Recent Investigations of the Lake Dwellings of Switzerland.

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AS a result of the persistent drought at the beginning of 1921, the level of the Swiss lakes fell considerably, and hitherto-unsuspected depths were brought to light. This phenomenon was particularly marked in the three lakes of Neuchâtel, Bienne, and Morat, in which important areas had already been laid bare by the regulation of the waters of the Jura. Long stretches of beach which, until that time, had not been accessible to the inhabitants of the shore, completely modified the aspect of these lakes.

During the early months of 1921, in those districts in which the men of the polished stone age had built their dwellings, a large number of piles gradually

culture of these ancient populations. We have obtained, to some extent, an insight into their mode of life; we can frame hypotheses as to their race; but there are still many problems which require elucidation. I will indicate here a few of these problems which relate to the neolithic period.

1. We do not yet know with certainty to which ethnological group to assign the builders of the lake dwellings and their successors up to the end of the bronze age. It has been held, on the evidence of bones recovered from among the piles, that this type of habitation was invented or introduced by brachycephals—until that time unknown in Western Europe.

FIG. 1.—Part of the site at Greng, Lake of Morat.

emerged which the present generation had seen only under several feet of water. It was a revocation of vanished ages which appealed to the emotions. It enabled the imagination to reconstruct more readily a picture of those who, thousands of years ago, were the authors of the greatest of social changes when they introduced the cultivation of cereals, the domestication of animals, and the like. From day to day more and more of the substructure of these cities of the lake was uncovered, and from all parts travellers came to look upon this impressive spectacle, which perhaps we shall never see again.

It will be readily understood that such exceptional conditions encouraged Swiss men of science to undertake fresh investigations on several of the lacustrine sites.

The numerous finds which have been made since 1854 in all the lakes which were at one time inhabited by men of the stone age and the bronze age have enabled us to reconstruct, in great part, the material

Further, that this race held its own on the Swiss lakes until the end of the neolithic age, when dolichocephals begin to appear in the lake-dwelling sites, coming, perhaps, from the north. (Their ethnical affinities also are still to be determined. Will our hypotheses stand?)

2. The dispositions of lake-dwelling sites, their town planning, if one may use the phrase, is, in essentials, unknown. Even the extent of the ground they covered in many cases has not been determined exactly.

What exactly was the topographical plan of each site? Were the sites, that is, those of the same epoch and situated on the same lake, arranged on a specific plan, identical throughout, or was a free rein given to the fancy of the builders in each case? In other words, was there a type of lake village, and, if so, what was it? Was the lacustrine city an organic whole, with the houses grouped on one frontage, or was it composed of a series of small islands, and, in that case, what were the dimensions and dispositions

of these islands? Did they communicate with one another by bridges or by navigable canals? If so, what were the measurements and arrangement of these bridges or canals?

What was the form of the dwellings? Those authors who have attempted to reconstruct groups of lake dwellings have differed remarkably in their attempts. These diversities show how little solid basis there is for our knowledge in this matter, notwithstanding the evidence from sites such as Schüssenried, Robenhausen, Niederwil, etc. Was the settlement protected against the waves caused by prevailing winds by some projecting construction—it may be assumed, a stockade of piles?

3. Do the most important of the articles in daily use by the inhabitants of the lake dwellings in the

tions on sites which are always submerged. The diving bell alone can be used. It is for this reason that the persistent drought at the beginning of the year 1921 has proved so favourable to research.

Let us now consider the results which were obtained in the course of recent investigation.

Very few human skeletal remains of neolithic age were found; but an important discovery was made at St. Aubin. In the lowest stratum of this site, which is the oldest of the Swiss neolithic lake-dwellings, M. Vouga found a human cranium, which was sent to me. It is unquestionably dolichocephalic. This is the first piece of definite evidence of this character. Does it affect previous hypotheses as to the race of the builders of the lake-dwellings? I do not think on such slender evidence we can maintain that it does.

FIG. 2.—Part of the Neolithic site at Greng, Lake of Morat.

neolithic period date from the beginning of lake settlements? Were the various types of objects which are exhibited in the cases of our museums invented at different ages in accordance with the growth of needs, or were they in use in the earliest period? This question can be settled finally only by stratigraphical study.

4. Were the five domesticated animals of the neolithic period (the ox, the dog, the pig, the goat, and the sheep) present in the earliest period of the lake dwellings, or may we accept the suggestions put forward by various authors that these domestic animals were introduced gradually during the age of polished stone?

These are a few of the questions which still await an answer, notwithstanding the numerous investigations which have been undertaken since the memorable winter of 1853-54. The solution of these problems is naturally very difficult owing to the nature of the ground upon which investigations have to be carried out. It is not easy to make stratigraphical observa-

The skull in question is feminine, from which fact we may conclude that it belonged to an inhabitant of the site at St. Aubin and not to a foreigner, whose head might perhaps have been brought home as a trophy of war. The discovery, however, is of importance, because it was made in the course of investigations on stratigraphical lines. It is not a skull unearthed at hazard from the mud or sand. It was *in situ*.

In the course of the spring and the summer of 1921, two detailed topographical surveys were made—one, at my suggestion, at Greng in the Lake of Morat (Figs. 1 and 2) by MM. Le Royer and Winkler, the other on the foreshore of Geneva. This is the first time that any work of this character has been undertaken in Switzerland. The station at Greng was not completely surveyed. A record was made of the position of those piles only which were left uncovered by the fall of the lake and of those which were in shallow water. At Geneva, work of considerable extent was undertaken.

by MM. Le Royer and Blondel. It has recently been completed (April 1922). Among the conclusions which emerge, it is now clear that the inhabitants of the lake-dwellings in the polished stone age had constructed stockades facing the open water, for protection against the waves raised by the prevailing northerly wind. These breakwaters must have afforded the dwellings relatively smooth water. From these investigations it may also be concluded that the lake-dwelling sites of Geneva were of considerable size. Unfortunately of these there remain to-day only some thousands of piles implanted in the bed of the lake.

Geneva is thus one of the most ancient cities of the world, since man has lived on this site continuously ever since the neolithic period.

The stratigraphical investigations undertaken by M. Vouga enable us to establish with certainty the succession of the types of industrial objects throughout the neolithic period of the lake-dwellings. Several of our *a priori* conceptions based on typology must be abandoned. Thus the pottery of the earliest period is more refined, more beautiful, more highly burnished than that of later periods. In technique it approaches more nearly the pottery of the bronze age than that of the middle and upper neolithic.

Thanks to a careful study of the stratification of objects found at Auvener, M. Vouga has been able to plot out the progressive modification of several objects in daily use, such as the axe-hafting sockets of stag horn, flint arrow-heads, and the like.¹

In many cases, however, stratigraphical study has only slightly modified classifications, such as those of Ischer, based upon the typology of lake-dwelling sites which have been investigated with minute care.

Other observations of importance for the history of culture have also been made by M. Vouga:—

The lowest stratum (IV.) has not yet yielded any of the spindle whorls which are necessary for weaving. The art of drilling stone would appear to begin in Stratum III., but only in the triangular axe hammer-head. The true perforated axe hammer-head appears much later—in Stratum I.

In Stratum I.—the latest—appear flint flakes of Grand-Pressigny type. Relations between Switzerland and western France are thus clearly established.

For the first time *all* bones found in the excavation of a lake-dwelling site have been preserved. My

¹ I would refer the reader to the reports published by M. Vouga in "Indications d'Antiquités suisses" in the *Arch. suisses d'Anthrop. Gén.*, Geneva, 1921 and 1922.

assistant, Dr. Reverdin, and myself have examined more than 4000 mammalian bones from the station of St. Aubin. Our conclusions, which are valid only in respect of the material obtained and for this site, may be summarised as follows:—In the neolithic period corresponding with the earliest lacustrine sites, the horse was not domesticated. It was not even hunted, or, if it was an object of the chase, its flesh was not brought back to the lake-dwelling. If this were the case, would it not be permissible to suggest a taboo as the reason? The five domesticated animals of the neolithic period were represented in the lake-dwellings from the earliest times. Accordingly, the suggestion that domestic animals appear at different stages cannot be accepted. It is true that these five animals are not represented in equal abundance. At the beginning of the period of domestication, the goat and the sheep are much more rare than the ox, the dog, and the pig.

For a considerable time man continued to rely for his food-supply on wild animals, especially the stag; but the proportion of domestic animals rapidly becomes preponderant.

As regards their culinary tastes, the neolithic lake-dwellers seem to show a preference for certain of the domestic animals. The species of which they ate most abundantly were the ox and the pig; next come the dog (though it is not certain that the dog was eaten), the sheep, and the goat. What is the reason for this order of preference? Does it depend upon a special taste for any particular meat? Would they not in that case rear in large numbers only those species which they appreciated most?

The lake-dwellers in the stone age ate the domestic animals when they were full grown, except in the case of the pig. This animal was frequently eaten while it was young, and even when it was still a sucking pig. The ox and the goat were never eaten when quite young. The distinction was dictated, without doubt, by the desire to use the milk-giving qualities of the cow and the goat, and also, perhaps, the sheep, as long as possible, but this explanation does not affect the males of these species.

It thus appears that the exceptionally low water in the Swiss lakes in 1921 has not been without interest to science. Thanks to this phenomenon, some new and important facts have been recorded in the history of the culture of the neolithic lake-dwellers and, at the same time, of all the neolithic peoples.

Vitamin Problems.¹

By Prof. A. HARDEN, F.R.S.

THE existence of three vitamins, termed A, B, and C, has now been firmly established and a general idea has been obtained of their distribution among animal and vegetable organisms. Hitherto, comparatively little quantitative work has been done in this direction, and further progress must depend on a more general adoption of quantitative methods. These are at present tedious and not very accurate. In the case of each of the vitamins the requirements of the special animal employed serve as the unit of

comparison and these vary considerably from individual to individual, so that many observations are necessary if any, even moderate, degree of accuracy is to be attained. Thus in the estimation of the antiscorbutic potency of food materials, by the method worked out by Miss Chick and her colleagues at the Lister Institute, it has seldom been possible to achieve a greater accuracy than about 25-50 per cent. This obviously imposes a very serious limitation on any attempts to study variations in potency unless these are of a very gross order. Another great difficulty inherent in this kind of observation is that when the

¹ Abridged from a Discourse delivered at the Royal Institution on Friday, April 28.