was six or seven inches in thickness, and lay at a depth of 19 feet (5.69 meters) below the present surface; in it were found some fragments of very rude pottery, some pieces of charcoal, some broken bones, and a human skeleton with a small, round, and very thick skull. Fragments of charcoal were even found a foot deeper, and it is also worthy of notice that no trace of tiles was found below the upper layer of earth.

Towards the centre of the cone, the three layers disappear, since, at this part, the torrent has most force, and has deposited the coarsest materials, even some blocks as much as three feet in diameter. The farther we go from this central region the smaller are the materials deposited, and the more easily might a layer of earth, formed since the last great inundations, be covered over by fresh deposits. Thus, at a depth of ten feet, in the gravel on the south of the cone, at a part where the layer of earth belonging to the bronze age had already disappeared, two unrolled bronze implements were discovered. They had probably been retained by their weight, when the earth, which once covered them, was washed away by the torrent. After disappearing towards the centre of the cone, the three layers reappear on the north side, at slightly greater depth, but with the same regularity

and the same relative position. The layer of the Stone age was but slightly interrupted, while that of the Bronze era was easily distinguishable by its peculiar character and color.

Here, therefore, we have phenomena so regular, and so well marked that we may apply to them a calculation, with some little confidence of at least approximate accuracy. Making then some allowances, for instance, admitting three hundred years instead of one hundred and fifty, for the period since the embankment, and taking the Roman period as representing an antiquity of from sixteen to eighteen centuries, we should have for the age of Bronze an antiquity of from 2900 to 4200 years, for that of the Stone period from 4700 to 7000 years, and for the whole cone an age of from 7400 to 11,000 years. M. Morlot thinks that we should be most nearly correct in deducting two hundred years only for the action of the dykes, and in attributing to the Roman layer an antiquity of sixteen centuries, that is to say, in referring it to the middle of the third century. This would give an age of 3800 years for the Bronze age and 6400 years for that of Stone, but on the whole he is inclined to suppose for the former an antiquity of from 3000 to 4000 years, and for the latter of from 5000 to 7000 years.

In the settlement at the foot of Mt. Chamblon we have, according to M. Troyon, a second instance in which we obtain at least some approximation to a date. The interest which attaches to this case arises from the fact that Pileworks have been found in the peat at a considerable distance from the lake, whereas it is evident that at the time of their construction the spot in which they occur must have been under water, as this mode of building would have been quite out of place on dry land. This however indicates a very considerable antiquity, since the site of the ancient city Eburodunum must have been, at that time, entirely covered by the lake, and yet the name, which is of Celtic origin, denotes that there was a town here even before the Roman period. In order, however, to form an idea of the time at which the dwellings at Chamblon were left dry by the retirement of the lake, we must have in the valley a point of determined age, to serve as a term of comparison, and such a point we find in the ancient city of Eburodunum (Yverdon), which was built on a *dune* extending from Jorat to the Thiéle. Between this *dune* and the lake, on the site at present occupied by the city of Yverdon no traces of Roman antiquities have ever been discovered, from which it is concluded that it was at that period under water. If then we admit that at the close of the fourth century the lake washed the walls of the Castrum Eburodense, we shall have fifteen centuries as the period required to effect this change. The zone thus uncovered in fifteen hundred years is 2500 feet in breadth, and as the piles at Chamblon are at least 5500 feet from the water, it may be inferred that three thousand three hundred

years must have elapsed since they were left dry. This Lake dwelling belonged to the Bronze period, and the date thus obtained, agrees pretty well with that obtained from the examination of the Cone de la Tinière. M. Troyon adds that "rien ne fait soupçonner, pendant l'époque humaine et antérieurement a notre ère, des conditions d'accroissement différentes de celles qui ont eu lieu postérieurement aux Romains; le résultat obtenu est même un minimum, vu que la vallée va se rétrécissant du côté du lac et que nous avons admis la présence de celui-ci au pied même d'Eburodunum dans le IV^e siècle de l'ère chrétienne, tandis qu'il est probable que la retraite des eaux n'a pas été insensible depuis le moment où les Romains se sont fixés sur ce point."

However this may be, and while freely admitting in how many respects this calculation is open to objection, we may still observe that the result agrees in some measure with that given by the Cone de la Tinière. The ancient history of Greece and Rome, as far as it goes, tends to confirm these dates, since we know that at the time of Homer and Hesiod, arms were in part at least, made of iron, and as we know that at a very early period, there was a certain amount of commerce between Helvetia and the shores of the Mediterranean, we can hardly suppose that a metal so immensely important as iron, can have remained unknown in the former country, long after it was generally used throughout the latter.

Still, though we must not conceal from ourselves the imperfection of archæological record, we need not despair of eventually obtaining some more definite chronology. Our knowledge of primitive antiquity has made an enormous stride in the last ten years, and the future is full of hope. I am glad to hear from M. Troyon that the Swiss archæologists are continuing their labors. They may feel assured that we in England await with interest the results of their investigations.