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

not; right or left handedness; the number of hours of sleep and the time of going to bed; whether dreams are frequent, sleep is deep, and so on.

The pathological section aims to record any serious diseases, and especially of the nervous system, through which the person has passed; the disease of which he died, if the record is of a deceased person; the number and sex of his children, and the periods of their birth; the occurrence of congenital defects, and whether they were transmitted to the offspring, and so on. The moral characteristics are more difficult to describe: the plan here followed is to give the recorder the choice between opposite epithets, and at times to include a neutral group. Is the temper of the subject of inquiry joyous, sad, or changeable; calm, or violent? Is he independent in his opinions, or easily led by others? Is he vain, or modest; remarkably truth-loving, or weak in this respect; credulous, or suspecting; selfish, or generous; harsh, or gentle; timid in society, or bold; aggressive in his opinions, or mild? Has he any special talent for music, poetry, the fine arts, science, etc.? Has he pronounced religious sentiments? Is he active, regular in his habits, or sluggish and fitful? Is he intellectually inclined, miserly, or spendthrifty, materialistic, or not? Such is the range of inquiry included in this scheme. The intellectual traits are of a similar nature. The maximum of intellectual work, the manner of working, the nature of the occupations; the strength of the attention, of his logical powers, of his imagination, of his insight, of his memory (and in particular of memory for forms, places, dates, numbers, names, tunes, prose, or verse), of his generalizing power, his classifying talents, and the scope of his mental tension; the soundness of his judgment, the ease of speech, the degree of precocity — these form the last of the group of questions. Throughout, any characteristic specially hereditary, either from the parents to the subject of the description, from the latter to his children, or in a collateral branch of the family, is to be especially noted as such.

To accurately fill out such a blank is by no means an easy matter; it is only of one's most intimate friends (one's family and kindred) that any thing like a complete list can be hoped for. The society does well in asking that where no definite answer is possible the question should be left unanswered; they do not want mere guesses, or phrases that say nothing. M. de Candolle, who has been influential in arranging this list, is much at home in this field of research; and in his seventy-ninth year states that there are thirty-one persons about whom he would be willing to draw up such records. This is an unusual number, and the average scientific observer is doing well if he can furnish ten such records. But even at this rate the society has good opportunities of contributing a valuable addendum to our information on the heredity of mental traits. It would be easy to criticise many points in the arrangement of the questions, and point out omissions and ambiguities, but the main point is the manner in which such answers are used: after the results of this inquiry are published, such criticism will be serviceable in making the next inquiry more thorough and valuable than this.

Recent writers have called attention to the important step in human evolution that occurs when the principles of development pass from the stage of being unconsciously intuited and uncertainly followed, to the stage when they are explicity expressed and purposely aided. If, as many believe, the future of the race is largely in our hands, the knowledge that such researches as those here noticed will furnish, must form the groundwork on which conscious and scientifically-conducted advance will be based.

THE DUCK'S BRAIN. — It is well known that the destruction of the cerebral hemispheres of a bird's brain reduces the animal to a mere automaton. While the functions are all capable of action, all spontaneity is gone. It is a 'sleep without dreams.' M. Ch. Richet has recently called attention to the change in these appearances when only *a portion* of the cerebrum is injured. He uses ducks because the division of their brain is more distinct and the animal less liable to fatal injury by the operation than in pigeons. Only such animals are included in the observation as have recovered from the injuries of the operation. In order to detect the absence of a function as a result of the cerebral lesion, one must know the normal functions of the duck. In the language of the duck, M. Richet detects six cries, associated with pain or fright, with being separated from a companion, with the recognition of a companion, with joy, with taking food, and with being chased by a dog. Add to this the actions occurring in attracting one another and the list is about complete. M. Richet finds that a duck whose cerebrum is partly destroyed acts exactly as a normal duck: an accurate observer could probably not tell which is which. The only difference that was found is this: when a normal duck is driven into a corner, it tries to escape by going to the side of the pursuer; a duck with an injured cerebrum huddles against the wall, and makes no such attempt. M. Richet thinks that this method of escape is really the only intelligent act a duck performs, and that the injury of the cerebrum has thus impaired the highest function; all the rest of a duck's actions are almost entirely automatic, and are performed by lower centres. The experiments accent the importance of correlating the effect of a lesion with the normal intelligence of the animal acted upon.

BOOK-REVIEWS.

On the Relation of the Laramie Molluscan Fauna to that of the Succeeding Fresh-Water Eocene and other Groups. By CHARLES A. WHITE. (U. S. Geol. Surv., Bull. No. 34.) Washington, Government. 8°.

ALTHOUGH it is not distinctly indicated in the title, this is really an important contribution to Eocene paleontology. Twenty-six invertebrate species from the Wasatch group, or lowest division of the fresh-water Eocene beds of Utah, are described and figured. The stratigraphic and geographic range of each species is presented in a table, which Dr. White has made the basis of some important conclusions concerning the relations of the Cretaceous, Laramie, and Eocene strata.

The intimate stratigraphical relation of the Laramie group to the marine Cretaceous series beneath it has been recognized by every field geologist who has studied those strata, and it is this fact, in addition to the discovery of dinosaurian remains in the Laramie, that has led them to range that group as a member of the Cretaceous series. While there seems no reason to doubt that sedimentation was continuous, not only through the marine Cretaceous series, but also from that series into and through the Laramie, it is true that there was at the beginning of the Laramie period a comparatively sudden change in the character of the previously existing molluscan fauna over the whole area which was then occupied by the Laramie waters; that is, at a certain horizon in the unbroken succession of strata there is an abrupt disappearance of all distinctively marine forms, and an equally abrupt accession of brackish-water and fresh-water forms which continue through the whole Laramie group.

On the other hand, similar evidence of continuous sedimentation from the Laramie into the Wasatch group has not hitherto been publicly announced. And wherever later strata have been discovered resting upon those of the Laramie group they have been found to be free from all fossil forms which can be reasonably referred to even a slightly saline habitat, while the Laramie strata contain many brackish-water forms throughout their vertical range.

But Dr. White has been able to show that such unconformities as exist between the Laramie and Wasatch groups are local and unimportant. And, starting with the hope that, although the physical changes attending the deposition of the last of the Laramie beds resulted in the extinction of all the brackish-water mollusca of that group, certain of the fresh-water species would yet be found to have continued their existence into the Wasatch epoch, he has proved that this is actually the case.

In other words, we seem to have conclusive proof that there is a complete and unbroken stratigraphical series in that western region, extending from the Middle Cretaceous to the top of the Eocene, and aggregating nearly or quite two miles in thickness. A remarkable fact connected with the production of this great series is that, while sedimentation was evidently not materially interrupted in at least a large part of the area within which those deposits are now found, the aqueous life was changed first from that of a purely marine character to that of alternating brackish and fresh waters, and finally to that of a purely fresh-water character; that is, the waters in which this series of strata were deposited were first