This 'extra' substance, with a mobility slightly greater than that of the albumin normally present in the blood serum, is found to have exactly the same rate of mobility as the 'fast component' of the tuberculin protein.

There is no longer any doubt, Dr. Seibert said, but that the protein fraction is of paramount importance in many reactions accompanying the disease. The whole question of hypersensitivity and allergy is interlinked with sensitization to the protein. For this reason much effort has been spent in attempts to isolate the protein in pure form. This work has been carried on for many years, first at the University of Chicago and during the past nine years at the Henry Phipps Institute, with grants from the Medical Research Committee of the National Tuberculosis Association.

Each succeeding stage in the purification, however, has brought with it the realization of its great complexity. Through the use of some of the modern physico-chemical methods, especially the ultracentrifuge and the Tiselius electrophoresis apparatus, it has been possible to formulate a definite picture of the complex composition of the tuberculin protein and to obtain some leads for further purification.

The free polysaccharide and nucleic acid have been shown not to be responsible for the biological reactions so characteristic of tuberculin. However, they form very definite combinations with the protein, some of which dissociate only at certain hydrogen ion concentrations. For example, it was shown in a heated fraction that nucleic acid and protein travelled in electrophoresis as a single component at hydrogen ion concentrations more acid than *p*H 5·0, whereas on the alkaline side they existed as two separate components with very different mobilities. This protein can exist in various molecular sizes and shapes. In general, larger, less denatured, and more spherical protein molecules in the bacillus are more dangerous than smaller, more denatured, and more elongated molecules. Among the effects produced are the stimulation of the body to produce antibodies and the heightening of susceptibility to later exposures to the disease.

The tuberculin protein has a doubly dangerous effect because when introduced into a body never previously infected, it proves more poisonous than most ordinary proteins, and in addition, infection causes a heightened sensitivity to this protein when it is formed in the disease in later exposures, rather than immunity. For example, 100–150 mgm., given intraperitoneally, will kill a normal guinea-pig. Ten times this amount of a protein from another acid-fast bacillus, the timothy grass bacillus, was not lethal. The toxicity of the tuberculin protein is increased about a hundredfold in the tuberculous animal, the sensitivity of which has been greatly enhanced by the infection. There seems to be no evidence that the antibody which can be demonstrated in the blood stream is directly associated with immunity. In fact, animals highly sensitized to the protein did not possess an immunity to infection. They showed a lessened immunity.

Furthermore, there is no evidence for a bactericidal effect by the blood serums of highly immunized animals on the tubercle bacillus *in vitro*. On the other hand, there is evidence from the work of Dr. Max B. Lurie (also of the Phipps Institute) that the body fluids of tuberculous animals are bacteriostatic in experiments with living animals.

Analysis and sorting out of the molecule comprising the tubercle bacillus is made extremely difficult by the presence, and even association, of the polysaccharide and nucleic acid with the protein. However, with the development of a satisfactory method for removing these two impurities without harming the protein, a very active protein can now be isolated. The potency can be carefully standardized, and a quantity of such a preparation for general standardization purposes has been prepared. But it is still obvious that more research must be done in order to be able to separate the different kinds of protein molecules from each other and then to develop satisfactory methods for producing them at will and in desired quantities.

PALÆOLITHS FROM THE WORTHING ARCHÆOLOGICAL AREA

By F. W. H. Migeod

PALÆOLITHIC implements of early types have been found recently by two local residents in the Worthing archæological area. One collection was made on the Worthing shore by Mr. Barclay Wills. His work came to an end when access to the beach was prohibited in the early days of the War. Mr. R. K. Stevens was able to begin his at Angmering-on-Sea, about five miles to the westward, when grassland was ploughed up for cultivation. Most of his finds were on the surface, a few only, but they of large size, coming from ditches. I had practically completed a detailed description of Mr. Stevens's finds before Mr. Wills's came to my notice. As a result the joint collection here briefly reviewed consists of a hundred of Mr. Stevens's flints and thirty-three of Mr. Wills's.

The cultures were mainly similar. A glance at them shows the great variety of uses to which the flints were adapted. The flaking is bold, and minor chipping in general rare. Their time-range is wide. Some seem to be of eolithic type. The majority, however, may be classed as Chellean. Three may be Clactonian, one Acheulean and one Mousterian. There are also some intrusions, which is only to be expected from the proximity of the neolithic flint mining industry on the nearby downs. Although there are time distinctions, the absence of a clear stratification at Angmering-on-Sea renders precision in this respect out of the question.

The technique of the main body of implements from both sites is in the first instance cleaving a piece off the flint block with a single blow, thus producing a smooth lower surface. The outer and crustal surface is then flaked as required. The smooth under-surface is retained whatever may be the nature of the resulting implement. What sort of implement will emerge depends on how the maker views the possibilities of the fragment he proposes to work on. This factor disappeared when in the later stone age the core of the flint nodule was principally used for implement making.

A wide range of implements has thus emerged, among which may be identified a variety of series as hand picks, hand axes (single and double), hand choppers, knives and saws, borers, spear heads, (?) sickles, side scrapers, hammer stones, planes, gravers, spheres (somewhat angular), hooks, and

miscellaneous small cutting flakes and pygmies. At Angmering-on-Sea intrusions include a sandstone axe head and a banded-chert implement, possibly an adze, with a cutting edge at one end and a point at the other; also some few neolithic implements.

The first series I shall describe consists of eight nodule implements, seven from Angmering-on-Sea and one from Worthing. These are similar to those found by Dr. E. Hugh Kitchin in the Bournemouth area. I use the name he gave to them. These are flints with the crust left, except at points where flaked. He considered his finds covered a wide range of time; and this seems to be the case here too, as some are patinated and others not. The few implements I have doubtfully called eolithic fall into this series.

The Clactonian flaked cores are from Angmering-on-Sea and have a rich patination.

An interesting series for which I selected a dozen specimens out of a larger number consists of what I have called 'worm-eaten' flints. They are deeply indented and the material is most refractory. Nevertheless implements were produced in the same technique as in the main body of the collection. The difficulties of excrescences and deep indentations were successfully overcome, especially as regards the latter, by ignoring their presence. The result is in some cases a veritable *tour de force*. There are what are intended for spear heads, (?) an adze, beaked implements of rostro-carinate type, a borer, a side-chopper, and axe head, (?) a plane, and a double-tailed implement as if for scraping down a pole to size. All this series comes from Angmering-on-Sea.

Another feature from the same locality, where numerous finds are of mint-like sharpness, is a series of crude implements, many of them picks, which have suffered from abrasion. They must for that reason be assigned a position among the oldest. The sharp edges of the facets are worn down, not necessarily on all sides. Whether the cause was moving ice requires further consideration.

As to the various classes of implements, there is an axe weighing 5½ lb., and measuring 194 mm. × 150 mm. × 70 mm. It is a natural block thinning towards what was adapted as a broad cutting edge. At the butt end a vertical cutting edge was contrived. It might have been used for killing elephants or other large animals. The knives and saws consist of a flint with a flat cleavage surface on one side, a rougher one on the opposite side, and crust left on the back. In one specimen there is clearly right and left chipping to make the saw edge. A fine and unique specimen is from the Worthing shore, measuring 208 mm. × 57 mm. × 30 mm. There is a gradually thickening blade which is about three fifths of the total length and 40 mm. wide with two edges. The handle widens abruptly, and there is no crust. A claw-shaped knife from Angmering-on-Sea, with flanged sides, measuring 95 mm. × 72 mm. × 21 mm. is also an interesting specimen.

The borers are of three kinds. A common form has a broad flattened point projecting from the middle of a long edge. Judging by the varying patination, this kind had a long time-range. The points of others are rectangular or prismatic, and at Angmering-on-Sea are found a number of water-rolled beach flints backed to the latter specification, their altered texture being helpful in this respect. Other points are more suitable for boring small holes.

Seven spear heads show some waisting near the base. One is especially outstanding in this respect. They, too, have in most cases one flat surface. In two or three flints, crescentic cutting edges may suggest their being sickles. The planes are of various shapes, specimens with a 'two-humped camel back' being among them. The plane surface is in some cases of a perfect smoothness. The 'steep-nosed' type of plane is common. Two hooks from Angmering-on-Sea, of thin tabular flint, the larger 118 mm. × 35 mm. × 20 mm. would suggest use as harpoons were they sharper.

The range in size of these implements is considerable, extending from the 5½ lb. axe, some hand picks being nearly as large, down to small borers and knife-like flakes, and to minute flint points half an inch long which might have served as gravers. A further feature is that some of the implements have a dual use, some of the knives or saws having a point as well as a cutting edge. As to the Worthing shore flints, they are commonly stained a blue-black, while a few are ochreous, which may only be on one side. Some have serpulæ and coralline growths on them. From the known history of the shore they cannot have been very many centuries under water, and that only at high or half tide. Mr. Wills considered he had found two hearths, around which he made most of his finds. He also considered knapping had been done on the spot. There were difficulties in examining a particular spot. The shifting sand on the chalk rock would for a few days facilitate the work, and then the site might be buried even for years.

In going over the many hundreds of flints brought in by Mr. Stevens, I was fortunate in finding two implements which had on them secondary growth, a comparatively rare occurrence. As the growth was on the sharp edge produced by flaking, a time value is forthcoming. I had not long before found a natural flint in a newly cut trench on a ridge near Cissbury also with such a growth on it, and all three specimens are now in the British Museum (Natural History).

Several industries may be tentatively identified from these collections. There was especially hunting and the preparation of skins. Agriculture cannot be entirely ruled out. Woodworking is also indicated, as there are stones suitable for the sawing and scraping of sticks and boring the wood. These early folk presumably lived in houses of some kind, a supposition all the more tenable seeing that there were no caves or other natural protection for them. The grouping of the flints would further seem to indicate village life.

Connexion with the flint industry on the downs is slight, as the industry up there is mainly neolithic, though the implements be not ground or polished. The mining operations on the chalk downs in search of good flints, which possibly did not begin before neolithic times, were elaborate. Shafts were sunk and galleries driven. The core of the flint nodule was wanted as opposed to the outer part used by the early coastal plain inhabitants. These latter could occupy the plain during the glacial period or periods when the hill tops were under ice or snow. In later ages when the névé disappeared the hills were preferred for living on to the damp and forested lowlands.

The discoveries of Mr. Stevens and Mr. Wills are of great interest. It is not possible in a short article to enter into more detail. They will, however, serve to shed a new light into the darkness enveloping palæolithic man on the Sussex coastal plain.