at the time well ventilated. Besides, the quantity of chloroform necessary to saturate the air sufficiently to produce anæsthesia is very considerable. Allowing one and a half grain of chloroform to the cubic inch of air, it would require thirty-eight fluid ounces to sufficiently impregnate the air of a room ten by twelve feet, with a ceiling eight feet high. It would certainly take a considerable time to vaporize this quantity of chloroform, to say nothing of the probability of awakening sleepers by any act of atomization, and even if it should succeed, what would be the effect on the burglars themselves?

MENTAL SCIENCE.

Why do we Sleep?

IN an address to the Anthropological Society of Brussels, Prof. Leo Errera has given a *résumé* of some points in the chemical theory of sleep. The phenomena of sleep have in common with other vital functions the character of periodicity. An examination of such periodic functions in general may aid in ascertaining the cause of sleep. The respiratory rhythm is regulated by the amount of oxygen and carbonic acid in the arterial blood. When the blood is charged with oxygen the respiratory centre momentarily suspends activity; but soon the tissues yield their oxygen to the blood, have it replaced by carbonic acid, and the blood thus modified acts as an excitant to the respiratory centre. Ranke has shown that the fatigue and recovery of muscles is due to a similar alternation of the accumulation and discharge of certain 'fatiguing substances,' chief amongst which is lactic acid. An injection of this acid into fresh muscle renders it incapable of work; washing the acid out restores the activity. Cannot sleep be explained by a similar chemical theory? Preyer has extended the views of Binz, Obersteiner, and others (who all agree in making the accumulation of certain products of fatigue — *ermüdungsstoffe* — the cause of sleep), by calling all such fatiguing products of activity 'ponogens.' These accumulate in waking life, are readily oxidizable, and absorb the oxygen intended for glands, muscles, and nerve-centres, until action is impossible and sleep sets in. Gradually the ponogens are destroyed by oxidation, slight excitation is sufficient to arouse the centres, and waking life begins. Amongst the ponogens, Preyer counts lactic acid as the chief, but the experimental demonstration of this has been unsuccessful, and the theory, accordingly, not generally adopted.

Since these researches Armand Gautier has found in the human body a series of five organic bases akin to creatine, creatinine, and xanthine, and calls them 'leucomäines' and 'ptomäines.' The physiological properties of these substances are narcotic, fatiguing, and sometimes lead to vomiting. This is just what the chemical theory requires. The periodicity of sleep would be explained by the conservation of energy being applicable to all bodily activity: work must be followed by repair; life is a slow suicide. There is, moreover, reason to believe that the action of these leucomaines is a direct one upon the brain; it is a direct intoxication of the brain-centres.

A theory of sleep must take account of three factors, work, fatigue, and sleep. The chemical theory satisfies these demands. All work, muscular or cerebral, produces waste products. These accumulate, make work more and more difficult: this is fatigue. As the process continues, the waste-products, notably the leucomaines, intoxicate the higher nerve-centres (just as a dose of morphine does), and render them incapable of action: that is sleep. The picture is, however, much more complex. There is a constant struggle against the fatigue, which for a time, by dint of hard work shown in increased secretions and so on, may succeed. We probably never arrive at the extreme limit of work; the sensation of fatigue intervenes to prevent such a disaster. Fatigue, as is well known, may extend from muscle to nerve, and from nerve to nerve-centre. We may be very tired from repeatedly lifting a weight, and not be sleepy, and may be generally sleepy without any considerable local fatigue. One is peripheral, the other central. As the waste products accumulate in the centres, motion and sensation become more and more sluggish until the time comes when the ordinary stimulation no longer arouses them, and we sleep. Partial sleep can be similarly explained. The centres go to sleep in a hierarchical order, the highest serving the most delicate function going first. In waking, the reverse is the case; the motor centres may be asleep while the intellectual centres are awake. In somnambulism the latter may be asleep while the former are awake.

The depth of sleep according to this theory ought to be proportional to the number of cortical molecules in combination with the leucomaines. In the beginning of sleep these are abundant, the cerebral cells inactive, and a combination easy. The sleep is deep. Soon the maximum number of combinations is reached, and sleep is deepest. From here on, the leucomaines are gradually eliminated and destroyed, and sleep should decrease with a decreasing intensity. Kohlschütter's experiments on the intensity of sleep, as tested by the noise necessary to awake the patient, gives the curve for the intensity of sleep corresponding to what we should expect by our theory. Variations in our sleep caused by an excess of work, etc., are evidently similarly explicable. In short, fatigue is a poison for which sleep is the normal antidote.

This theory maintains (1) that the activity of all the tissues (and primarily of the two most active, the nervous and muscular) gives rise to substances, more or less allied to alkaloids, the leucomaines; (2) that these induce fatigue and sleep; (3) that on waking, if the body is rested, these substances have disappeared.

To complete the demonstration of these statements much careful experimentation is necessary; but the facts as far as they go make it probable that the chemical theory of sleep will gain in strength as our knowledge advances.

ETHNOLOGICAL NOTES.

THE HAWAIIAN ISLANDS.—Dr. E. Arning's researches have been very successful. He was sent there by the curators of the Humboldt Fund at Berlin, in order to study leprosy, which has recently become the plague of the natives of this group. He stayed there for two and a half years, and during this time carefully collected relics of the ancient Hawaiian culture, and succeeded in bringing to light many points of interest, thus proving that European influence, which has swamped the islands since 1820, has not totally destroyed the remembrance of olden times. When the missionaries established their schools in Hawaii, the natives rapidly adopted European customs, burnt their temples and idols, and cast the stone images of their deities into the sea. The destruction was so complete that no traces seemed to remain. Arning, in studying the disease mentioned, had ample opportunities to come into contact with the natives in the remote villages of the islands, and here he found still many relics, and received information about the ancient arts and customs. His notes on the fishery of the Hawaiians are of interest. They were skilful divers, and used to frighten the fishes out of the caves and hollows of the rocky ground with sticks, and then catch them in nets. When fishing in the canoe, they used a sacred piece of heavy wood, called *melomelo*, which was kept in the sacred part of the hut, and was placed, with many ceremonies, in the canoe. It was attached to the net in order to attract the fish by its magic spells. A variety of hooks were used for different kinds of fish and according to the time of day, irisated shells being applied at noon and in a bright sun, while white ones served early in the morning and late in the evening. Arning describes their games, the wooden sledges on which they used to glide down the steep slopes of the mountains; the remarkable boards of koa-wood, shaped like an ironing board, standing on which they rode through the surf; the *moa*, a spindle-shaped piece of heavy wood, the use of which was allowed to the chiefs alone, who let it glide down the slope of a hill, at the foot of which it had to pass between two poles; and the famous game of *maika*, which is similar to the Italian 'boccia.' At the present time, when a powerful reaction against the missionaries is spreading all over the islands, the old *hula* dance has been revived, and the ancient dancing, ornaments, and musical instruments are used again. Arning describes a foot ornament made of 960 canine teeth of dogs, the work of several generations, — for dogs were slaughtered only at high festivals, — their drums, flutes, and xylophones. Arning's observations and collections form one of the most important recent contributions to Polynesian ethnology, and are the more valuable as they were made in a country which seemed to have lost all its originality by its rapid commercial development.

THE BOTOCUDOS. — Dr. P. Ehrenreich has published the results of his study of the Botocudos of the Rio Doce in the *Zeitschrift für Ethnologie*. He discusses the observations of former travellers, and compares them with his own experience, thus giving the best sketch of this interesting nation which can be obtained at the present time. Dr. Ehrenreich has collected a considerable amount of anthropological, ethnological, and linguistic material. He gives a number of craniological and anthropometrical measurements, sketches the life of the tribes, who live in a remarkably low state of civilization, and gives a vocabulary — which he has compared with the older ones of Martius — and brief grammatical notes. His researches lead him to the conclusion that the Botocudos formerly occupied a more extensive territory than they do at the present time, inhabiting a tract of land which extended from the coast far westward. They are related to the Ges nations, who inhabit the central parts of Brazil, and a member of whom was discovered by Von Steinen on the upper Xingu. It is of importance to know that the Ges and the Botocudos wear labrets and ear ornaments, that their ceramic art and methods of navigation are very primitive, and that they do not use the hammock. Ehrenreich is of the opinion that the Botocudos remained in an earlier stage of development than the Ges nations, who migrated west and came into contact with other peoples, while the former remained isolated. He believes that the remains found in the caves of the province of Minas Geraes belonged to the ancestors of the Botocudos.

ORIGIN OF THE ESKIMO.—In the *American Naturalist* of August, 1887, Mr. Lucien M. Turner criticises Dr. H. Rink's theory. The latter supposes that the Eskimo were originally an inland people, living somewhere in the north-western part of North America, whence they descended to the seacoast along the rivers. In several articles, Dr. Rink tries to prove this theory by comparing the languages and customs of the different tribes. Though convincing proofs cannot be given, it seems very probable that the Eskimo have come from the rivers and lakes in the interior of America. This theory is open to criticism, but Turner's objections fail to convince us, and do not meet Rink's arguments. The latter is right in laying stress upon the fact that the Eskimo are not so exclusively a coast people as is generally supposed. The most difficult problem of the study is the difference of the tribes west and east of the Mackenzie. Rink emphasizes the fact that the former have certain inventions which the latter have not, while other implements are more developed the farther east we come. From this fact he concludes that the Eskimo first reached the sea and came into their present environment west of the Mackenzie, near the mouth of the Alaskan rivers. This theory, though not improbable, ought to be scrutinized by a study of the anthropology of Alaskan and eastern Eskimo tribes. It seems to us that much of the difference may be due to foreign influence. An interesting paper on the anthropology of the Eskimo, more particularly of those of East Greenland, is contained in the Bulletin de la Société d'Anthropologie (ix. p. 608). While the population of western Greenland is mixed with Danish elements to such a degree that there is probably nobody of pure Eskimo descent in South Greenland, this tribe has never mixed with Europeans. They are less dolichocephalic and slightly taller than the West Greenlanders and other eastern tribes. Their noses are described as being aquiline, but this also occurs among other tribes. The researches in East Greenland which were carried out by Lieutenant Holm show definitely that the tribes of the east coast never came into contact with the ancient Normans.

BOOK-REVIEWS.

The Treatment and Utilization of Sewage. By W. H. CORFIELD and LOUIS C. PARKER. London, Macmillan. 8°.

THE fact that this work has reached a third edition is evidence of its value and usefulness. Since the second edition was published, sixteen years have elapsed, during which time great progress has been made in the methods of treatment of sewage, so that it has been necessary, in order to bring the book up to date, to incorporate much material which will not be found in the earlier editions. The historical portions have been retained in their entirety, as being not only interesting in themselves, but also, on the one hand, descriptive of a state of things still to be found in many places, and, on the other, important as a record of methods and processes which have been adopted at various times, for methods and processes which have been tried and abandoned as useless are liable to be brought forward again as new at some future time unless such a record is kept. Special attention has been given in this edition to the important investigation of the British Association Sewage Committee, more especially as regards the determination of the percentage of the manurial ingredients of sewage actually utilized by irrigation on land, and recovered in the form of crops, and the accurate method devised by that committee for taking samples of sewage and effluent-water for analysis. The practical inquiry originated by the suggestion of the late Dr. Cobbold that entozoic disease might be spread through the agency of sewage farming, and the quantitative examination, with a view to its manurial value, of the compost resulting from the use of earth-closets, are described in detail. The table of contents is a very extensive one, occupying twenty-two pages, and includes many subjects of great interest and importance of which the title of the book gives no suggestion.

In the opening chapter reference is made to the early systems for the collection and removal of excreta, the midden heaps, the stagnant ditches, and the open cesspools. In some of the English towns, in 1845, the privies were in the cellars, and often overflowed. This condition of things could not but be detrimental to health, and must of necessity favor to an alarming extent the spread of many epidemic diseases. Those who question the relation between filth and disease will do well to read that chapter in Dr. Corfield's book in which he treats of this subject. He succeeds in demonstrating that the opinion that the pollution of drinking-water by excreta, and of the air by emanations from cesspools and so forth, on the one hand, and on the other the amount of general sickness, and, in many cases, of special epidemics, stand in the relation of cause and effect, is a true one. Instances are given of fever, cholera, and other forms of disease, breaking out in English towns, which are directly traceable to the filth which had been allowed to accumulate.

In the reports of the Health of Towns Commissioners it is continually pointed out that sickness is the chief cause of the non-payment of rent. One witness says: "Three out of five of the losses of rent that I now have are losses from the sickness of the tenants, who are working men. Rent is the best got from healthy houses." Another says: "Sickness at all forms an excuse for the poorer part not paying their rent, and a reasonable excuse," so that filth causes sickness, sickness inability to work, inability to work poverty and non-payment of rent, to say nothing of starvation. We not infrequently hear in this country, the statement that the State has no right to interfere, that a man's house is his castle, and that he can do what he likes within it. It is this sentiment which for so many years prevented legislation for the protection of tenants in our large and dilapidated tenement-houses, a sentiment which is, we are glad to say, being done away with, more, however, we fear, because the laboring men are beginning to realize and exercise their power than because of any general awakening of landlords to the duty which they owe to their fellow-men. Writing on this subject in 1844, with reference to the then state of Liverpool, Mr. Howe said: "The man who, in a crowded street, is living in filth and breathing a putrid atmosphere, or who makes that street a receptacle for the offal which he casts from his dwelling, becomes the instrument of danger to his neighbors by spreading infection, and he not only hazards his own life, but endangers that of others. The man who erects a flimsy edifice in a crowded thoroughfare, which by its falling may destroy life, should be prevented doing so; and he who constructs a house to let for profit and pays no attention to those matters which are essential to comfort, but, on the contrary, so constructs it as to engender fever and endanger the lives of his tenants, — all these are cases where, with propriety and in justice the legislature ought to interfere, and to insist upon such a mode of construction as will not endanger human life." The earth and ash closets are fully described and their advantages and disadvantages discussed. In speaking of this system, Dr. Corfield says that there can be no doubt that a well-managed dry-earth conservancy system, or midden and ash-pit system, is better than no system at all, but it by no means follows that they are free from danger. They both go upon a wrong principle: we do not want conservancy at all; our first object must be