sarily that indicated by the number appearing at the same moment uppermost on the corresponding wheels.

"The wheels containing the figures are governed by an electro-magnetic motor, which, for each observation, sets the three wheel systems successively in motion, until the corresponding wires have reached the mercury in their respective meteorological instruments, when the above-mentioned electrical current instantly arrests the motion, so that accordingly all three steel wires stop with their lower extremities each in contact with the surface of the mercury in its respective instrument. The numbers therefore that stand uppermost on the numbered wheels are just those which indicate the height of the barometer and of the two thermometers, and now the same electro-magnetic motor operates upon a printing apparatus which, after having deposited colour on the type, presses the slip of paper against them. This being done, the steel wires are drawn up again by the motor, which stops as soon as a certain distance from the mercury is attained, and all is ready for the next observation.

"The interval between the observations is a quarter of an hour."

Attention is then directed to the following considerations :—

"The instrument delivers the observations in a form in which they may immediately, and without further modification, be used by the meteorologist in his work.

"A very large number of very carefully made comparisons have shown that the observations registered by this method possess an accuracy equal to that which is generally attained by ocular observation.

"The zinc vessel, in which the upper ends of the thermometers are enclosed, is so air-tight that it is found possible, by means of chloride of lime and caustic potash, to keep the enclosed air always free from damp and carbonic acid, a precaution which it will be easily understood is necessary in every climate where the temperature is liable to sink below the freezing-point, but is still further necessary to protect both the mercury and the steel wires from oxidation, and thus preserve the galvanic contact.

"A meteorograph of this construction has for two years and three-quarters been in use at the Upsala Observatory, executing six observations every hour, without any perceptible alteration of the surface either of the mercury or the steel wires, that could in any way affect either the free efficiency of the instrument or its degree of accuracy, which throughout the whole time has been found to be that above named.

"As the clock which determines the time of the observations does not require winding up—the instrument itself restoring the tension of the mainspring every quarter of an hour—it continues to go as long as the driving force, *i.e.*, the electrical current, is maintained ; and, as the slip of paper applied lasts fully three months, it is clear that that is the period for which the instrument may be left to itself. The work then requisite is little more than to take out, cut, and sew up in order the paper of observations, and replace it with another slip. We thus see that this instrument requires but very little time and labour of the person who takes charge of it.

"It is entirely for special reasons that the construction of the instrument has been limited to the registration of thermometrical, psychrometrical (hygrometrical), and barometrical observations, for the method may be applied advantageously to observations of the course of any phenomena whatever, provided they can be indicated by an index admitting of galvanic contact. It is, therefore, applicable for all the now usual kinds of meteorological observations, and nothing prevents the same instrument executing and printing them all in one and the same table."

The following is an extract (giving one hour's instrumental readings) of one of the printed forms referred to in the first paragraph:—

1	.	.	57	.	.	130	.	. 673
			57	.	.	1305	.	. 6725
			57	.	.	132	.	. 672
			57	.	.	133	.	. 673
2	.	.	57	.	.	1335	.	. 672

The width of the slip of paper used in these observations is 4·25 in.

In the Exhibition meteorograph, the timekeeper (referred to in the eighth paragraph) is merely a watch-movement of moderate size.* In the place of the ordinary minute-hand there are four, fitted on the same centre and projecting from each other at right angles in the form of a cross ; in other words, the points (one of which resembles what is technically termed a *spade* hour hand, and indicates the time) are 15 min. apart. Every time one or other of the hands comes opposite the figure III. it depresses a small steel lever which, through suitable mechanism, completes the circuit.

I am indebted to Dr. Theorell for a very courteous letter, dated from Upsala, respecting the block used in the original description, also to Messrs. Norstedt and Son, printers to the Swedish Government, for supplying me with an electrotype copy of the same through the Swedish Consulate.

JOHN JAMES HALL

ON SLEEP†

PROFESSOR HUMPHRY commenced his lecture by giving a brief account of some of the changes that take place in the tissues when their function is active, and explained that during this time a slight deterioration of structure takes place, which, affecting the voluntary system, the muscles and hemispheres of the brain, causes the sense of tiring, and necessitates a period of rest for the restoration of the tissues to their former condition. In the case of the muscles this rest is provided for by periods, quickly alternating periods, of action and cessation of action. But in the case of the brain, the actions upon which consciousness, volition, &c., depend cannot be thus frequently suspended. Their continuance is needed for the safety of the body during long periods, through the whole day, for instance ; and longer periods are therefore required for repair. These are the periods of sleep.

He next took a cursory glance at the different parts of the nervous system, explaining that the upper regions of the brain are those which minister to consciousness and volition, the intellectual operations, &c. He showed that the functions of these regions not only can long be suspended without interfering with the action of the lower parts of the brain, which are more immediately necessary to life ; but that they are very easily suspended—slight causes, such as a jar, or a shock, or an alteration in the blood current, being sufficient to stop the action of these parts and deprive the person of consciousness. The spontaneous stopping of their action, consequent on the slight deterioration of their structure from the continuance of their functions during the day, is the proximate cause of sleep during the night ; and the periodic recurrence of sleep is in accordance with the periodicity observed in several of the nutritive functions, and, indeed, witnessed in many of the other operations of nature.

After observations upon the condition of the brain during sleep, the circumstances that conduce to sleep, the time that should be allotted to it, and other points, the Professor entered at some length into the subject of dreams. These he regarded not, as has been supposed by some, to be a necessary attendant on, or feature of, sleep, but rather to be the result of an abnormal condition. In the natural state we should pass from wakefulness to complete uncon-

* On the other side of the instrument to that seen in the engraving.

† Abstract of a Lecture delivered at the Royal Institution, on Friday, February 9, by Prof. Humphry.

sciousness, and *vice versâ*, quickly, almost instantaneously, and many persons habitually do so. But the transition period is sometimes prolonged, and stages are observable. The first thing that occurs is the lowering, or cessation, of that control over the mental processes which is the highest of our powers, the one requiring the greatest effort, and the one most easily lost. In this condition the thoughts ramble unchecked, chase one another confusedly over the mental field, and give rise to all sorts of incongruities of the imagination. At the same time, being unrestrained, they are excited, and evince efforts of memory and even of combination, of which, in the regulated state of wakefulness, they are quite incapable. In this way the images of persons and places, events, and items of knowledge, long forgotten in the ordinary state, are recalled with distinctness, and we fancy that new information has been acquired when it is only forgotten facts that are recalled. He did not agree with the physiologists who conceive that dreaming depends upon an inequality in the condition of different parts of the brain, some being excited or wakeful, while others are quiescent or asleep. He rather took the view that all the parts of the cerebral hemispheres combine in each of the efforts of control, consciousness, memory, and other mental acts, that all suffer alike from those efforts, alike need the restoring changes which take place in sleep, and, together, *pari passu*, pass through the stages on the way to and from sleep, in which dreaming, sleep-walking, &c., occur.

NOTICE OF THE ADDRESS OF PROF. T. STERRY HUNT BEFORE THE AMERICAN ASSOCIATION AT INDIANAPOLIS *

IN a brief notice of the recent address of Prof. Hunt, it is stated that, while the discussions show learning and research, and his review of the progress of opinions with regard to the Taconic and associated rocks is an able presentation of the subject, its conclusions are throughout open to doubts and objections. Since it is fairer to an author to make special, rather than general, criticisms, I propose to state here a part of the objections referred to in that remark. They are as follows :—

1. That, while accepting the ordinary views with regard to most "pseudomorphs by alteration" (crystals chemically altered without a loss of form), he rejects them with respect to those that are silicates in composition ; that is, he denies that the crystals of serpentine having the form of chrysolite, pyroxene, dolomite, &c., are pseudomorphs ; and the same of those of steatite, having the form of hornblende, pyroxene, spinel, &c. ; of those of pinite having the form of nephelite, scapolite, &c. ; and so in other cases :—notwithstanding that (1) they bear positive evidence of change in having ordinarily no polarising properties, and no other interior features or qualities conforming to the external form ; that (2) the crystalline forms are just those presented by the species after which they are supposed to be pseudomorphs, and the idea of their being real forms of a single polymorphous species is wholly inadmissible, as pronounced by every crystallographer who has written on the subject ; that (3) the pseudomorphs show all stages in the process of change from incipient to complete alteration, in the latter case not a trace of the original mineral remaining.

In this assumption, for it is little better, he opposes the views of every writer on pseudomorphs, excepting one—Scheerer ; and Scheerer's chemical speculations, which are at the basis of his opinions, he rejects, like all other chemists.

This unwarranted assumption has a profound position in the system of views on metamorphism which Prof. Hunt holds, and gives shape and intensity to his opinions of the views of others.

2. That, in commencing a paragraph with the sentence, "The doctrine of pseudomorphism by alteration, as taught by Gustaf Rose, Haidinger, Blum, Volger, Rammelsberg, Dana, Bischof, and many others (meaning thereby other writers on pseudomorphism), leads them, however, to admit still greater and more remarkable changes than these, and to maintain the possibility of converting almost any silicate into any other"—he grossly misrepresents the views of at least Rose, Haidinger, Blum, Rammelsberg, Dana ; and that he completes the caricature in the closing sentence of the same paragraph, in which he says, "In this way we are led from gneiss or granite to limestone, from limestone to dolomite, and from dolomite to serpentine, or more directly from granite, granulite or diorite to serpentine at once, without passing through the intermediate stages of limestone and dolomite ;" part of which transformations, I, for one, had never conceived ; and Rose, Haidinger, Rammelsberg, and probably Blum and the "many others," would repudiate them as strongly as myself. Next follows a verse from Goethe, that is made to announce his personal vexation with their "sophistries ;" *alias* absurdities, as the context implies.

Prof. Hunt's rejection of established truth alluded to under sec. 1 here manifests its effects in leading him to misrepresent—although unintentionally—the views of writers on pseudomorphism ; and to add to his misrepresentation by means of the strange conclusion, that, because such writers hold that crystals may undergo certain alterations in composition, therefore they believe that rocks of the same constitution may undergo the same changes ; as if it were not possible that external or epigenic agencies might reach and alter crystals under some circumstances of position, when they could not gain access to great beds of rock. Haidinger, the eminent crystallographer, mineralogist, and physicist of Vienna, and one of the most prominent writers on pseudomorphism, never wrote upon the subject of the alteration of rocks at all, and this is true of others, against whom the above charge is made by Mr. Hunt.

With a little clearer judgment, part at least of that vexation of spirit which required the help of a great German poet, and the German language, adequately to express, might have been avoided.

3. That he charges me with the opinion of Bischof, that "regional metamorphism is pseudomorphism on a grand scale :" when I make no such remark, neither express the sentiment, in my Mineralogy of 1854, in which I give an abstract of Bischof's views and make my nearest approach to them ; and when, if there was any occasion for a notice of my opinions, a critic of 1871 should have referred to the formal expression of them in my "Manual of Geology," first published in 1863. The reader will there find the "diagenesis" of Gümbel, which Mr. Hunt takes occasion to commend, applied, as had been done by others, although Gümbel had not then announced it ; and also other points discussed, with but a brief allusion to pseudomorphism.

The above remark by Mr. Hunt is not made with special reference in his address to magnesian silicates, or any other particular class of siliceous minerals ; but, as the context shows, to rocks in general. I have held to views respecting the origin of serpentine which Prof. Hunt rejects, and have sustained them on the ground that the pseudomorphous crystals of serpentine show what transformations are chemically possible, and that hence they may possibly illustrate the changes which beds of rock have undergone. I have not applied this principle in accounting for the origin of ordinary metamorphic rocks, because, as above observed, crystals may often be reached by agencies which can never reach or affect rock-formations, and for various other reasons against it. But the case of serpentine has been regarded as somewhat

* Prof. Hunt's address has been published in the "American Naturalist" for September, 1871, and, since then, in part, in NATURE, Vol. v. Nos. 105, 106, 107. Prof. Dana's reply is reprinted from advance-sheets of *Silliman's Journal* forwarded to us by the author.