

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 'leucomaines' and 'ptomaines.' 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, irised 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.