Gafsa, a considerable town in the southern part of the regency, preserving the site and the name of the Roman Capsa. The author describes three remarkable hills, which rise to a moderate elevation in the neighborhood of that town. These hills, having been made posts of observation of the occupying army, are now known as Posts I., II., and III. Post I. is an eminence rising on one side, by a gradual slope, to a height of sixty metres (about two hundred feet) above the level of the town, and descending on the other side in a steep, cliff-like face, of forty-two metres, to an upland plain. This precipitous face offered to the investigator the advantages of a cutting, showing the composition of the hill from base to summit. It proved to be, in the greater part, a limestone conglomerate, in which are embedded small particles of quartz, with rolled flint-stones of various sizes, and fragments of brown silex. Geologically, the hill belongs to the earliest period of the quaternary or pleistocene epoch. The lower half is of stone sufficiently compact to be quarried for building-stone. Above this is a layer, about eighty feet thick, of somewhat looser and more friable conglomerate, with larger embedded stones. And this, again, is surmounted by a stratum of yellow travertine, about six metres (twenty feet) thick, containing no flints.

The remarkable fact is, that throughout the conglomerate were discovered relics of human handiwork, in the shape of wrought flints embedded in the rock. Still more remarkable is the fact that in the lower and harder stratum these relics were all of one sort, while in the upper and looser layer that sort had disappeared, and other kinds had taken its place. In the lower stratum he found specimens of that rude tool — the rudest of all tools — which is described sometimes as the 'drift-implement,' sometimes as the 'axe of St. Acheul,' and by Prof. G. de Mortillet, in his noted work 'La Préhistorique,' as the 'fist' (*coup de poing*), — a stone clipped into an ovoid or almond-like shape, and intended evidently to be grasped at the smaller end and used in pounding or hacking. With these were some of the coarse flakes, or clipped fragments, which usually accompany them. These stone fists and flakes were all in the typical forms which distinguish the work of the earliest quaternary race, — variously known as the 'River-drift,' or 'Canstadt,' or 'Chellean' race, — and were the only traces of human industry found in that stratum.

In the looser stratum above, not one of the ovoid implements was found, though a single specimen was extracted just on the line of division between the two layers. All the worked flints in the upper layer belonged to what M. de Mortillet styles the 'Mousterian' type, but were mostly of a heavy, coarse, and worn appearance. They were of various shapes, — triangular points, thick blades, rude scrapers, and the like. Dr. Collignon is of opinion that the implements in the upper conglomerate stratum were a development of those in the lower; but the facts, as described by him, do not seem decisively to bear out this opinion. Finally, in the highest stratum of all, the travertine, as has been said, no flints of any kind were found. The hill known as Post III. resembles that of Post I., except that it is lower, and that the layer of travertine is wanting.

The necessary conclusions from these facts, as set forth by the author, are, that in the earlier part of the quaternary era this region was inhabited by the race or races of men who formed these implements. During a period of great but unknown length the land gradually sank, and was finally covered by the sea. When it again rose above the surface, the currents swept away nearly all the formation which had accumulated during this subsidence, leaving only a few hills, such as have been described, to indicate the original level.

After this denudation, a new but briefer subsidence took place, giving rise to a new formation, and followed by a new elevation. These facts are shown by the evidences displayed in and around another hill, known as Post II. This is one of the 'foot-hills' of a small mountain-chain which sinks gradually into the plain at a little distance north of Gafsa. Around these hills and on their declivities are scattered many small mounds of clayey loam. These mounds rest on a layer containing many coarse Mousterian implements, exactly similar to those in the upper conglomerate of Post I. Above this layer is a stratum of argillaceous earth, between three and four metres thick, containing no flints. Then follows a thin layer or film of earth, about four inches thick, full of flint implements of every description. This layer clearly indicates what was for a considerable period the inhabited surface. Above this layer are a few feet of earth; but the same implements are scattered profusely over the present surface, and are found below it where the soil is furrowed by the rains. They belong to every one of M. de Mortillet's 'ages,' subsequent to the Chellean and the earlier Mousterian; viz., the upper (or later) Mousterian, the Solutrean, the Magdalenian, and the Neolithic. So far as prehistoric Tunis is concerned, Dr. Collignon is satisfied that no distinction in point of time can be made among these different industries. It is clear, also, that they have continued in existence to a very recent period, since the soil which covers some of the Roman constructions holds flint implements of the same description.

A very curious fact, ascertained by Dr. Collignon, is that all these stone implements, of every age, are restricted to a comparatively narrow area in the south and west of Tunis. While they abound in that district, they are almost entirely absent from the northern and eastern portions of the country. Dr. Collignon does not attempt to explain this phenomenon. It may possibly be due to an early condition similar to that which exists at present in parts of our own continent, where two hostile races, like the Eskimo and the Athabascan Indians, are separated by a wide space of unoccupied land.

It should be mentioned that in the middle of the Tunisian territory there is a limited area, quite distinct from that in which the stone implements occur, where megalithic monuments — dolmens and covered passages — abound. In one locality no less than four hundred dolmens were counted. These monuments Dr. Collignon believes to have been the comparatively late constructions of an intrusive tribe; and he is further of opinion that the descendants of this tribe and of the stone-implement makers still live in their respective districts, and are distinguishable by their very different physical traits. In the district of the dolmens the people are of rather low stature (1.63 metres, or about 5 feet 4 inches, — an average which must be understood as including both sexes), with long heads (index 74), and a visage short, broad, and irregular, closely resembling in outline that indicated by the Cro-Magnon crania. On the other hand, the people of the south of Tunis are comparatively tall (1.69 metres, about 5 feet 6 1-2 inches), very dolichocephalic (index 73), with retreating forehead and chin, and projecting glabella and brows; the nose turned up, and the lips thick, but with no prognathism. They are neither negroid, Berber, nor Arab. In his view, they represent the earliest ethnic stratum of the existing population, and preserve the blood and the type of the people who dwelt in this region during the stone ages.

The positive conclusions which we seem authorized to draw from Dr. Collignon's report may be stated in a few words. They are, first, that the human race is of an immense antiquity, dating back to the beginning of the quaternary age; and, second, that the first race of men, judged from the relics of their industry, were of a very low grade of intelligence, little surpassing that of the most sagacious brutes; but how far this apparent defect of intellect was real, and how far it may have been due to the circumstance, that, as M. de Mortillet has suggested, the faculty of speech was yet undeveloped, is uncertain. Finally, it is plain that the period of this earliest stone age was of a vast duration, which can only be expressed in geological terms. The same may be said of the early Mousterian era, which perh aps formed part of the first age. As for the various so-called 'stone ages' which followed, it seems impossible to make any real distinction of periods among them. They all apparently form one modern epoch, not of very great duration, and not yet closed.

## CHILLED ARMOR FOR LAND-DEFENCES.

THE Gruson Works of Buckau-Magdeburg have recently published a book of some size, written by Engineer von Schuetz, in which the system of construction of chilled cast-iron armor for use in the protection of earthworks and in the making of turrets for land-batteries, as devised by Dr. H. Gruson, some years ago, is described at length, and an account is given of the results of the experiments which have been made, from time to time, by several European governments, to determine its efficiency in resisting the impact of the heaviest modern ordnance. This work has been

translated into English by Commander Grenfell, R.N., and we are indebted to the courtesy of Captain Piorkowski, Dr. Gruson's representative in this country, for an early copy. The subject and the matter of the work are of exceedingly great importance to a nation which, as is the case with our own, is destitute of the most ordinary means of defence in the event of a foreign attack either by land or sea. So serious is our case, that, as remarked in a private letter from the Admiral of the Navy just received and lying under the hand of the writer, if we desire to learn what advances have occurred during the last twenty years, we must go to England, France, Germany, Russia, and even to Constantinople, to study those of the scientific and mechanical departments of the military and naval establishments, and not to our own army or navy. This work of Dr. Gruson would seem to illustrate such advances in the defence of coasts.

Dr. Gruson's armor is simply a chilled cast-iron shield, of which the body is a strong normal iron, while the surfaces on the exposed side are chilled like the 'tread' of an American car-wheel. Such enormous masses are handled, in this case, however, that correspondingly enormous chills are needed, and the manufacture of these plates becomes a matter of extraordinary difficulty and cost. All the resources of a great establishment are drawn upon, and all the ingenuity, knowledge, and experience of an able staff are called out in the prosecution of the work. Chilling, as is well known, probably, to most of our readers, consists in the casting of a peculiar quality of cast-iron, known as 'chilling iron,' in contact with a large mass of cold iron forming that part of the mould which is to form the surface to be chilled. The sudden abstraction of heat prevents the isolation of the carbon in graphitic form, as would otherwise occur in the slow process of cooling naturally, and insures its retention in the combined form, producing a steel layer of considerable depth. The depth so secured is dependent upon the quality of the iron and the efficiency of the 'chill,' as the iron mould is called. The latter must have great thickness and good conducting power to give best results in these applications. Successfully carried out, this process gives a surface harder than tempered steel over a strong and massive interior, the best possible combination, apparently, for an armor-plate.

Dr. Gruson constructs large fixed turrets and land batteries of such plates, and the results of trial indicate them to be more reliable defences than any wrought metal, whether iron or steel, or 'compounded,' yet introduced. The weight of these shields is too great for use in naval construction. The first trials were made in 1869, at the Tegel range, and it was found that all shots fired against the chilled plates broke into fragments, and that the plates bore the hammering with remarkable success. The experimental committee reported that the chilled armor was well adapted for its use. Later trials confirmed this opinion, and the Prussian government at once gave directions for its adoption in important lines of frontier defences, and Austria, Italy, and Holland followed its example. In all these trials the chilled iron shot were found superior, if well made, to any steel shot, except in one or two cases in which makers, like Krupp and the Ternitz company, had either succeeded in securing an exceptional quality of steel, or had found remarkably effective methods of tempering. Plates were tested of from 13.77 to 49.21 inches thickness, and were attacked by guns varying from 6 to 17 inches calibre, throwing shot weighing from 61 to 2,205 pounds. The thickness of plate was usually not far from three times the diameter of the bore of the gun to be resisted. The energy of impact was, in the case of the largest gun, over 47,000 foot-tons; which was only obtained, however, by firing at short range — 150 yards. In all such cases, the shield is subjected to more severe trial than would be likely to be met in actual battle. In trials last year at Spezia, with the 100-ton gun, the shot weighed a ton, and the powder charge 327 pounds, the velocity of impact being over 1,700 feet per second. The maximum penetration was four inches, the plates finally breaking up under repeated blows.

The method of proportioning is to give the plates a maximum thickness in inches equal to from one-fourth to one-third the fourth-root of the energy of the attacking shot measured in foot-tons. The total weight of each plate of which the armor is composed is not far from the weight of the gun expected to be used in the attack.

The system of defensive armor here described is one in which we have a peculiar interest. We have in the United States, in the 'Salisbury' and 'Hanging Rock,' and other brands, the best chilling irons in the world, and it would seem very possible that this may prove to be the best system for our purpose yet devised. It is especially one which we may hope to obtain permanent advantage from, as it seems probable that its advantages over other forms are not likely to be soon lost. R. H. THURSTON.

## MENTAL SCIENCE.

### Heredity of Mental Traits.

STATISTICAL inquiries have become a recognized instrument of research in mental phenomena. Mr. Francis Galton has set the pattern in his study of the life-histories of English scientists, in his investigation on the heredity of physical and other traits, in his record of development in childhood, in his researches on visual imagery; and his composite photography is simply a 'pictorial average.' Students of educational science have adopted the same plan: the contents of children's minds, the record of the daily progress of infants as affected by heredity and by environment, have been registered in almost every civilized country. The increased activity in this direction is sure to bear good fruit. As soon as modern psychology substituted, for the old notion of a single, uniform, typical mind innately endowed with definite faculties and ideas, and uniformly proceeding in definite grooves, the recognition of the endless diversity in every particular of human faculty, it was no longer sufficient to introspect one mind and record the results of your exploration as psychology: one must now use every possible method, study mind from all its many aspects, call in the aid of the psychologist, the pathologist, the educationalist, the anthropologist, and the sociologist, in order to present a picture that shall have the slightest chance of truly representing the reality. That such statistical researches are unusually open to various kinds of falsification, and are apt to be 'worked' for more than their worth, every one will admit. It requires great insight as well as caution and patience to draw from a series of answers on mental topics such conclusions as are really warranted without going beyond what the facts logically yield, and again without losing the suggestiveness of incomplete records. But all this is an argument, not against the use of such methods, but for the need of *more* such researches.

The French Society of Physiological Psychology — an organization constructed on a much more useful plan than our psychic research societies, and yet including such work as the latter do — have recently issued a circular of inquiry, similar to the 'Record of Family Faculty' of Mr. Galton. This blank they send only to persons of whose reliability, scientific zeal, and accurate observing powers they have abundant evidence. Each such person fills blanks describing a person with whom he is intimately acquainted, another for his friend's father, and a third for his mother. If he have sufficient knowledge of any other member of the family to answer two-thirds of the questions on the blank concerning him or her, he is to add such information. The person whose traits are described must be at least twenty-five years old, so that his character has fully matured. It goes without saying that the records will be treated in the most confidential manner.

The questions are grouped under six heads. I. Education and social position; II. Physical traits; III. Physiological traits; IV. Pathological traits; V. Moral traits; and VI. Intellectual traits. The first group asks for one's religion; his mode of education; his origin, whether of noble kind, wealthy or poor; and so on: it outlines the environment of the individual. Under the second group are questions regarding height; weight; size of head, whether small or large for the height; shape of forehead; color of hair and eyes, etc. The physiological questions test the sensibility of the several senses, — of the eye as to near-sightedness, color-blindness, and the like; of the ear as to fineness; the development of taste and smell, and so on. They also include the temperament, i.e., nervous, melancholic, sanguine, and phlegmatic; the diet, whether a drinker of alcoholic liquors, of tea or coffee, and how strongly addicted to them, and the same regarding smoking; habits of exercise, whether regular, violent, and how taken; general health, whether robust or