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BRAIN REST

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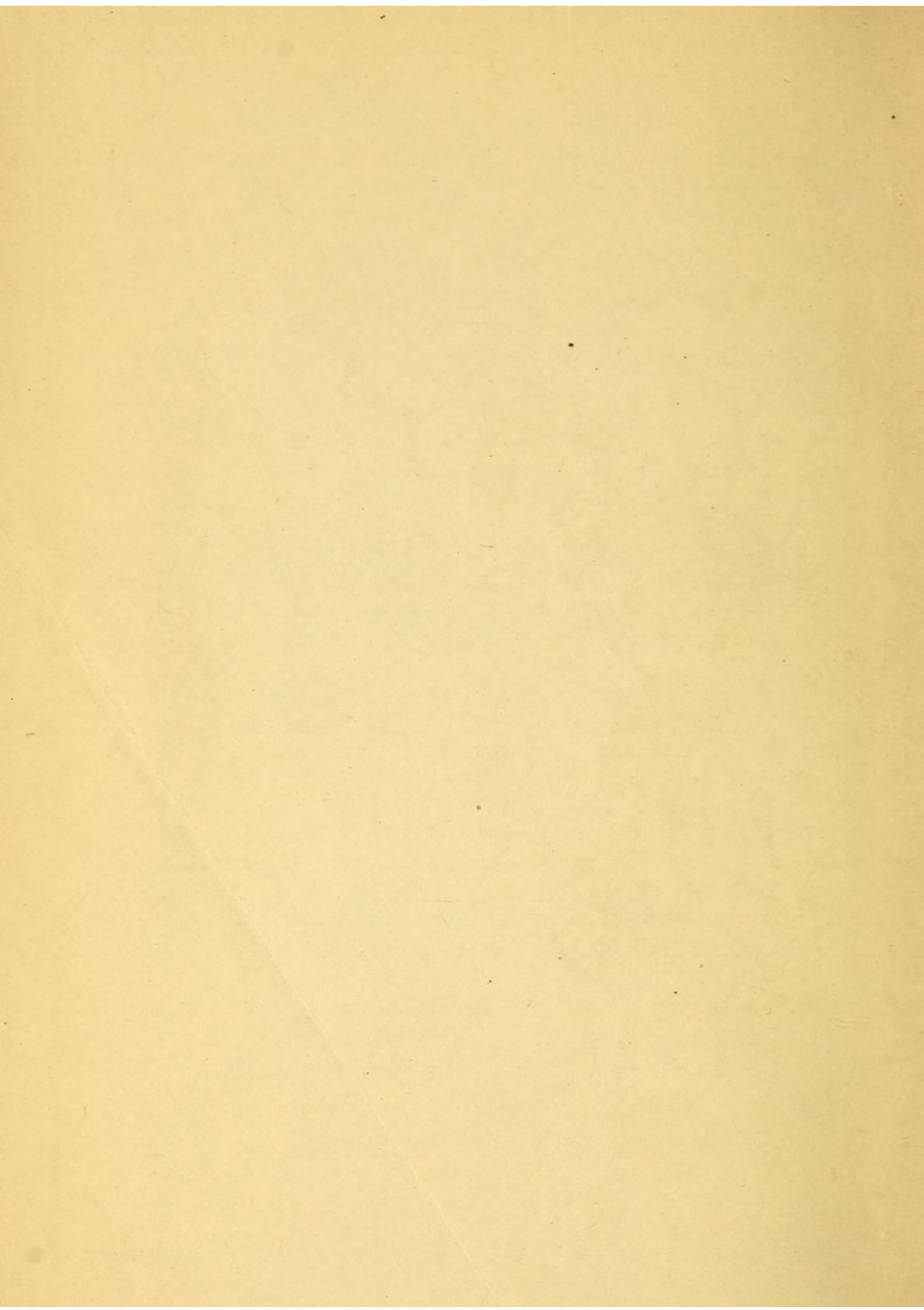
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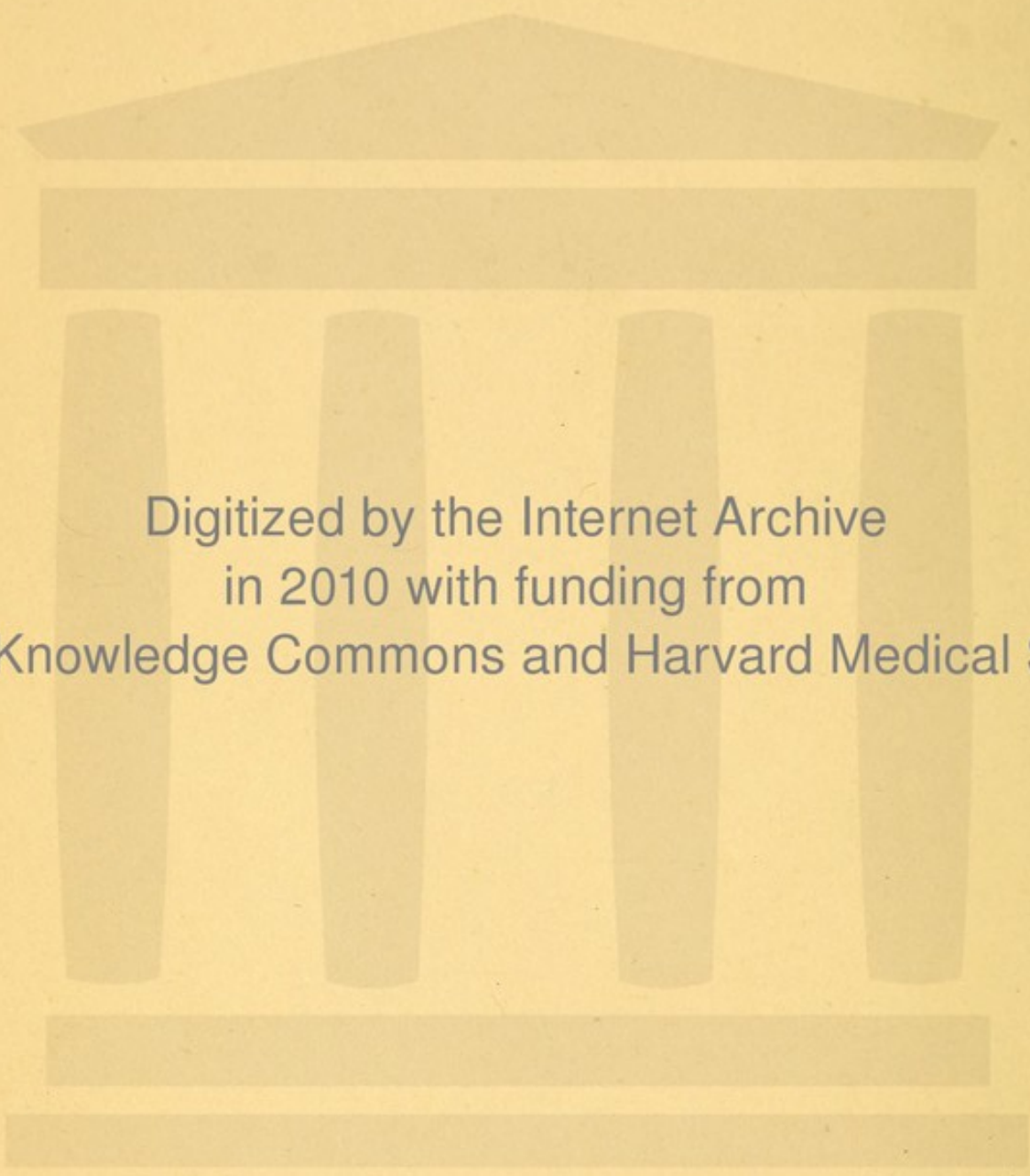
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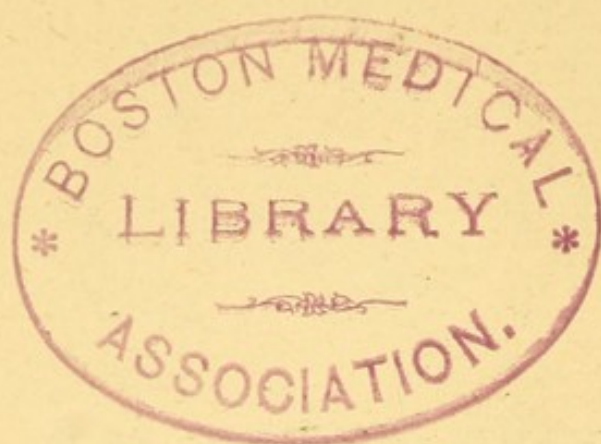
BRAIN-REST

BY

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TO THE MEMORY OF

MY MOTHER

THESE PAGES ARE INSCRIBED AS BUT AN
INADEQUATE TOKEN OF NEVER-
ENDING AFFECTION.

PREFATORY.

IN the following pages I have sought to elucidate and amplify certain opinions embodied in various scientific contributions, and more particularly in a monograph ("Carotid Compression and Brain-Rest;" Anson D. F. Randolph & Co., New York) published about one year since. The ideas then expressed were also discussed before the "New York Neurological Society" in a paper entitled "Physiological Brain-Rest."

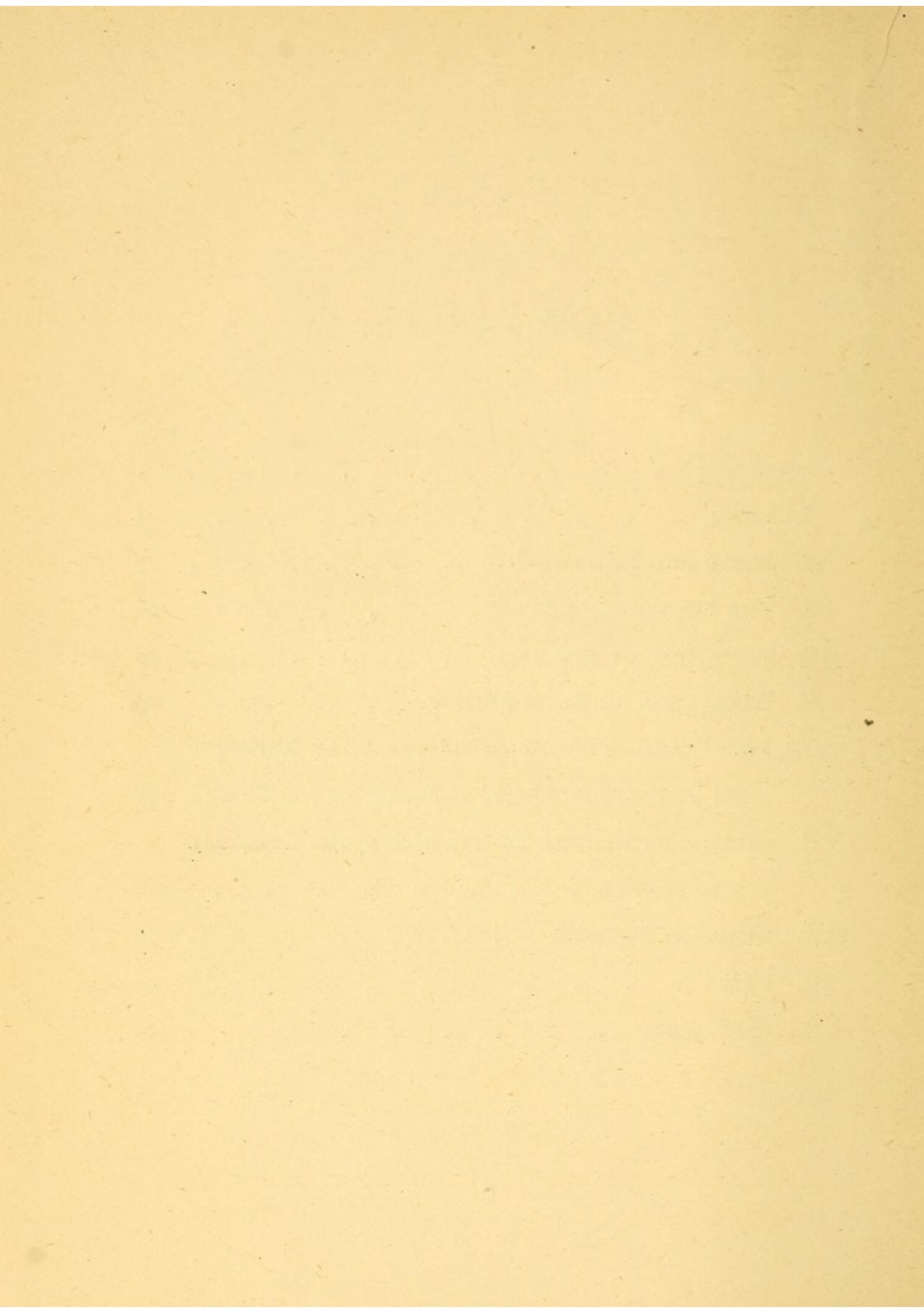
The favorable reception accorded these earlier contributions, both in this country and Europe, has led me to hope that this more extended exposition of a subject, the vastness and importance of which is perfectly apparent, may not prove without interest.

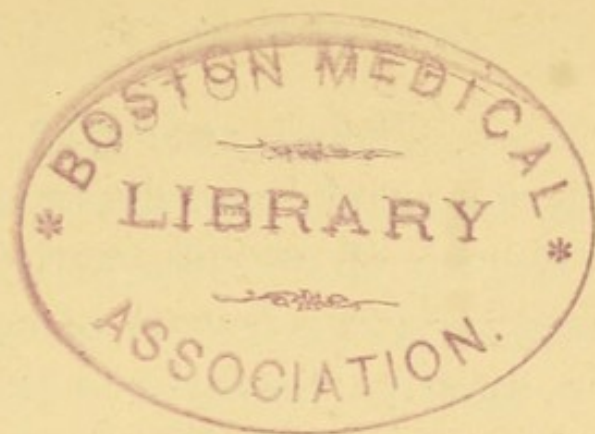
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CONTENTS.

	PAGE
INTRODUCTORY	I
I. SLEEP	5
II. BLOOD AND BRAIN-FORCE	19
III. THE HYGIENICS OF SLEEP	28
IV. DEFINITION OF INSOMNIA	36
V. EXHAUSTION OF BRAIN-ENERGY.	53
VI. THE THERAPEUTICAL SIGNIFICANCE OF AN EXCESSIVE OR INADEQUATE SUPPLY OF BLOOD TO THE BRAIN .	57
VII. OF THE MECHANICAL REGULATION OF THE CEREBRAL CIRCULATION	70
VIII. INTERNAL REMEDIES	79
IX. BATHS	94
X. ELECTRICITY	100





INTRODUCTORY.

SLEEP AND INTELLECTION.

ONE of the most characteristic and significant features of this century, and particularly of this continent, is the subtle complex of circumstances which impels the majority of men to an incredible and morbid degree of activity. This excessive output of energy is particularly manifest among the brain-workers, for the reason that inordinate demands upon the nervous centres are far more disastrous in their ultimate results than the effects of mere overwork in the domain of the muscular system. The hygiene of the muscles has received very considerable attention, and consequently has been well worked up; but the problem of the philosophical development and conservation of brain-energy has as yet received but scant attention. With the exception of high-sounding and often fallacious generalizations, we have little to record of a practical nature in this connection.

In a speech published recently,¹ Mr. Herbert Spencer has drawn special and deserved attention to the excessive degree of nervous activity which has become so characteristic a feature of centres of modern civilization, more particularly as exhibited in this country. In this connection Mr. Spencer says, —

“What I have seen and heard during my stay among you has forced on me the belief, that this slow change from habitual inertness to persistent activity has reached an extreme from which there must begin a counterchange, a re-action. Everywhere I have been struck with the number of faces which told in strong lines of the burdens that had to be borne. I have been struck, too, with the large proportion of gray-haired men; and inquiries have brought out the fact, that with you the hair commonly begins to turn some ten years earlier than with us. Moreover, in every circle I have met men who had themselves suffered from nervous collapse due to stress of business, or named friends who had either killed themselves by over-work, or had been permanently incapacitated, or had wasted long periods in endeavors to recover health.”

These are cogent utterances, but there is certainly nothing novel in the facts themselves. Indeed, the late Dr. G. M. Beard has made substantially the same statements, more particularly as embodied in a monograph published in 1881. Dr. Weir Mitchell has also put forth some very excellent ideas in the same direction.

That discrepancy in the correlation of cerebral

¹ The Gospel of Recreation, by Herbert Spencer: Popular Science Monthly for January, 1883.

forces — that predominance of waste over repair — is a fact, then, which is not only perfectly well understood among members of the profession, but which is now beginning to attract extensive attention in circles other than scientific. There is therefore no necessity of expatiating upon the fact itself: that is already sufficiently well established, both in this country and abroad. But, now that the importance of the subject has been recognized, another question arises; namely, How is the evil to be adequately met? To this interrogatory there can be but one reply. It is impossible to adapt the environment to the individual, except within circumscribed limits; it is impossible to abrogate the laws of competition: in a word, the so-called "spirit of the times" is something against which it is quite hopeless to combat with any very great degree of success. On the other hand, however, it is possible for the individual to so adapt himself to his environment that disaster may be successfully avoided. This scientific adaptation of the internal *régime* of the organism to the exigencies of its surroundings is certainly one of the great questions of the day. The sooner the fact becomes thoroughly appreciated, that the human organism is a mechanism with well-defined limitations of activity, the sooner will progress be felt in the prophylaxis of functional brain-troubles. Again, when it becomes thoroughly understood, that, with the maintenance of a proper relationship between

rest and activity, between waste and repair, the central nervous system is capable, without detriment, of an amount of activity often bordering on the fabulous, there is reason to hope for greater attention to brain-hygiene. But it would be the height of folly to suppose, that, by the propagation of sound hygienic rules, brain-exhaustion, sleeplessness, and other functional brain-disorders, are to be made to disappear entirely from pathological cognizance. On the contrary, an increase, rather than a decrease, of these disorders is probable.

There remains, therefore, nothing but to investigate and improve, by every method at our command, the means best calculated to remove the morbid nutritive and functional conditions of the brain when they have once become established.

The following pages are devoted more particularly to the treatment of those morbid conditions which lie at the root of sleeplessness, and its accompaniment brain-exhaustion. It is hardly necessary to say, that the question is one of the very first magnitude, not only on account of the relation which it sustains to the prophylaxis of insanity, but on account of its importance to all those brain-workers who are liable to, or are actually suffering from, sleeplessness and morbid brain-fatigue.

BRAIN-REST.

I.

SLEEP.

SLEEP may be defined in general terms as that state of the central nervous system in which the higher centres are, to a great extent, in a condition of physiological quiescence, with all the consequences thereby implied. In its most profound form, and perhaps also its most perfect manifestation, there is a total cessation of the strictly psychological functions. The automatic and reflex centres, on the contrary, are active, so that the functions dependent thereon — such as respiration, circulation, digestion, secretion, etc. — are regularly carried on. Again, the re-actions to external excitation must be considered as systematized reflex actions, as the former are in every respect similar to that automation observed in decapitated animals. Certainly, judged by the light of experimental investigation, there is not the slightest reason for ascribing these phenomena to the

higher centres. As regards dreams, they may be considered as fractional activity of the psychical mechanism with the inco-ordination consequent upon imperfect and irregular cerebration. The sensations experienced during dreams are entirely subjective, and volitional conceptions are without objective result. The psychological manifestations of dreams have often been compared to those of certain phases of insanity. Most certainly the fantastic and extravagant logic of dreams has little in common with the ratiocination of wakefulness. The physiological factors, which are more or less intimately connected with sleep, have long been subjects of speculation. It is only, however, of more recent years that the phenomena involved have become subjects of experimental inquiry. Owing to the peculiar difficulties of the problem, progress has necessarily been slow; but it may confidently be predicted, that what has been gained in this direction is destined to maintain a prominent place in the category of physiological acquisition. The most important experimental contributions are those which have for their object the elucidation of the questions of cerebral integration and disintegration, — problems inseparably interwoven with the condition of the cerebral circulation. One of the most fundamental observations in this direction is to the effect, that the temperature above the cerebral hemispheres is lower during sleep than during wakefulness. In inverse ratio it has also been

remarked, that insomnia frequently goes hand-in-hand with a heated vertex. When these things are duly considered, there will be found slight matter for surprise that experimenters should have sought to establish the connection subsisting between the sanguineous ebb and flow in the cerebrum thus indicated on the one hand, and the conditions of sleep and wakefulness on the other.

A priori reasoning had been indulged in by the older writers on this and allied physiological themes. Indeed, the idea that the brain is in a state of comparative anæmia during sleep has been postulated on purely theoretical grounds by certain physiologists. As above intimated, however, it is only of recent years that actual experimental research has contributed somewhat to our more exact knowledge of those factors which are more or less directly concerned in the production of the group of phenomena known as sleep.

It was Durham,¹ who, in 1860, demonstrated on dogs the fact, that there is a well-marked reduction in the amount of blood circulating in the brain during sleep. His experiments were performed in the following manner: he trephined a piece of the skull, and, cementing a watch-glass over the opening, observed, that, when the animal was awake, the vessels of the *pia mater* were moderately distended, whereas,

¹ The Physiology of Sleep, by Arthur L. Durham: Guy's Hospital Reports, 1860, vol. vi.

during natural sleep, the brain retracted, and presented a pale appearance. The contrast between the aspect of the brain during its functional activity and during its condition of repose is said to have been remarkable.

In 1869 Dr. William A. Hammond¹ published the results of certain experiments, undertaken with a view to ascertaining the amount of cerebral pressure present during sleep, as well as during wakefulness: "In every instance the pressure was lessened during sleep, and was increased during wakefulness." The instrument devised by Dr. Hammond, and employed by him in these experiments, is of so ingenious a nature, and is, withal, capable of so extended an employment in cerebral physiology, that I cannot forbear giving an account of the same in this place. The following description is quoted from the "Appendix" of Dr. Hammond's classical work on "Sleep and its Derangements:"² —

"The experiments were performed upon dogs and rabbits. . . . Briefly, the instrument consists of a brass tube, which is secured into a round hole made in the skull with a trephine. . . . Both ends of this tube are open; but into the upper is screwed another brass tube, the lower end of which is closed by a piece of very thin sheet india-rubber, and the upper end with a brass cap, into which is fastened a glass tube. . . . The

¹ *Vide* New-York Medical Gazette and Quarterly Journal of Psychological Medicine and Medical Jurisprudence, January, 1869.

² Sleep and its Derangements, by William A. Hammond, M.D., Philadelphia: J. B. Lippincott & Co., 1869.

inner arrangement contains colored water, and to the glass tube a scale is affixed. . . . This second glass tube is screwed into the first, till the thin rubber presses upon the *dura mater*, and the level of the colored water stands at 0, which is in the middle of the scale. . . . Now, when the animal goes to sleep, the liquid falls in the tube, showing that the cerebral pressure has been diminished, — an event which can only take place in consequence of a reduction in the quantity of blood circulating through the brain. . . . As soon as the animal awakes, the liquid rises at once.”

Very convincing are also certain experiments performed by Dr. Alexander Fleming¹ as early as 1855. This investigator was enabled, by exerting pressure upon the carotids, to produce sleep on several occasions. I have myself produced sleep in this way,² being unaware at the time of the experiments of Fleming. On a subsequent occasion, however, I was careful to point out: that anæmia — which, among other things, is equivalent to reduced oxygenation — is, under normal conditions, initiated by intraganglionic exhaustion; and that when anæmia, *within certain limits*, is brought about, either through the operation of physiological law or by means of artificial appliances (Junod's apparatus, instrumental compression of the carotids, etc.), its effects as a *concomitant* physiological factor in the production of sleep will be directly in the ratio of the intraganglionic exhaus-

¹ British and Foreign Medico-Chirurgical Review, April, 1855.

² Prolonged Instrumental Compression of the Primitive Carotid Artery as a Therapeutical Agent: Medical Record, Feb. 18, 1882.

tion. The fact that somnolence by compression is more easily produced toward evening than in the early hours of morning, — in other words, when the cerebral substance is in a state of exhaustion, — was cited by me in corroboration of the above proposition.

The topographical position of the carotid, however, is — for the sake of the logical completeness of the argument which assumes cerebral anæmia as the proximate cause of sleep — an unfortunate one. Owing, namely, to the contiguity of the artery to the pneumogastric nerve, there are those who affirm that compression of the carotid is only another name for pressure upon the pneumogastric. The real fact of the matter is, however, that it is much easier to compress the carotid *without* the nerve, than to compress the latter without the artery. And I believe, furthermore, there can be little doubt that those who imagined they were exercising pressure solely upon the nerve were, in reality, expending their energies upon the artery. But the possibility of an implication of the pneumogastric, sympathetic, or jugular vein in experiments conducted by means of carotid compression, is capable, fortunately, of satisfactory elimination, albeit indirectly. There exists, namely, a most striking analogy between the physiological effects of ligation of the carotid,¹ and those obtained by com-

¹ *Vide* Zur Ligatur der Arteria Carotis Communis, von Dr. C. Pilz, contained in Langenbeck's Archives for Clinical Surgery, vol. ix., p. 406, 1868.

pression of that artery ; and, although the phenomena are subject in both instances to a certain amount of variation, I am very confident that any such apparent inconstancy is adequately accounted for by the variability in the anastomotic facilities at the circle of Willis.¹

In addition to the somnolence, observed after ligation of one or both carotids, it has also been observed by Junod, — and I have had occasion to confirm this observation, — that the determination of blood to the lower extremities, by means of the vacuum, is productive of a condition favorable to sleep, — a tendency which will be proportionately in accord with the ideal physiological somnolence, according as the intraganglionic exhaustion is greater or less.

Besides the inductive data already referred to, there are certain other facts, observed as the sequence of severe cranial injury, which possess all the value which attaches to the experimental method. Thus a remarkable case of cranial injury occurred some years since in the practice of Dr. William A. Hammond, which, by reason of its important bearing on the problem under consideration, is especially worthy of attention. The case in question is published in Dr. Hammond's classical work on "Sleep and its Derangements ;" and I cannot do better than

¹ *Vide* Charcot's *Localization in Diseases of the Brain*, p. 39, 1878.

quote the same in the language of the eminent observer himself:—

“In 1854 a man came under my observation who had, through a frightful railroad accident, lost about eighteen square inches of his skull. There was thus a fissure of his cranium three inches wide and six inches long. The lost portion consisted of a great part of the left parietal, and a part of the frontal, occipital, and right parietal bones. The man, who was employed as a wood-chopper, was subject to severe and frequent epileptic fits, during which I often attended him. In the course of my treatment I soon became acquainted with the fact, that, at the beginning of the comatose condition which succeeded the fits, there was invariably an elevation of that portion of the scalp covering the deficiency in the cranium. As the stupor passed away, and sleep, from which he could easily be aroused, ensued, the scalp gradually became depressed. When the man was awake, the region of the scalp in question was nearly on a level with the upper surface of the cranial bones. I also noticed, on several occasions, that during natural sleep the fissure was deeper; and that in the instant of awaking the scalp covering it rose to a much higher level.”

In spite of the conclusive evidence already referred to, there are still some who refuse to believe in the variability of the intracranial circulation; and this in the face of the experiments of Naunyn and Schreiber, as well as in total opposition to ever-recurring clinical experience!

The observers above cited¹ removed the posterior

¹ Ueber Gehirndruck von Naunyn and J. Schreiber in Königsberg in Preussen. Leipzig: F. C. W. Vogel, 1881. *Vide* also a most ex-

lumbar vertebral arches in dogs, and, inserting a canula just behind the *conus terminalis*, were enabled by means of a ligature to attach a fold of the *dura* around it. It was found, by these investigators, that a change in pressure of the spinal subarachnoid fluid is immediately transmitted to the cerebral spaces. When the roof of the fourth ventricle of one of the animals was exposed, it was found that a rise of only from six to eight millimetres of mercury produced a well-marked bulging of the *tegmen ventriculi*. Inversely, very moderate pressure with the handle of a scalpel upon the latter was immediately registered by a corresponding rise of the column in a manometer connected with the spinal subarachnoid canula.

Why, in the face of all physiological analogy, the possibility of an ebb and flow of the intracranial circulation should ever have been questioned, it is hard to say. Aside from the experimental evidence, even the most superficial observation of the very great variability in the individuality of the carotid pulse, with its accompanying psychical changes, is sufficient in itself to carry conviction to all but those who would appeal from the logical decision of their own senses. The physiological variability of the intracranial circulation must therefore be accepted: to deny it is simply to be unscientific.

cellent review of this monograph, contained in the American Journal of Neurology and Psychiatry of February, 1882.

As regards the primary impulse, which forms the first link in the chain of physiological events, which culminates in the production of anæmia, I am induced to perceive such a rudimentary behest in the periodic exhaustion of the available intraganglionic energy. I am confirmed in this, my opinion, that the two great factors of sleep are ganglionic exhaustion, and a *physiological* degree of cerebral anæmia; by my own observation,¹ that *a certain degree* of compression of the carotids is much more fruitful in the production of soporific effects toward evening than in the early hours of morning. In other words, somnolence by compression of the carotids is more quickly and certainly obtained after an expenditure of motor and psychical energy than directly after the brain has been in a state of repose for a considerable length of time. This fact, I believe, forms the solid basis of an argument in favor of the view that the ganglia are capable, through the benignant influences of rest, of hoarding up a *certain* amount of available explosive energy, which renders them (the ganglia) in a measure independent of the necessity of extensive assimilation from the plastic materials of the blood-stream, at least *for a time*. We must not forget, however, that what we are here considering is a *certain degree* of compression, — an amount, which, though it would cause somnolence toward evening, would not do so

¹ *Vide* My article on Sleep, contained in The Medical Record of July, 1882.

during the hours of early morning, when the central nervous system is in a state of *plastic* rejuvenescence. If it be asked what certainty we possess, that, in the instance cited above, the *primary* soporific effects might not be owing to a curtailment of oxygenation, I reply, that in both cases the degree of compression was the same : consequently the amount of oxygen conveyed to the brain was in both instances the same. Consequently the somnolence obtained after psychical or motor activity must have been primarily inaugurated by some change which had taken place within the ganglia during the day, — a change equivalent to a condition of *hors de combat* of the intraganglionic substance.

Let those who have philosophized about this exhausted condition of the ganglia *call* the phenomenon what they please. Let them talk about cessation of interplasmatic activity, due to the collection of *débris* within the ganglia, or of molecular inertia, or any thing else, the fact remains the same. But does what has been said, then, exclude reduction of oxygenation as a causative factor in sleep? Not at all. What I would insist on is simply this : that anæmia, which, among other things, is equivalent to reduced oxygenation, is, under normal conditions, *initiated* by intraganglionic exhaustion ; and that when anæmia, *within certain limits*, is brought about either through the operation of physiological law or by means of artificial appliances, its effects as a concomitant physi-

ological factor in the production of sleep will be directly in the ratio of the intraganglionic exhaustion (always assuming, of course, the absence of irritation within the plasma of the ganglia themselves.) I would repeat, *when the anæmia is not carried beyond certain bounds*; for if it so be, either through the agency of perverted physiological law or by artificial means, a state of unconsciousness may be induced irrespective of ganglionic exhaustion. But this condition has far more in common with syncope than with *physiological* sleep.

There has been much argumentation as to whether sleep is cerebral anæmia pure and simple, or whether its whole nature is expressed in the term "ganglionic exhaustion." Others there are, who, while recognizing in experimental results undeniable proofs of the anæmic condition of the brain during sleep, still persist in perceiving in this anæmia only one of the *collateral* and unimportant effects of ganglionic exhaustion. To corroborate this most gratuitous assumption of the unimportance of the position which anæmia occupies among the causative factors of sleep, they have cited the observation that gourmands frequently sleep after enormous meals, their red and swollen features meanwhile bearing ample witness to the condition of cerebral hyperæmia. They forget, however, that there is a vast difference between the condition of partial *stupor*, engendered by such causes, and the healthy *physiological* sleep which the

laborer enjoys after a day of toil. The truth of the matter is this, that the term "sleep," when employed to designate more particularly a condition of rest of the central nervous system, means, physiologically considered, a similar condition of things to that which prevails during inactivity in certain tissues which are subject to periodical exacerbation and diminution of function; as, for example, the glands. The temperature in these structures is found to be much lower during rest than during functional activity. It has also been observed, that the temperature of muscles is higher during activity than during rest. Now, a rise in temperature, among other things, means the conveyance of an increased amount of oxygen to the tissues within a given length of time, or, in other words, a condition of physiological hyperæmia. Inversely, rest takes place in the tissues as a co-sequence of reduced oxygenation and intraplas-matic exhaustion. Strikingly suggestive as these analogies are in themselves, there are, moreover, the *direct* proofs of the exceptionally dependent condition of the brain on the good offices of the blood-stream, as seen in the remarkable phenomena induced by cerebral hyperæmia and cerebral anæmia. We shall have occasion to refer to this point hereafter. Sleep, therefore, may be proximately considered as the result of the phenomena included in general terms under the designations *cerebral anæmia* and *intraganglionic exhaustion*.

The preceding considerations have been a necessary preliminary to the discussion of the nature and treatment of sleeplessness; as it is very necessary to have some conception of the normal, before proceeding to investigate the nature of abnormal, phenomena.

II.

BLOOD AND BRAIN-FORCE.

AMONG the various complicated factors involved in the construction of a rational system of cerebral physiology, there is not one of more importance, or of a greater absorbing interest, than the question of the relationship subsisting between the quantity of intracranial blood on the one hand, and ganglionic phenomena on the other. That this connection is of the most intimate character is abundantly proven by the fact, that whatever modification takes place in the amount of blood circulating in the brain is certain to be expressed by a corresponding modification in ganglionic energy. In inverse ratio, whatever disturbs the rhythm subsisting within the internal economy of the ganglia is sure to cause a corresponding sedition in the domain of the vasomotor mechanism, — a sedition which finds its expression in certain morbid fluctuations of the blood-stream. Most remarkable are the *effects* produced upon the ganglia by a variation of the cerebral circulation above or below those *normal* fluctuations incident to the two opposite conditions of waking and sleeping,

and which alternate with each other in *inflexible* and synchronous harmony with the rising and setting of the sun.

Again, that the *rhythm* subsisting between brain-rest and brain-activity is indeed inflexible in its demands, is but too well proven by the disaster and chaos which supervene in the realms of cerebral phenomena upon a deliberate disregard of its behests. Who but has experienced the sluggish confusion of ideas consequent upon a more or less protracted vigil?

That the ebb and flow of brain-activity (and of the cerebral circulation in consequence) transpire, *under normal circumstances* like other similar manifestations of organic life, in synchronous harmony with the setting and rising of the sun, is proven by the fact, that sleep during the daytime, after a night of activity, is not, and never can be made to be, as refreshing as that indulged in after sunset. Out of seventy-five persons whose occupations necessitate night employment and day sleep, of whom I made inquiries, I could find but four per cent who thought that they obtained approximately as much benefit by day sleep as by night sleep.

To return to the circulation: let us briefly examine the inductive evidence bearing upon the relationship subsisting between the blood-stream on the one hand and ganglionic energy on the other. As has already been noted in a former chapter, it was Dur-

ham,¹ who, anxious to ascertain by direct observation the vascular condition of the brain during sleep, trephined a portion of the skull of a dog, and, having removed the corresponding portion of the *dura mater*, cemented a watch-glass over the opening, thus avoiding any sources of error liable to arise from atmospheric pressure. When the animal was asleep the brain was observed to be comparatively anæmic; whereas during wakefulness the arterial vessels were distended, and the surface of the brain became turgid with blood. The brilliant corroborative experiments of Dr. William A. Hammond, by which that eminent observer proved, in a most conclusive manner, the comparative anæmic condition of the brain during sleep, have been referred to in the course of the considerations on sleep. In the same chapter reference is also made to the experiments of Dr. Fleming, as well as to my own subsequent researches in the same field, in the course of which sleep was produced as a result of reducing the amount of blood in the brain by means of compression upon the carotid arteries. It would thus appear, that the questions relative to the *vascular* condition of the brain during sleep and during wakefulness had been definitely settled. *That the brain is comparatively anæmic during sleep, and hyperæmic during wakefulness, may therefore be considered to be experimentally and conclusively demon-*

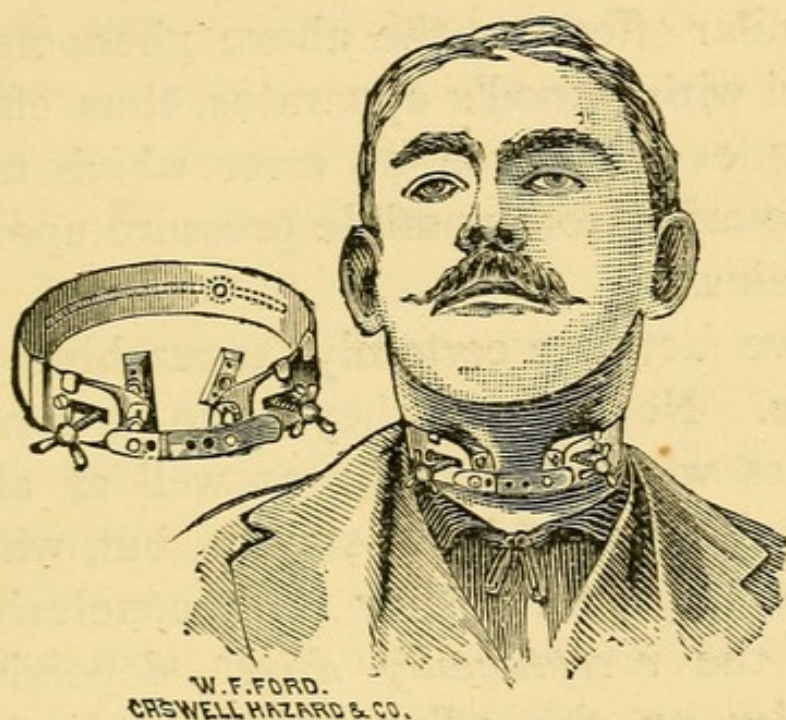
¹ The Physiology of Sleep, by Arthur E. Durham: Guy's Hospital Reports, Third Series, vol. vi., 1860, p. 149.

strated. Let us inquire what are the effects produced upon the ganglia by the production of an abnormal amount of cerebral anæmia, — an amount considerably in excess of that which is a physiological concomitant of natural sleep. This is fortunately a query which may be answered by the results of direct experimentation. Below are the results which I obtained in regard to the effects of anæmia on intellection and motility, — experiments performed about two years ago.

EXPERIMENT I. — I compressed both carotids of a man of full habit with an instrument¹ devised by me for the purpose, and observed, as pressure was rapidly augmented, —

- (a) Facial pallor.
- (b) Drooping of the eyelid.
- (c) Dilatation of the pupil. (This symptom was not mentioned in my former papers, but I am now convinced that it is sufficiently constant in occurrence to merit attention.)
- (d) Soporific tendency.
- (e) Dizziness.
- (f) "*Heaviness*" and *confusion of ideas*. (The subject complains frequently that he is unable to "collect" his thoughts, and is unable to think.)
- (g) Syncope. (Very easily produced in anæmic persons.)

¹ *Vide* my paper read before the New-York Neurological Society, June 6, 1882, and published in the Philadelphia News of June 17, 1882, and in the American Journal of Neurology and Psychiatry, 1882.



AUTHOR'S METHOD OF APPLYING INSTRUMENTAL
COMPRESSION TO THE CAROTIDS.

EXPERIMENT 2. — A somewhat anæmic man was selected, and the strength of each hand was carefully measured with the dynamometer. Firm pressure was then made over both common carotids; and, while these arteries were thus compressed, the strength in each hand was again measured with the dynamometer, and found to be reduced.

Very similar effects to the above phenomena may be obtained with Junod's apparatus, thus effectually eliminating every source of error which might be supposed to arise from possible pressure upon nerve-stems or veins.

The above facts are certainly far-reaching in their significance. Not only do they serve to exhibit the indebtedness which the brain, as well as all other tissue, sustains to the blood-stream, but, what is of vastly more importance, they show conclusively the *immediate*, the *exceptionally direct*, dependence of *brain-function* on the offices of the blood-stream. Certain it is, then, that whatever may be the ability of the ganglia to hoard up during periods of functional quiescence plastic material, — and there is no reason to doubt this quality of the cell, — the explosion of that same material is *immediately* dependent on the presence of arterial blood in the cerebral parenchyma. And, furthermore, that other conditions being equal, the *intensity* of ganglionic function will be in the ratio of the blood-supply, — in the ratio of the oxygenation; whereas the *extensity*, the *continu-*

ance, of function will depend more upon the magnitude of the available plastic store within the cell itself. In inverse ratio, a *subsidence* of ganglionic activity it is impossible to conceive of, in the light of the above facts, without assuming a concomitant physiological retrocession of the ganglionic bloodstream. As regards the application of the above to the analysis of that periodical decline of ganglionic function which is the prominent characteristic of sleep, little need be said in this place, except to affirm, what is already sufficiently evident, that only on the basis of a diminished oxygenation—of a reduced blood-flow to the cerebral parenchyma—can we adequately explain the phenomena. That this reduced blood-flow is initiated by a condition of exhaustion within the ganglia themselves has already been pointed out in the chapter on sleep. None the less important, however, is the second step in the chain of physiological events,—cerebral anæmia. The presence and superlative importance of this second factor we are bound to admit, both by reason of the *direct* experimental results bearing upon the matter, as well as on account of inevitable corroborative deductions derived from our experimental knowledge of the *inseparable* relationship which subsists between the intracranial blood on the one hand and ganglionic function on the other.

The striking analogy which exists between the

phenomena of cerebation and those of combustion cannot have escaped notice. The magnitude of a conflagration may be curtailed either by reducing the flow of available oxygen, or by diminishing the amount of inflammable material, or by both. The output of ganglionic energy may be reduced either because a large portion of the available amount of intracellular explosive material is exhausted, or because the quantity of oxygen conveyed to the cerebral parenchyma in a given length of time is lessened, or because *both* these events have transpired. In the physiological type of nocturnal sleep, there is little doubt that the latter eventuality transpires. As regards the imperfect form of sleep called "napping," which may be studied to any extent among the inhabitants of warm countries, or among those of luxurious habits, I believe an adequate explanation for the condition in question is found in a reduced oxygenation of the ganglionic plasma, coupled, perhaps, with a peculiar lethargy of the explosive material itself, the nature of which, in the present state of our knowledge, it is quite impossible even to surmise.

In striking contrast to the *immediate* dependence of brain-function upon uninterrupted oxygenation, is the condition of comparative independence of aëration enjoyed by the muscle. It has been observed, namely, that muscle will remain active for a considerable length of time in a vacuum, or in gases free

from the presence of oxygen,¹ thus proving that the absorption of oxygen is not an immediate indispensable necessity of muscular activity. If, on the other hand, the amount of oxygenated blood flowing to the brain be progressively curtailed, we have all the symptoms of a commensurate decline in brain-energy till finally volition and consciousness are completely abolished.

From what has already been said, it will readily appear, that the cerebral circulation occupies a position of paramount importance to brain-function. Nor is this in any sense an hypothesis. On the contrary, the proposition that brain-function sustains an immediate, dependent relationship to the cerebral blood-supply, is corroborated by experimental evidence, which is perfectly convincing to all but the dogmatically sceptical.

Viewed in the light of the foregoing, it will not be matter of surprise that I have assigned considerable importance to the treatment of those circulatory anomalies which form so prominent a feature of functional brain-disorders.

¹ Grundriss der Physiologie des Menschen, von Dr. L. Hermann, 1870, p. 234.

III.

THE HYGIENICS OF SLEEP.

ENOUGH has already been said of the nature of sleep to clearly demonstrate that it is a rhythmical habitude of the organism, for the preservation of whose integrity such a *modus vivendi* should be adopted as is least liable to seriously interfere with the great principle of periodicity, which pervades this as well as all other vital phenomena.

It is not enough that an individual shall have slept for a given length of time during the twenty-four hours which constitute the two symmetrical periods of vital activity and vital repair: *it is quite as necessary that the requisite period of rest should invariably occur at the time indicated by nature as the best suited for the restoration of spent energy, — namely, as soon after sunset as possible.* This decline of vital phenomena during the hours of darkness and comparative cold, and their subsequent rise during the period of light and heat, is in perfect harmony with the fundamental laws of physics and chemistry. The peremptoriness of this universal behest is but too well proven by the disaster which sooner or later

supervenes upon its systematic disregard. No doubt the exigencies of modern life are in great measure responsible for the gross violations which are constantly perpetrated against the most important laws of our being. Doubtless, also, civilization, as at present encountered, means far oftener the perversion of nature to utilitarian ends than the adaptation of the sociological mechanism to the profound truths of natural law. Nevertheless, in spite of the inherent defects which are incident to competition, to the strained relations which subsist between capital and labor, and to the incredible subdivisions of the latter, there still remain far greater opportunities for compensatory precautions in the realms of the physical and physico-mental economy than is generally imagined. Thus the desultory and unscientific mode of life affected by the more favored classes is something whose injurious effects upon the organism are best avoided by a modification of the prejudicial habits themselves,—a reform both in consonance with the opportunities and future happiness of the individual. As regards the physiological act of sleeping, which we are here considering, it is a melancholy fact, that the highly organized are those most liable to suffer from any material derangement in the domain of rhythmical brain-rest. To such, a proper understanding and pursuit of the laws of physiological sleep is of the very first importance. *All worry and vexatious circumstances should as far as possible*

be habitually excluded from the mind for a considerable time before the regular hour for retiring. But to be able to banish those thoughts whose baneful effect is to first cause over-mental tension, and, finally, as a result, persistent irritation of the thought-mechanism itself, the individual must accustom himself to the invariable habit of divesting the mind of thought at those times, when a continuance of the psychological function is derogatory to the best interests of cerebral function. This is not to be accomplished through the instrumentality of any one of those flimsy devices, so commonly recommended in popular effusions upon this subject, such as regarding a particular object fixedly, counting the same number again and again, etc. It is rather to be obtained by an *unvarying habit* of excluding each and every species of mental exertion *at the time* when inviolable law has decreed repose of the brain-centres. *Regularity* in this regard will go far toward securing and preserving those rhythmical relations between rest and activity which constitute so important a factor in the well-being of the entire organism. And let it not be concluded from what has already been said, that the ability to eschew worry at *all* times is a *sine qua non* for the maintenance of healthy sleep. That, indeed, would be assuming the possession by man of powers which at will were capable of rendering him entirely independent of circumstances of environment. What is intended is simply a protest against

that species of *thought-martyrdom* which renders man not the possessor of thought, but its wretched *victim*. Another important hygienic rule for the maintenance of healthy sleep is *never to thwart the drowsy impulse*, which, in healthy individuals, will be found to occur at about the same hour each night. This same drowsiness is the precursor, *the advance-guard of sleep*. At its approach the individual should *invariably* betake himself to rest. Nor should he tarry until this drowsiness verges on unconsciousness, but rather, at the very first intimation of brain-weariness, seek to assume a horizontal position as quickly as possible. If this rule be scrupulously observed, it will usually be found that sleep supervenes almost as soon as the head touches the pillow; that is, presupposing that there has never been any disorder of the function of sleep, and that the individual is in an otherwise healthy condition. If, on the contrary, nature's well-timed behests be systematically disregarded, a very long period will not have elapsed before difficulty will be experienced in falling asleep promptly. The individual, on retiring, will find, instead of the usually well-marked symptoms of approaching unconsciousness, a tendency to morbid intellection. Extravagant pictures, conjured up from the depths of an irritated consciousness, form a grotesque panorama which unrolls itself before the mental vision like a species of pictorial cyclone; one impression not succeeding, but rather heaping itself

upon those which have gone before, until coherency is swept away upon the tidal wave of a hopeless confusion. Such a one tosses to and fro, seeking in vain for some position in which to obtain relief from the persecutions of an irritated and relentless consciousness. Finally, after a vigil, frequently of many hours' duration, sleep comes at last; but, alas! its effects are far from refreshing. Pale and dejected, the following morning finds such a one in the midst of an ominous depression of spirits, which he seeks to relieve by resort to copious libations. Should this state of things continue without resort to means of rational treatment, a condition of affairs may be eventually engendered, the baneful outcome of which it is quite impossible to estimate. When the intimate relationship which insomnia sustains to insanity, and a host of functional nervous troubles, is borne in mind, the imperative necessity of treating all early manifestations of the disorder will be abundantly evident. As for myself, I am quite satisfied that a large amount of the success to be hoped for in the prevention of insanity will be directly in the ratio of the good results obtainable in the treatment of the premonitory insomnia, which is so characteristic a symptom of this most terrible disorder.

Regarding the posture best adapted to sleep, this much may be said: that *the position upon the right side is, in the majority of cases, best suited to the requirements of brain-repose.* Various theories have

been advanced in explanation of the superiority of this position, none of which, however, appears to me satisfactory. It is certain, however, that, except in special instances of lung or other organic trouble, the *type* of sleep enjoyed in the position under consideration is of a physiologically more perfect character than that obtainable in certain other postures. Thus, however agreeable the purely dorsal position may be as such, it has the fundamental disadvantage that dreaming is thereby greatly facilitated, and that thus the *type* of sleep is rendered less perfect. This lack of physiological adaptability is perhaps owing to the fact that a certain unequal increase in the cerebral circulation is engendered, thus partially arousing certain brain-districts, whilst others still maintain their condition of repose.

Elevation of the upper or lower extremities above the level of the trunk is not advisable (except in cases of general anæmia),¹ as the former become numb and cold from the fact that the circulation is diminished and retarded by the force of gravity. Again, the additional amount of blood which is thrown into the circulation of the trunk must, to a greater or less degree, affect the vascular conditions of the cerebro-spinal axis, and this, *under normal circumstances*, is to be avoided.

The relation of various forms of food to sleep is not

¹ *Vide* what has been said on anæmia.

without importance. *Those kinds of nutriment which are most easily digested are those to be recommended for the evening meal.* The above assertion is also borne out by experience, as well as the argument in favor of the proposition that easily digested food at night has far more to do with the promotion of perfect sleep than a mere reduction in the amount of nutrition without due regard being paid to its digestibility. A sufficient period of time should also always elapse between the last meal and the hour for retiring, to insure as far as possible the completion of the digestive act. It has frequently been affirmed that sleep supervenes with particular preference after a hearty repast. This is indeed true; but the type of sleep thus engendered is far inferior to that uncomplicated form of brain-rest which follows a day of healthy toil. This after-dinner napping should, as far as possible, be avoided; for it is neither favorable, on the one hand, to the maintenance of the rhythm of healthy sleep, nor, on the other, to the exigencies of digestion. Most people are familiar with the various forms of morbid dreams which frequently supervene upon an undue indulgence in that modern barbarism, a late *table d'hôte*. The coated tongue and feeling of distress in the stomach on the morning following such feasting cannot have failed to arouse an interesting train of reflections.

As regards *the use of narcotics*, such as tea, coffee, and the like, this much may be said: that, although

their physiological effects differ according to amount and individual idiosyncrasy, their employment before retiring is, on the whole, to be condemned. The restlessness engendered by tea, particularly by the variety known as "green," is familiar to most persons. That, however, these agents, like tobacco, opium, etc., have their legitimate therapeutic functions is not to be denied; but their employment in this sense is not what we are here considering. What is really met with is not so much the philosophic application of these agents, as means to ends, as their systematic and phenomenal abuse.

By a proper attention to the rules above laid down, which of themselves are but the logical outcome of well-established physiological law, there is every reason to believe that very many brain-workers may secure exemption from insomnia, with its train of baneful consequences.

IV.

DEFINITION OF INSOMNIA.

CLASSIFICATION OF INSOMNIA.

In the consideration of every complex and extensively ramified subject, a philosophical grouping of the phenomena involved is of the first importance. This is particularly true where a sharp demarcation between cause and effect is sought after. That such divisions are frequently imperfect, and open to the accusation of possessing a certain degree of arbitrariness, is not to be denied, more particularly where some of the phenomena involved are as yet unknown or but partially elucidated. Nevertheless, while bearing in mind the relative nature of all philosophic systems to the ocean of the unexplored, it is none the less incumbent upon every conscientious investigator to cultivate that species of order and rhythm in the contemplation of scientific subjects which will eventually result in the presentation of an entity in harmony at once with ascertained facts, and with the exigencies of logical deduction.

The following division of Insomnia into two prin-

cial groups has seemed not devoid of merit, at least from a clinical stand-point. Insomnia may be divided, then, into an idiopathic and into a symptomatic variety.

1. Idiopathic ("Primary") Insomnia is that form of wakefulness, the predisposing cause of which cannot be traced to any particular source extraneous to the brain itself.

2. Symptomatic ("Secondary") Insomnia is that form of the disorder which may be observed in the course of many acute and chronic disorders. Under this head may also be considered that form of the affection which arises from a more or less severe degree of pain.

IDIOPATHIC INSOMNIA.

Exciting Causes of Sleeplessness. — The most fruitful sources of this pre-eminently important variety of the affection are *over-mental taxation* and excessive emotional disturbances. Among these latter belong anxiety, profound sorrow, jealousy, fear, heavy responsibility, disappointed ambition, suspense, sudden pecuniary losses, and, in short, all that vast array of causes which act with such disastrous effect and directness upon the cerebral mechanism itself. This form of wakefulness it is, which, like a gaunt spectre, follows in the wake of progress and civilization, carrying disaster among all classes of society. That its ravages are not less, but, on the contrary,

are increasing from year to year, as the heat of competition becomes more and more intense, there can be no doubt. The note-book of every physician bears melancholy record of the ever-increasing number of victims to this baneful affection. In speaking of the relation of insomnia to brain-disorders, Dr. William A. Hammond says,¹ —

“In my opinion no one cause is so productive of cerebral affections as persistent wakefulness; for not only is the brain prevented from obtaining rest, but it is kept in a state of *erethism*, which, if not relieved, must sooner or later end in organic disease.”

During the hours of wakefulness the destruction of brain-tissue exceeds the nutrition; but during sleep this waste is amply compensated for by a repair which is much in excess of the previous disintegration. It is thus that during sleep the ganglia hoard up an amount of available explosive energy which renders them in a measure independent of plastic assimilation from the blood-stream during the hours of active wakefulness. This by no means implies, however, that the cerebral substance is at any time *absolutely* independent of the offices of the blood-stream. On the contrary, as we have seen, there is nothing more certain than that a most intimate relation subsists between the exacerbations of cerebral function and the increased flow of the blood-stream.

¹ Dr. Hammond on Sleep and its Derangements, p. 224.

The greater the amount of brain-force expended, the greater will be the afflux of blood in the direction of the cerebrum. This persistent increase of blood within the active organ has for its object the conveyance of an increased amount of oxygen to the nervous centres, — an amount which is directly in proportion to the cerebral force engendered. That the ganglia actually do hoard up an amount of explosive material during sleep, which renders them in a measure independent of direct plastic assimilation from the blood-stream during wakefulness, is proven by the fact, already referred to, that, whereas artificial limitation of the amount of blood in the brain will result in the production of soporific phenomena towards evening, this is not to the same extent the case during the early hours of morning, when the protoplasm of the ganglia is in a state of plastic rejuvenation. This fact I have frequently verified in the course of a long series of experiments with carotid compression. As stated on a former occasion, I have observed that an amount of compression which resulted in no particularly well-marked soporific tendencies during the early morning hours would produce somnolence towards evening; thus proving that something had taken place within the brain-substance itself during its activity, — a something which is well expressed by the term “exhaustion.” If, by any combination of pathological circumstances, those reparative processes concerned in the neutralization of waste be

suspended, what is the consequence? The reply in general terms is, that, first of all, there is an impairment of the extensity and intensity of brain-energy; secondly, that a state of irritation is engendered within the ganglionic substance itself, which in its turn results in the complete abolition of that automatic rhythm which is the preserver of the physiological equipoise between waste and repair. Nowhere is this demoralization of cerebral function so eloquently expressed as in the chaotic condition of the vaso-motor mechanism. Indeed, the morbid circulatory phenomena constitute a species of barometer of the degree of functional perversion. The most characteristic form of these disorders, and one which is especially peculiar to the idiopathic variety of insomnia, is cerebral congestion. This congestion may be of different degrees of intensity (within certain limits) according to the gravity of the affection.

To these congestive phenomena, the importance of which it is impossible to overestimate, we shall have occasion to refer again, previously to entering upon a discussion of the philosophical questions involved in the treatment of wakefulness. Among the imposts which humanity pays for the true or imaginary advantages of what, for lack of a more consistent term, is denominated "civilization," there is not one whose tyrannical invasion of physiological law is so surely fraught with mental and physical bankruptcy as sleeplessness. In spite of the salu-

tary effects obtained by an almost incredible subdivision of labor; in the face of a considerable reduction in the amount of toil required from the laborer *per diem*; and in spite of gigantic strides in the realms of hygienic and prophylactic medicine, — there seems to be something inherent in the very mechanism of progress, which, in variable degrees, conditions a greater or less amount of subversion of physiological law. Nowhere are the opposing influences of these occult foes to organic life so plainly visible as in the domain of the nervous system. Irritability, habitual melancholy, brain-exhaustion, hypochondria, and insanity are a few of the symptoms which follow in the wake of an increasingly complicated existence; and what is of particular importance here is the fact, that these and similar disorders of the nervous system *can almost always be traced to some primary disorder of the function of sleep*. These are facts which are perfectly familiar to every specialist in the domain of the nervous system; and some have gone so far as to affirm, that, if the sleeplessness which precedes insanity could be broken up, we should have no such thing as insanity. While unwilling to indorse so broad a statement as this, I am fully convinced, that, where there do not already exist profound organic changes in the brain or its membranes, mental derangement can be effectually prevented by proper *brain-rest*. Such rest, however, is not to be obtained simply for the

asking. Sleeplessness, more particularly that variety which precedes insanity, is the symptom of profound derangement in brain-function and brain-nutrition. Disintegration of the cerebral plasma is often out of all proportion to integration: consequently the problem presented for the solution of the physician is nothing less than a complete reform in brain-economy. Such a problem requires, not the application of one paltry medicinal measure, but rather the employment of every therapeutic agent which a philosophic and practical consideration of the subject indicates.

We have heard a great deal about the psychological method of treating that form of insomnia which is the result of extreme worry, disappointment, or morbid intellection. But, while I am perfectly willing to admit that such persons should be persuaded with all possible tact to submit to the exigencies of life with philosophy and resignation, I feel compelled to declare that I have seen more actual amelioration of this condition of mental irritation and depression produced by one Turkish bath than it was possible to obtain by the most Socratic wisdom.

Mind-troubles must be treated by therapeutic measures which act directly upon the physical conditions that give rise to mind. Those therapeutic measures, which, while calming and curtailing cerebration, also deaden the thinking mechanism to extraneous impressions, are far more valuable in

this connection than any amount of argument. In stating these convictions, I do not wish to be understood, however, as undervaluing the results obtainable by the direct action of the mind upon the body. I wish simply to draw attention to the paramount necessity of influencing the thought-mechanism by addressing our therapeutics to the brain itself. When we bear in mind the delicacy of mental organization which is one of the characteristic outgrowths of modern civilization, and when due heed is also paid to the fact that that same delicate mental mechanism is subject to the influences of countless suppressed as well as gratified emotions, the justice of the position here assumed will be apparent to all who have bestowed any attention upon the question of mental economics.

As already stated, the most prolific, and at the same time also the most dangerous, sources of wakefulness are those causes which directly affect the mechanism of thought and emotion.

Those who pursue a desultory method of thinking are very often the victims of an obstinate and peculiarly distressing form of insomnia. During the day such persons are observed to apply themselves with apparent zeal to the regular vocations of life; but, if closely observed, there is often visible a certain absence of concentration and devotion to the particular matter in hand. When questioned upon this point, they admit that they are "absent-minded;" and,

while only too willing to apply themselves, are frequently tormented by the intrusion of ideas totally foreign to the particular subject in hand. Again, when the responsibilities of the day are over, instead of accepting the results of their actions in a philosophic manner, they carry their responsibilities to bed with them; and, when other minds are at rest, their own intellection is morbidly active. Midnight, and even the small hours of the morning, find such individuals speculating upon the pros and cons of the past and future with an intensity which often drives them to a state of positive desperation. The small ills of life assume alpine proportions, and even the most trivial circumstances are distorted and magnified a thousand-fold. When at last sleep actually does supervene, it is no longer physiological, but, on the contrary, perverted by dreams and unconscious cerebration to such a degree that these unhappy individuals can hardly be said to have slept in the ordinary sense of the word. Daylight finds these persons in a condition of complete nervous relaxation, often bordering on complete prostration; and only after the sun has long since risen are they enabled by dint of copious stimulation to re-assume the activities and responsibilities of life. Such persons frequently complain of sensations of "heaviness" in the head; of feelings of fulness and even acute pain, which may be variously located.

Sometimes, after even slight mental exertion, they complain of an unendurable feeling of distention in the region of the vertex. I know of a man, employed as a night clerk in a hotel, who has long been a sufferer from insomnia, and who, when obliged to apply himself to the adjustment of the accounts, complains that he feels as if the top of his head were being blown off with gunpowder. This man has frequently attempted to resume employment during the day, and to sleep at night ; but so accustomed has his system become to a complete reversal of the normal laws of rhythmical brain-rest and brain-activity, that he finds it totally impossible to obtain even an hour's sleep at night, and is consequently obliged to continue his irregular methods of living, his constitution, meanwhile, steadily giving way. In no case is day sleep, however regularly indulged in, equal to that brain-repose which takes place under normal conditions with the supervention of darkness. But those whose occupations necessitate night work are, with few exceptions, any thing but regular in their habits of sleep. As a rule, they pass but five or six hours during the day in actual sleep, the system remaining during the remainder of the time in but a semi-dormant condition. When sleeplessness has persisted for a considerable length of time, a state of chronic irritability is set up within the central nervous system. This irritable condition may be accompanied by circulatory derangements, which greatly enhance

the morbid manifestations. Very often there is a condition of permanent or periodic congestion. Sometimes, however, there is anæmia of the nervous centres. Again, I have very frequently observed a condition of things in which there is a periodic alternation of the two conditions of congestion and anæmia. Sometimes, in the early stages of the disorder, there are no morbid circulatory phenomena whatever visible; but sooner or later these vascular derangements are almost certain to appear. They form a very important and serious complication, and their removal should always be a subject of especial solicitude in every rational system of treatment. Their treatment, however, is but a portion of the therapeutic problem. The irritated brain-substance itself must be restored to a normal condition; and this can best be obtained by certain internal remedies which act directly upon the brain-substance itself, and by certain other therapeutic agents which enable us to act upon the constitution as a whole. Special efforts must, moreover, be directed to a restoration of the physiological integrity of the sympathetic system. To these and allied therapeutic considerations a more extended reference will be made hereafter. Those means which enable us to modify the cerebral circulation will also be considered at some length; and, after what has already been said respecting the intimate relationship subsisting between brain-function and the intracranial cir-

culatation, it will be easy to understand the importance to be ascribed to this portion of the therapeutic problem.

Whatever be the causes, which, acting upon the brain with more or less directness, give rise to sleeplessness, we have always this to bear in mind: that not only is it necessary to eliminate as far as possible the extraneous exciting factors, but also to combat *seriatim* those morbid nutritive and functional conditions which may have become established within the brain and automatic mechanism of the superior portion of the cord.

SLEEPLESSNESS ARISING FROM IRRITATION OF CENTRIPETAL NERVES.

During the most perfect form of natural sleep, sensory impressions are more or less blunted. This diminution of impressionability is in direct proportion to the profundity of sleep. Thus, as has been proven by Kohlschütter's¹ experiments, the magnitude of a sound which will arouse a sleeping individual must be increased in the ratio of the degree of sleep. By arranging a pendulum so that its distance from a given resonant object could be accurately measured, and then noting the height from which it was necessary to allow the pendulum to fall in

¹ Messungen der Festigkeit des Schlafes, Inaugural Dissertation von Dr. Ernst Kohlschütter, Leipzig, 1862. *Vide* Criticism upon same in Schmidt's Jahrbuch der Medicin, 1863, vol. 118.

order that its concussion should arouse an individual from sleep, Kohlschütter was enabled to determine at what portion of the night sleep is most, and at what part least, profound. Guided by an erroneous interpretation of this phenomenon, some have sought to perceive in sleep *only the result* of reduced sensory impressions. While perfectly willing to concede the paramount importance to the organism, and especially to the nervous system, of the re-active effects engendered by extraneous stimuli, I cannot bring myself to believe that sleep itself is the sole result of diminished sensory impressions. I am led rather to perceive in such speculations one of those logical vagaries in which cause has been confounded with effect. The truth of the matter is this: that diminished sensibility *is one of the effects, and not the cause, of sleep*. Nor is there lack of direct proof in corroboration of the above proposition. Thus prisoners have been known, when excessively exhausted, to sleep while undergoing the most horrible tortures. Again, if the blood-supply to the brain be artificially diminished, as in compression of the carotids, the susceptibility to extraneous impressions will often be found to be appreciably diminished. Accepting the proposition then, that diminished sensibility is one of the effects and not the cause of sleep, it is nevertheless necessary to admit that *irritation* of peripheral nerves is very frequently fatal to sleep, except where the exhaustion is something phenomenal, as in the

instance above cited. We should be in gross error, however, as already noted, should we, guided by the above fact, assume deductively any *direct* causative agency on the part of reduced sensibility in the production of sleep. Peripheral irritation may cause insomnia; but it does this, not because reduced sensibility is the cause of sleep, but because the ganglia are aroused from repose by the shock conveyed through the centripetal nerves. This repose of the ganglia — this sleep — was something which pre-existed, and of which reduced sensibility was but one of the consequences.

Irritation of the centripetal nervous system, then, produces insomnia indirectly by interfering with the internal economy of the ganglia, and arousing the latter from a state of repose consequent upon exhaustion.

In an interesting clinical lecture by Dr. Robert J. Graves,¹ some excellent practical suggestions are advanced concerning the modifications in treatment to be adopted in various forms of insomnia, particularly in those varieties which are attributable to some acute or chronic disorder. Like all opinions, however, expressed prior to the experimental researches of late years, these considerations shed but meagre light upon the more intimate physiological questions involved in the consideration of sleep and its various

¹ Clinical Lectures, by Dr. Robert J. Graves, second American edition: Ed. Barrington & Geo. D. Haswell, Philadelphia, 1842.

modifications. Nevertheless, this author advances certain therapeutical suggestions, albeit of a purely empirical character, which are not devoid of merit. More particularly to be commended is the vigor with which he advocates a *persistent* and continuous treatment of the disorder. It is more especially, however, to an interesting variety of insomnia described at some length by Dr. Graves, and which well illustrates the anti-soporific effects produced by irritation of the peripheral organs of centripetal nerves, that I would here draw attention. The irritation referred to was caused by blisters. In speaking upon this subject, Dr. Graves says, —

“The bad effects on the nervous system, occasionally produced by the application of blisters, are somewhat analogous to those which result from wounds and other external injuries, and to be accounted for on the same principle. . . . Wounds and injuries sometimes make an impression on the nervous system by no means proportioned to the importance of the injured organ to life, or to the extent of the mischief. . . . An injury produced by a body which strikes the sentient extremities of the nerves with great force will sometimes produce very remarkable effects on the system. . . . Thus a musket-ball striking a limb may, without wounding any great artery or nerve, or destroying any part of importance to life, produce a train of nervous symptoms of an extraordinary character. . . . The person without feeling much pain, and scarcely knowing that he has been wounded, without being terrified, or having his imagination excited by any apprehended danger, turns pale, gets a tendency to faint, and sometimes actually dies from the impression made on the nervous system. . . . In the same way an external injury re-acting

on the nerves may bring on high mental excitement, delirium, and a *total privation of sleep*, as we exemplified in delirium traumaticum. . . . The delirium and sleeplessness arising from blisters is by no means an uncommon disease."

When properly considered, the above observations afford a perfect clew to the causation of the various forms of sleeplessness, comprehended under the general designations of symptomatic or secondary insomnia.

There is a form of insomnia very prevalent among some classes of society which owes its origin to various forms of digestive disturbances. A functional or organic disturbance of almost any organ may produce insomnia. Syphilis is a not uncommon source of wakefulness, more particularly the cerebral type. Again, certain forms of liver and kidney trouble may produce sleeplessness. Persistent acute pain is another prolific and terrible source of wakefulness. It is not my purpose on this occasion to enter into a specific discussion of all the various morbid accidents which may indirectly give rise to a more or less protracted condition of wakefulness. I must content myself with having referred to the above generic truths, which, when properly considered, will be found to constitute the key-note of the whole subject.

As regards the treatment of these forms of the disorder, we have two short rules to follow: 1. Treat the exciting cause. 2. Treat any secondary morbid

changes which may have taken place in the course of time within the realms of the brain-economy. The first rule involves the resources of general medicine; the second is comprehended in the chapter on the therapeutics of sleeplessness.

V.

EXHAUSTION OF BRAIN-ENERGY.

IN concluding the consideration of sleeplessness, I cannot refrain from referring to a condition of the brain which is often closely associated with protracted wakefulness, and which finds its chief expression in a curtailment of available brain-energy. Those who suffer from this disorder complain that they are quite unable to perform the usual amount of mental work; that they are easily fatigued by a continuation of the same employment for any length of time; that the memory for past as well as recent events has become unreliable; that society has become distasteful to them; that ambition has deserted them; that they are frequently, and even profoundly, depressed. Sometimes they complain of fatigue upon even the slightest bodily exertion; but very often there is no impairment of the motor functions whatever, and the disturbances are purely psychical in nature. Sometimes those afflicted by this disorder are the victims of various forms of morbid fear. This fear may be directed towards extraneous sources, or may confine itself to the individual economy. In the first instance

it may manifest itself in a vague dread of being left alone, in a dread of society, in a fear of open or exposed places or of circumscribed localities. Again, there may be an ever-present fear of pecuniary calamity, or a dread of a possible loss of social status, etc.

Where the attention of the sufferer is directed towards himself, the symptoms often assume the form of hypochondria. The individual imagines that his liver, or some other organ, is diseased; that he is about to become insane; that he is about to suffer from a stroke of paralysis; or that he has entered upon some form of insidious malady which is sure to result in death.

It is very necessary, however, that the physician should use the utmost caution before ascribing importance to the apprehensions of these persons. Usually these fears have only a subjective significance, and are purely the outgrowth of a morbid condition of the mind-mechanism.

Otherwise to be considered are those symptoms which point directly towards those organs enclosed within the cranial cavity. Those symptoms are: 1. Great weariness upon the slightest mental exertion, and often total inability to work at all. 2. Pain in the region of the vertex, following even slight mental work. 3. Sometimes frontal headache. 4. Tenderness of the scalp.¹ 5. A feeling of constant weariness.

¹ *Vide* on this subject *Nervous Exhaustion*, by Dr. J. M. Beard; William Ward & Co., New York, 1880.

ness. 6. Disorders of memory. 7. Impairment of will-power. 8. Sometimes occipital pain, which not infrequently disappears after a few applications of the Faradic current. 9. Morbid excitability, which often assumes the form of violent anger upon slight provocation. 10. Very great depression, particularly during the early morning hours. 11. Disorders of the cerebral circulation, which may sometimes assume the form of congestion, sometimes of anæmia, or sometimes the two conditions may alternate with each other. In any event the vascular derangements, although, doubtless, of secondary origin, deserve especial attention on account of the painful effects which they, in their turn, exercise upon the already demoralized condition of the central ganglia.

In brain-exhaustion we have to do with a condition of the ganglia in which the processes of disintegration have outstripped those of integration, — a condition in which the ganglia are no longer able to hoard up the usual and requisite amount of explosive energy. Exhaustion of brain-energy is therefore the outgrowth of defective nutrition, primarily inaugurated by an illegitimate demand upon available brain-resources. It is the state engendered by an excess of demand over supply.

TREATMENT OF EXHAUSTED BRAIN-ENERGY BY PROLONGING THE DURATION OF BRAIN-REST.

If, then, brain-exhaustion be that condition of the organ in which the mechanism of supply has become more or less defective, the problem presented for therapeutical solution is how best to bring the supply of brain-energy up to the normal standard. I know of but one method of accomplishing this end; namely, by decreasing for a time the expenditure of cerebral activity to a minimum, and increasing the amount of available cerebral force. By prolonged sleep it is possible for the ganglia to hoard up, in spite of the defective mechanism of supply, an amount of energy proportionate to the temporarily reduced output of brain-force. Thus by slow degrees the proper correlation between integration and disintegration may be re-established. But it is utterly useless to hope for such a result at once; as, when the perverted nutritive conditions have once become established, nothing short of prolonged brain-rest can by any possibility result in the re-establishment of the normal nutritive processes of the cell economy.

As I have discussed in a subsequent chapter the various therapeutical questions involved in the treatment of sleeplessness and morbid brain-function, I shall content myself with referring to the principles therein enunciated, thus avoiding needless repetition.

VI.

THE THERAPEUTICAL SIGNIFICANCE OF AN EXCESSIVE OR INADEQUATE SUPPLY OF BLOOD TO THE BRAIN.

THERE are certain fundamental principles which it is constantly necessary to bear in mind when the question arises, What shall be the treatment to be prescribed in a given case of insomnia? First of all, there should be presented to the mind a perfect picture of natural sleep, in which every physiological factor connected with the phenomenon should stand forth in consciousness with the vividness appropriate to its importance. Such factors are ganglionic exhaustion, *with absence of interplasmatic irritability*; a *physiologically* diminished blood-supply to the ganglia; absence of any and every form of irritation, transmitted through the centripetal system of nerves; exemption from all psychical irritation, — viz., worry, grief, abnormal intellection, etc.

If in every instance it be asked, In what particular regard does this individual case of insomnia differ from the normal type of sleep? it will usually be possible to ascertain the factor or factors in which

the abnormal deviation is present. Thus a careful inquiry into the condition of the circulation will usually afford data sufficient to form conclusions as to whether the causation or perpetuation of the insomnia is the result of irritation, consequent upon too much or too little blood-supply (*vide* chapter on Blood and Brain-Force). Let us examine briefly the symptomatic evidence of an undue blood-supply to the ganglia on the one hand, and an inadequate supply on the other.

CEREBRAL HYPERÆMIA.

An undue blood-supply to the brain is certainly one of the most constant and baneful accompaniments of the idiopathic variety of sleeplessness. That this redundancy of the blood-supply is inaugurated by certain disturbances of the sympathetic nervous system can admit of no doubt. Equally clear is the fact, that those disturbances of the vaso-motor mechanism were *primarily* induced by some form of irritation, acting more or less directly upon the ganglionic centres themselves. Such irritation may be the result of psychological causes, or of impressions transmitted through the centripetal system of nerves. In the first category belong mental overwork, sorrow, disappointment, worry, responsibility, jealousy, real or imaginary disgrace, pecuniary losses, etc. Under the second head are comprised pain, tickling sensations, discordant noises, certain forms of foul odors,

intense and irregular undulations of light, visceral disturbances, etc. The first group of irritating causes possesses far more importance than the second group, which is of comparatively secondary consequence. It thus appears that the circulatory aberrations are consequent upon some form of irritation affecting the brain itself, and involving to a greater or less degree the functional decrepitude of the vaso-motor mechanism. None the less certain, however, is it that these morbid circulatory changes, having once become established, *re-act* in their turn in a most derogatory manner upon the brain itself. And thus it happens, that those pathological circulatory conditions which were *primarily* induced by an irritation of the brain itself, in their turn *re-irritate* that organ, and serve to *perpetuate* the chaotic state within the economy of the ganglia.

That such a *re-irritation* must take place will abundantly appear on a consideration of what has already been said concerning the intimate relationship subsisting between the blood-stream on the one hand, and brain-function on the other (*vide* chapter on Blood and Brain-Force). When the intimate connection which subsists between blood-supply and brain-activity is borne in mind, when the remarkable effects are duly considered which take place within the realms of the ganglionic economy upon even moderate variations in the magnitude of the intracranial circulation, and when proper account is taken of

those disasters which supervene upon, and are directly traceable to, aberrations of the cerebral circulation, the imperative necessity of directly treating all *early* morbid circulatory derangements will be apparent to all. Let the excuse for the prominence which is herein given to the treatment of the morbid circulatory accompaniments of insomnia be found in the overwhelming importance which such phenomena possess among the causative, and what may also be truly designated as the perpetuating, factors of the disorder. But *let us also at the same time not forget to address our efforts towards calming the state of irritation which already pre-exists within the ganglia themselves.* To this end the excellent therapeutic co-operation to be obtained by the scientific employment of certain remedies must not be ignored. Of this, occasion will be found to speak hereafter.

CLINICAL CHARACTERISTICS OF CEREBRAL HYPER-ÆMIA.

Let us now briefly inquire what are some of the more prominent symptoms of cerebral hyperæmia.

In the very early stages of the disorder, there is frequently such an entire lack of symptomatic manifestations, that a detection of the nature of the disturbance would be impossible, were it not for the fact that fluctuations of the cerebral circulation *above or below* a certain physiological standard are almost

invariably revealed by the presence of a greater or less degree of sleeplessness. In consequence, the attention of the physician (if he be so fortunate as to see his patient at this stage of the disorder) should at once be directed to a careful investigation of the condition of the cerebral circulation. A comparative determination of the condition of the circulation prior to, during, and after the vigil, as well as at different portions of the day, should be made by means of the cerebral thermometer. Although this instrument is of comparatively little value where it is a question of recording very slight variations of temperature, it nevertheless affords sufficiently accurate results for ordinary clinical purposes when properly manipulated. Where comparative determinations are to be made, the applications of the instrument should be made under absolutely similar conditions. Thus one of the important conditions to success in conducting thermometric measurements over the cranial bones is, that the pressure of the instrument should be so slight as not to cause occlusion of the capillaries: otherwise entirely erroneous results may be obtained. Again, the very slight pressure employed should, in comparative determinations, be invariably the same. This is neither to be obtained by simply holding the instrument with the hand, nor by incasing it in one of the numerous clumsy appliances designed to retain the instrument in place, the chief features of which are the number-

less sources of error introduced into experimental researches by their employment. Having on numerous occasions been but too well convinced of the truth of the above, I resolved to endeavor to remedy as far as possible the objections inherent to the existing methods of applying the surface thermometer. Accordingly I devised the following apparatus:—

It consists, in the first instance, of a metal box, which terminates in a tube. The tube encircles the thermometer loosely. Around the thermometer is a very fine spring. The lower end of the spring impinges against a thin disk of india rubber, encircling the thermometer just above the bulb. The upper extremity of the spring can be pressed towards the lower, and secured in place by a ring provided with a screw-attachment, which slides in a graduated slot of the tube, and can be fixed by a nut. It is easy to perceive, that when the box is placed upon the vertex, for example, and secured by elastic bands which pass under the chin, a certain amount of pressure will be exerted upon the thermometer, equivalent, in fact, to the tension of the spring. Now, it is equally evident, that, by sliding the ring upwards and securing it in place by the nut, the tension can be rendered as delicate as possible. Furthermore, it is quite as clear, that if the position of the ring, having once been decided upon, *remain undisturbed*, all measurements with the instrument will be conducted under identical pressure conditions.

The surface thermometers are usually graduated in tenths of a degree. The instrument should remain in place till the column of mercury ceases to rise or fall. In making comparative determinations, the individual examined should occupy the identical position each time. Thus, when conducting investigations as to the condition of the cerebral circulation at different times, we should fall into grave error were we to ascertain on one occasion the cerebral temperature while the subject remained in a recumbent posture, and on another while he assumed the erect attitude. Nothing is more certain than that changes are wrought in the cerebral circulation by modifications of position of either head or trunk: consequently, to associate with the time of day certain changes which were far more attributable to position would be very poor logic indeed. Happily such mistakes can be avoided. Other instruments for ascertaining very slight variations of temperature are (1) Becquerel's disks and (2) Dr. Lombard's thermoelectric differential calorimeter.¹ These beautiful appliances certainly possess very great advantages, but, owing to their cost, are not obtainable by all. Nevertheless, expense is one of the things which should, as far as possible, be ignored where the question of scientific accuracy is involved.

¹ *Vide* Memoir on the Pathology and Treatment of Organic Infantile Paralysis, by William A. Hammond, M.D., in *Journal of Psychological Medicine*, No. 1, July, 1867, p. 53.

After the condition of hyperæmia has continued for some time, certain other symptoms besides sleeplessness begin to manifest themselves. Prominent among these are an *extreme degree of irritability, hypochondriacal manifestations, and a pessimistic tendency of mind*, which finds in petty annoyances overwhelming evils, and perceives in the brighter episodes of life only the insidious precursors of impending misfortune.

The more prominent physical symptoms observed are, besides *heat* already referred to, *sensations of pain at the vertex, a feeling of tightness* across the forehead or some other portion of the head, *impressions of fulness, vertigo, and headache*. The latter symptom usually assumes the form of a dull pain, and is greatly aggravated by any attempts at long-continued mental exertion. Disturbances of sensation are frequent accompaniments of the disorder. Thus "at times the sense of hearing is morbidly acute, while at others it is markedly impaired."¹ There is frequently great intolerance to even moderate impressions of light or sound. Short, informal conversations frequently produce an amount of irritation entirely out of proportion to the slight mental strain involved.

"Ophthalmoscopic examination shows the arteries of the retina to be increased in size and tortuosity,

¹ Diseases of the Nervous System, by William A. Hammond, M.D., seventh edition, 1881.

and vessels which in health are not visible are now clearly perceived." The optic disk is often more or less congested, exhibiting the appearance to which Allbutt has applied the name "congestion papilla," but which is perhaps more generally known as "choked disk."¹

In a series of interesting experiments performed by Professor Roosa and Dr. William A. Hammond,² it was found that the tympanum frequently affords an indication of the state of the intracranial circulation. Certainly, considering the results which those eminent observers have obtained, an examination with the aural speculum should always be undertaken where an engorged condition of the cerebral vessels is suspected.

Change of position, or any insignificant emotional excitement, frequently leads to a very considerable acceleration of pulse, and even violent palpitations.³ Krishaber has sometimes remarked an apparently febrile condition at the beginning of the attack, characterized by a chill and an appreciable rise in

¹ Dr. W. A. Hammond, on Cerebral Congestion, contained in his systematic treatise on the Diseases of the Nervous System, 1881.

² The Influence of the Disulphate of Quinine over the Intracranial Circulation: *Psychological and Medico-Legal Journal*, October, 1874, p. 230.

³ *Vide* observations of Krishaber in this direction, cited by Hammond in his work on Diseases of the Nervous System; also Dr. Hammond's more recent studies in the same direction, referred to in the treatise above quoted.

temperature. In speaking of this subject, Dr. Hammond says, —

“I have observed this condition in about one-third of the cases that have come under my observation; though usually close questioning is necessary to elucidate the fact of its existence, so little impression does it make upon the mind of the patient. . . . Sometimes, however, the paroxysms are of such severity as to excite the belief that they are of malarious origin; and, being treated with quinine, they and the other symptoms attendant on the disease are greatly aggravated.”

The truth of this latter statement I myself have had the opportunity of corroborating. Notably in two instances of supposed “malaria” I can recall the baneful effects of large doses of quinine frequently repeated. The cases in question exhibited all the characteristic symptoms of cerebral hyperæmia. In both instances the congestion had assumed very considerable proportions. After the administration of excessive doses of quinine, which had been prescribed for the “fever,” had been persisted in for a certain length of time, the engorged and livid appearance of the countenance, combined with tinnitus and an alarming “scratching” pain at the vertex, so frightened the sufferers that they refused longer to continue the use of the drug. Appropriate treatment eventually restored both patients to health.

Contracted pupils are a very constant and significant accompaniment of cerebral engorgement.

Of the “apoplectic,” “paralytic,” and other grave

forms of the disorder, I shall not speak on this occasion, as what most nearly concerns us here is a proper recognition of that variety of cerebral congestion which is so frequent and baneful an accompaniment of sleeplessness.

CLINICAL CHARACTERISTICS OF CEREBRAL ANÆMIA.

In the preceding pages the more prominent appearances, induced by an over-supply of blood to the brain, have been sufficiently considered, at least in so far as they possess direct interest in connection with the pathogeny and treatment of sleeplessness. It now remains to bestow some attention on a group of phenomena which are intimately associated with, and directly the outgrowth of, an *inadequate* blood-supply to the brain.

The most prominent symptoms of cerebral anæmia are (1) *Vertigo*, "notably increased on rising from the recumbent posture."¹ (2) Headache of a more or less circumscribed character. (3) Dilated pupils,² which re-act but slowly on exposure to strong light. (Sometimes only the pupil of one eye is thus affected.) (4) A morbid susceptibility to sensory impressions, particularly of light and sound. This sensitiveness

¹ Hammond in his Treatise on Diseases of the Nervous System, p. 71.

² *Vide* some interesting facts, bearing on this question, contained in an article entitled, *Zur Ligatur der Arteria Carotis Communis*, by Dr. C. Pilz, and published in *Langenbeck's Archives for Clinical Surgery*, vol. ix., 1868.

to light is often so great that it becomes necessary to relegate the patient to a perfectly dark room. Again, even moderately loud noises prove excessively irritating. Indeed, so intolerant are these individuals of acoustic impressions, that even such ordinary occurrences as the rumbling of a vehicle, the squeaking of a door, or conversation upon the most trivial matters, are sufficient to cause intense headache, and, in a word, to materially aggravate the condition of the patient. (5) The face is pale, and cold to the touch. (6) There is drooping of the eyelids.¹ (7) In rapidly induced anæmia frequently dimness of vision. (8) Drowsiness² is a very frequent symptom, and prevails during the daytime, especially in the morning. Towards evening, however, marked restlessness is often developed; and night brings only short, fragmentary sleep, which leaves the sufferer unrefreshed. (9) Inability to continue mental activity for any length of time disposes to listlessness, which often assumes the form of intense dread of all forms of intellectual work. (10) A diminished temperature over the vertex, often perceptible to the touch, is very constantly

¹ *Vide* experimental results obtained by compression of the carotids contained in my monograph on Carotid Compression and Brain-Rest, published by Anson D. F. Randolph & Co., New York; also a paper read by me before the New-York Neurological Society, June 6, 1882, and published in the Phila. Medical News of June 17, 1882.

² Considered a very unfavorable symptom by some writers; but my own observations lead me to a contrary opinion,—at least where the drowsiness shows no tendency to increase.

met with. (11) Feeble pulsation of the carotids is a significant and characteristic symptom. (12) Very *slight* pressure upon the carotids of a person suffering from cerebral anæmia will produce an immediate sensation of dizziness bordering on syncope ; whereas in cerebral hyperæmia a vastly greater amount of compression must be employed to produce the same result. The difference in the amount of force required is very striking. This, so far as I am aware, is the first time that diagnostic prominence has been assigned to a symptom, of whose importance I have had abundant opportunity of convincing myself both clinically and experimentally.

DIFFERENTIAL SUMMARY.

CEREBRAL HYPERÆMIA.

Restlessness and irritability during the day ; confusion of ideas and sleeplessness at night.

Increased temperature over hemispheres and vertex.

Facial flushing.

Diffuse headache.

Energy of cardiac action increased, — palpitations.

Throbbing of the carotids ; moderate pressure upon these arteries does *not* produce syncope.

Choked disk.

Contracted pupils.

CEREBRAL ANÆMIA.

Drowsiness during the day ; sleeplessness not characterized to the same extent by confusion of ideas.

Decreased temperature over hemispheres and vertex.

Facial pallor.

Circumscribed headache.

Energy of cardiac action decreased.

Feeble and frequent pulsation of the carotids ; *moderate* pressure produces dizziness and syncope.

Pale retina.

Dilated and sluggish pupils (frequently uneven).

VII.

OF THE MECHANICAL REGULATION OF THE
CEREBRAL CIRCULATION.

METHODS OF DIMINISHING THE CEREBRAL CIRCULATION.

IN former years it was fashionable in some quarters to ligate the carotids, not only for surgical purposes, but also for therapeutic reasons. This measure was more particularly in vogue in the treatment of epilepsy, which malady, if not cured, was often greatly reduced in severity by ligation of one of the carotids. Of late, ligation of the vertebral arteries has been essayed in epilepsy, and in some instances with quite remarkable benefit. There always has been, and always will be, however, doubt among medical men as to the advisability of undertaking this class of operations in the treatment of purely functional cerebral disorders; more particularly on account of a certain element of danger which must always attend such surgical undertakings. Nevertheless, some method of directly and immediately diminishing the blood-flow to the brain

is certainly a desideratum of the very first magnitude in neurological therapeutics.

Some time since, I devoted a very considerable amount of time and labor in the endeavor to devise some adequate and *perfectly safe* method of reducing the blood-flow to the brain, by means of pressure applied to the trunks of the right and left carotid. Finally, after very many experiments, I succeeded in constructing an instrument by means of which it is possible to compress the carotids for any desired length of time. The instrument here referred to, and which I have designated as the "carotid truss," consists of two semicircular springs, — one of which is provided with a longitudinal slot. Through this slot passes a screw, that is securely embedded in the periphery of the second spring, which lies directly below and in perfect apposition with the first. By sliding one over the other, the radius formed by the two springs may be increased or diminished at will; while, by tightening a nut with which the screw is provided, they may be held in any desired position. To each of the free extremities of the springs is attached, by means of a ball and socket-joint, a delicate pad. The ball of this joint is attached to a screw which can be lengthened or shortened at will. The pads can be moved to and fro by means of a short longitudinal slot, and secured in position by screws.

That portion of the continuity of the common

carotid artery which I have found best suited to the application of instrumental compression, is situated opposite a point which is located slightly above the juncture of the thyroid with the cricoid cartilage.

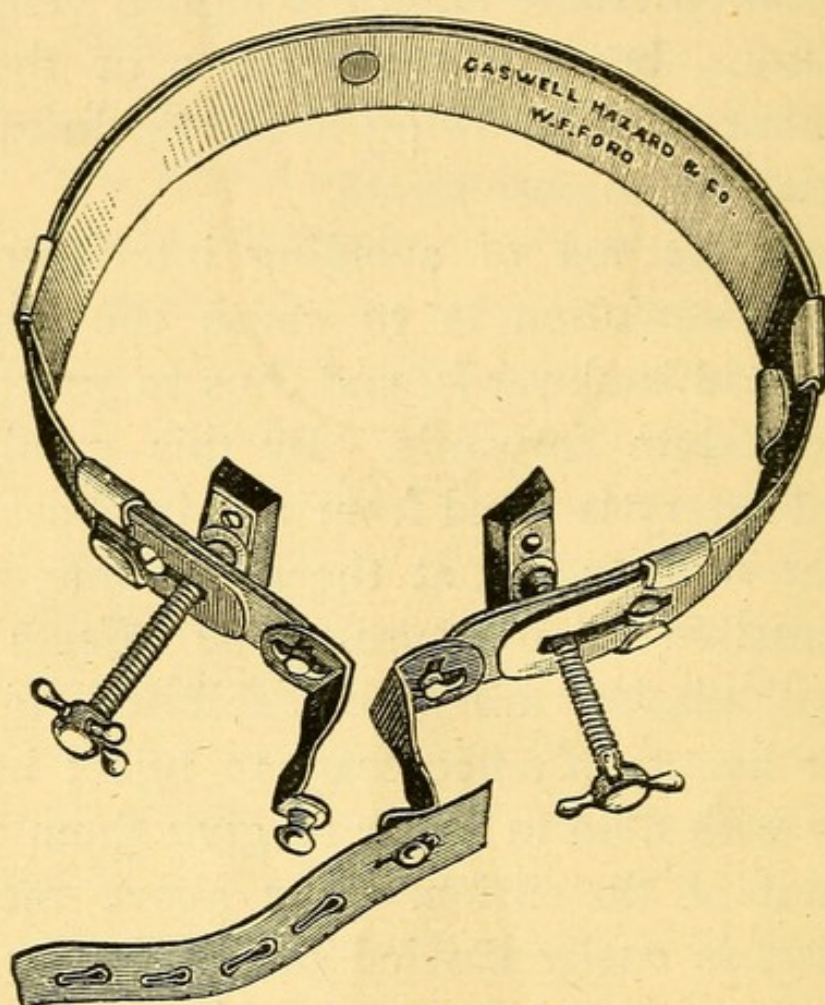
The mode of applying the above instrument is as follows: having first, by means of the radial screw, which provides a *coarse* adjustment, adapted the radius of the truss to the circumference of the neck of the patient whose arteries are to be compressed, the operator next proceeds to adapt the pads to the arteries by means of the smaller anterior slots and screws, which afford a *fine* adjustment. The pads should be so arranged that their superior margin is situated about opposite the juncture of the thyroid with the cricoid cartilage. Connection is established between the extremities of the truss by means of an elastic band secured at each extremity by detachable clamps. This elastic band is provided with an arrangement which admits of lengthening or shortening it at will. The pressure can thus be increased or decreased at will. Compression should never be so great as to cause serious inconvenience or giddiness. On the other hand, it must be sufficient to sensibly diminish the lumen of the artery: otherwise no good will be likely to result from the procedure. More difficulty is experienced in the adjustment of instruments to the necks of fleshy persons than to those of less full habit. Prolonged compression is furthermore not so well borne by these fleshy per-

sons, as, in order to act upon the lumen of the artery through the superincumbent adipose tissue, considerable pressure must be employed; and this they find it hard to reconcile themselves to for any considerable length of time. Again, it is not so easy to avoid pressure upon the jugular vein in very fleshy persons, because the isolation of the artery is much more difficult, owing to the thickness of the superincumbent adipose strata.

The best method of avoiding interference with the venous circulation is to cause the patient to throw the head backwards, and thus to protrude the cervical vertebræ forwards. By this manipulation the carotid artery is freed from any implication with the jugular vein, and is, at the same time, rendered more accessible to pressure. The effects of the above manipulation are well exhibited upon the cadaver, it being only necessary to inject both vein and artery with fluid in order to give them the natural amount of distention. The above method of compression is easily carried out while the patient maintains the sitting posture. It is well to employ for the purpose a chair with a high back; and a roller bandage or folded towel should be placed behind the neck, while the head is thrown backwards, in order to protrude the vertebræ in an anterior direction. With the employment of proper tact and dexterity, it is usually an easy task to induce patients to wear the instrument described above for considerable

periods of time ; though of course it would be quite impossible to require them to assume for over a few hours the position just referred to. Nevertheless, in office practice I always put the patient in this position ; and, indeed, I employ a chair with a special

No. 1.

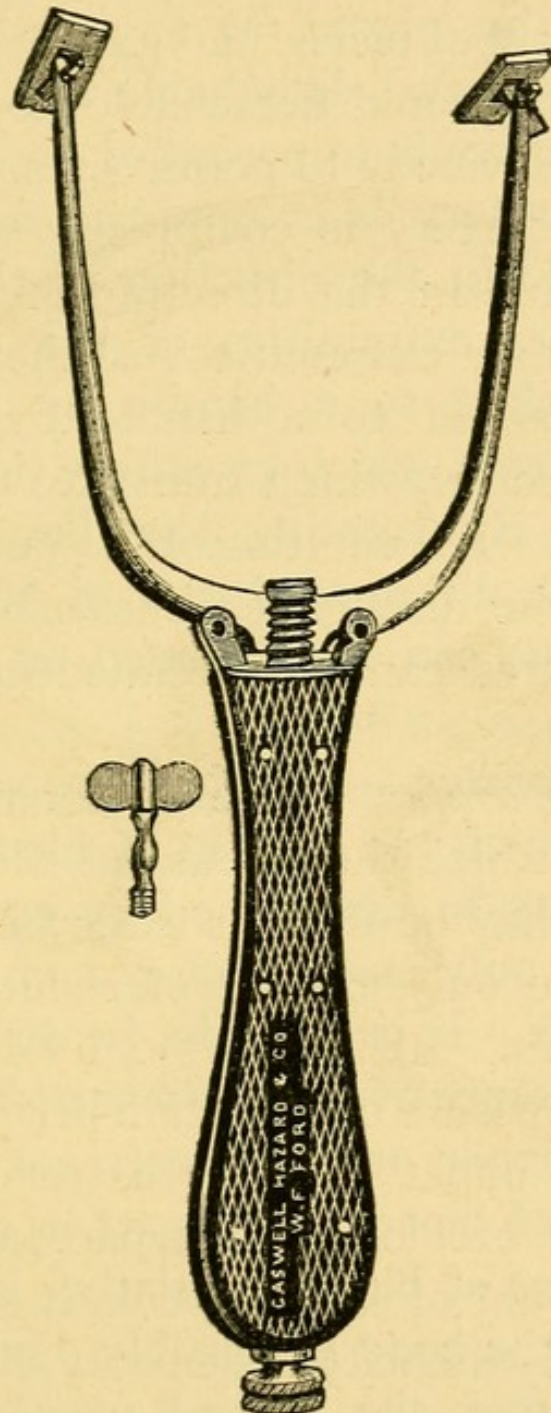


Author's Carotid Truss.

head-rest, which resembles the head-attachment of a dental chair, in order that the proper position may be continuously maintained. Swallowing and conversation should as far as possible be avoided, owing to the displacement of the instrument, which may be caused by the action of the larynx.

Besides the implement above described, I have also designed an instrument for the purpose of apply-

No. 2.



Author's Instrument for Temporary Compression of the Carotids.

ing a high degree of pressure for a short time ; as, for example, during the convulsions of epilepsy, in cases

of congestive headache, etc. The chief features of this instrument are two curved metallic armatures, to each of the extremities of which is attached a pad. This pad can be placed at any desired angle by means of a screw and detachable key. The object of this latter device is to permit of so arranging the pads that the artery is compressed *away* from the jugular vein, and in the direction of the spinal column. The other extremities of the curved armatures are attached to a handle by means of an Archimedian screw, which transfixes the latter in its entire length. By rotating the button which is attached to the disengaged end of the screw, the curved armatures can be extended or approximated at will.

Junod's Apparatus. — We have considered above the means by which the amount of blood circulating in the brain may be diminished by exclusion. But this is not the only method of reducing the blood-flow to the brain. It is possible, by diminishing the atmospheric pressure over certain peripheral districts, — such as an upper or lower extremity, — to cause such an afflux of blood to the part in question, that the entire amount of blood circulating in the remaining regions of the body is sensibly diminished. As a matter of course, the central nervous system is also affected by this diminished blood-supply. This method, so far as I am aware, was first employed by the famous Dr. Junod ; and its merits have been set

forth in what seem to me rather extravagant terms by the renowned investigator. I have never been able to achieve *all* the advantages claimed for this method of treatment by its originator. Still, I am far from denying that it has certain therapeutical advantages, which, if properly understood, often render this species of gigantic dry cupping a most useful procedure. Where, however, the district enclosed within the apparatus is very extensive, there is need of employing the utmost caution, as otherwise there is no little danger of causing a sudden attack of syncope. The radial, and particularly the carotid, pulse should be carefully investigated. For further particulars respecting this method of depletion, I would refer the reader to Dr. Junod's well-known work upon this subject. Unquestionably, the method has been much neglected by the profession, on account of the ridiculous and extravagant claims put forth in its behalf by unprincipled charlatans.

METHODS OF INCREASING THE CEREBRAL CIRCULATION.

As it is possible to diminish the amount of blood circulating in the nervous centres by diminishing peripheral pressure, so conversely it is perfectly practicable to increase the amount of blood circulating within the brain by *increasing* peripheral pressure.

There are two methods of accomplishing this end.

In the first place, by *increasing* the atmospheric pressure in Junod's apparatus, considerable pressure may be applied to the periphery; and thus the amount of blood circulating within the brain and remaining corporeal districts can be increased. Secondly, by enveloping a portion of the periphery (as for instance, an extremity) with an Esmarch bandage, or with an elastic stocking, any desired amount of pressure can be applied; and, in consequence, the amount of blood in the brain and remaining portions of the body is proportionately augmented. The tension should not be so great as actually to cause occlusion of the veins and arteries, and complete interruption of the circulation. In very anæmic individuals elastic stockings may sometimes be extended up as far as the perinæum; but this is not usually necessary. The stockings may be applied one or two hours before retiring, and then removed, the extremities being elevated in bed upon appropriately placed cushions, or they may be worn all night. In the latter case it is not necessary to elevate the extremities in bed.

These are the most practical points connected with the question of the mechanical regulation of the cerebral circulation. It only remains to add, that elevating the lower extremities has some effect in increasing the blood-flow to the brain, and *vice versa*.

VIII.

INTERNAL REMEDIES.

IN a preceding paragraph the mechanical methods have been discussed, through the employment of which it is possible to produce a more or less direct effect upon cerebral metamorphosis. A very considerable degree of prominence has been accorded to the early and rational treatment of circulatory anomalies, not because such vascular derangements constitute in themselves the entire pathological picture of sleeplessness, but on account of the exceptionally intimate relationship which subsists between brain-function on the one hand, and the condition of the cerebral blood-supply on the other. Nor is the assertion of this interdependence of blood-stream and cerebral activity a mere empty assumption, nor an attempt at a brilliant generalization. It is a direct and absolutely unavoidable conclusion, derived from a consideration of the bulk of experimental and clinical evidence. While giving due prominence, however, to the morbid circulatory phenomena, we were careful to point out the equal necessity of correcting by every means at our dispo-

sition that condition of irritability already resident in the cerebral plasma itself. That in sleeplessness we have a predominance of the processes of disintegration over and above those of integration, there can be no doubt.

To make this point clear, we have but to call to mind the enormous loss in weight frequently sustained during protracted insomnia. In a rational system of treatment, therefore, the counteraction of ALL the factors concerned in undue disintegration, is a perfectly apparent necessity. Thus, while seeking by every means at our disposal to correct all morbid manifestations in the domain of the cerebral circulation, we must also endeavor to calm the condition of irritation which already pre-exists in the brain-substance itself, and which eventually results, if not properly checked, in a permanent decrepitude of the vaso-motor mechanism. The means by which this end is to be accomplished consist in the employment (not abuse) of a series of internal remedies, which exert a soothing effect upon the brain substance itself, and tend to re-establish the physiological relationship between cerebral waste and repair.

I am perfectly well aware, however, that there are some who entertain a positive antipathy to that useful class of remedies to which reference is here made. To such persons the very mention of chloral or the bromides in any therapeutic connection whatsoever is quite sufficient to call forth a perfect hyperbole

of opposition. Nevertheless, when inquiry is made respecting the origin of these adverse opinions, we are surprised at what a small amount of statistics is actually required to generate the most obstinate of prejudices. The truth of the matter is simply this, that we are sure to hear far more of the abuses of a remedy than of those good offices, which, in competent hands, it has rendered to the cause of rational therapeutics. Thus, if a person die from the effects of an over-dose of chloroform or nitrous-oxide gas, the public is sure to hear of it; but what of the tens of thousands who have happily passed, unscathed by the hand of pain, through the most frightful operations?

To those, then, who, led by the recital of the *abuses* of any one remedy, are induced to fulminate the most wholesale condemnation of its employment, however rational such application of means to ends may be, one word of advice: Do not attempt to treat functional nervous disease, for your position is just as hopeless as that of the gynæcologist who is opposed on "general principles" to supporting a displaced uterus.

Among the various therapeutic agencies which have attracted the attention of the profession of late years, there are none whose value is more thoroughly ascertained, both clinically and experimentally, than that of the bromides.

The more obvious effects produced by a protracted employment of these remedies are —

“Diminished sensibility, followed by complete anæsthesia of the soft palate, uvula, and upper part of the pharynx. . . . The sexual organs are among the first to be influenced; for there is soon produced failure of sexual vigor, and, after a time, marked diminution of the sexual appetite itself.”¹

Diminished sensibility of the palate is one of the earliest symptoms which bears witness to the fact that the nervous system has been brought under the influence of the drug. Hence the following method employed by Voisin for determining the dose (in the treatment of epilepsy) :—

“I have employed, for many years, a method which has given me the best results, which consists in determining the condition of reflex nausea by introducing a spoon as far as the epiglottis. I have remarked that a therapeutic dose of the bromide of potassium is not obtained till reflex nausea is suppressed. It is not till then that the bulb is acted on, and its excito-motory force diminished.”

It has been urged by some, that the production of the condition known as *bromism* is only justifiable in epilepsy; but such a position is, to my mind, entirely unjustifiable, and for this reason, that there are many functional disturbances of the nervous system in which a resort to a copious application of the drug is the only possible method of averting dire calamity. Nowhere is this more evident than in the treatment of sleeplessness, and more particularly

¹ Bazaire; quoted by Ringer.

in that form of insomnia which is the precursor of grave mental disorder. When brought face to face with this variety of the affection, the physician has often simply to choose between two evils, — *bromism* on the one hand, and impending *mental alienation* on the other. The choice, under such circumstances, will not be difficult for most persons. Again, the majority of those who suffer from insomnia, and who present themselves for treatment, have been almost invariably addicted to the habit of taking large quantities of chloral, hyoscyamus, morphia, etc., before retiring, laboring under the almost universal delusion that insomnia is a disorder to be treated at night; whereas a philosophic consideration of the subject shows that *the proper time to treat sleeplessness* is during the day. It will be found, that, by ordering such persons to take, for example, ten grains of the bromide of potassium before the first meal, twenty before the second, and thirty shortly before retiring, the dose of chloral, belladonna, cannabis indicæ, hyoscyamus, etc., which they had been in the habit of taking before retiring, can be progressively reduced, and, finally, entirely abandoned.

Those who suffer from insomnia are almost, without exception, beset by a variety of disagreeable mental symptoms during the day. They are frequently harassed by a vague dread of impending evil, accompanied by extreme irritability and depression. The ordinary duties and petty annoyances of life are

magnified, through the agency of a distorted fancy, until the unhappy sufferer imagines himself the most wretched of mortals. Such patients often conceive the most unfounded dread of society, which they themselves are wholly at a loss to account for. By degrees the mind falls into the habit of a continual morbid introspection. A dreary waste of distorted pictures is unrolled in never-ending succession before the mental vision, till the unhappy condition of things is brought to a close, either by the supervention of insanity or suicide. In such cases, argument, as such, can do little. We must first seek, therefore, by appropriate treatment, to correct those morbid physical conditions which result in the development of the morbid psychological phenomena. The bromides are, under these circumstances, the remedies *par excellence*, not alone on account of the soothing influence which they exercise upon the brain-substance itself, but also by reason of the deadening effect which they exert upon mental, as well as peripheral, sensibility.

Respecting the amount of the remedy to be employed, it is impossible to lay down any general rules which shall cover all cases. Enough that the physician keep constantly before him the fact, that what is sought after is a progressive decrease in mental and motor manifestations from mid-day till sunset. It is thus clear, that what is required is a cumulative effect from the drug, which is obtained by

increasing every subsequent dose until the desired result is obtained. I sometimes begin by giving about ten grains of a mixture of the bromides before the first meal, twenty before the second, and thirty in the evening. As above intimated, however, the size of the doses must be graduated to suit each individual case; and the same may be stated respecting the number of doses.

There has been considerable discussion respecting the manner in which the bromides produce their characteristic effects upon the central nervous system. Some there are who ascribe these effects wholly to the power possessed by these remedies of producing an anæmic condition of the central nervous system. This is the opinion, I believe, which is entertained by Dr. Clark and several other gentlemen of eminence. As for myself, I cannot accept this view entirely. I believe that this remedy exercises a direct influence upon the substance of the brain itself, as well as upon the intracranial circulation: hence its great value in the treatment of those disorders in which there is present a greater or less degree of morbid metamorphosis within the plasm of the brain itself.

Hydrate of chloral is an *hypnotic par excellence*. The first effect produced by its administration is said to be a raising of the arterial tension, corresponding with a certain degree of excitement. This condition is followed by a well-marked lowering of

the arterial tension. Another striking effect of the drug is to cause a considerable reduction in the temperature of the body. The remedy has a powerful effect upon the action of the heart, which it weakens when given in large doses. An enlarged heart is a contra-indication of the employment of chloral. Smaller doses of the remedy — such as are usually sufficient, when properly employed, to produce sleep — are often without effect upon the pulse, though sometimes, it is true, the latter may become slower.

This remedy constitutes one of the most powerful agents which we possess for the treatment of sleeplessness. It is necessary, however, to constantly bear in mind that it is not a “specific” against wakefulness, as some enthusiasts would have us believe. From previous considerations it is very clear that the restoration of the proper equilibrium between waste and repair — between cerebral integration and disintegration — is not, in the very nature of things, to be accomplished by any one remedy. The problem is far too complicated in its nature to be dealt with in an off-hand manner. The chief virtue of chloral, in so far as it concerns us here, consists in this: that by its use we are enabled to give to the *already tranquillized* brain that primary impulse to drowsiness which shall result in the supervention of sleep. Consequently the time to give chloral is shortly before retiring, although under certain circumstances it may also be advisable to administer the remedy

during the day in small doses combined with the bromides.

Chloral is said to cause a comparatively anæmic condition of the brain, to which fact the hypnotic effect of the drug is ascribed by some writers. While perfectly willing to admit that sleep is greatly facilitated by diminishing the amount of blood in a congested brain, I am not prepared to accept the theory that the whole efficacy of chloral consists in its ability to cause cerebral anæmia. On the contrary, I am of the opinion that chloral not only reduces the amount of blood circulating within the brain, but that it also exercises a "soothing" influence upon the cerebral plasma itself: hence the striking relief experienced in those cases of insomnia where the exciting cause is traceable to mental overwork, responsibility, anxiety, sorrow, disappointment, etc. Indeed, so well recognized are these effects, that persons are led to employ the drug without stint as a panacea against those ills which are the inevitable accompaniments of human existence; and so seductive do these periods of temporary emancipation become, that a habit is formed, ere long, which, if not speedily checked, may result in the most deplorable consequences. The chloral habit, if not as pernicious as the habitual abuse of opium, is certainly fraught with very considerable danger. Persons afflicted by this habit are distinguished by their loquacity, irritability, and a certain abruptness of man-

ner. Such individuals are subject to frequent attacks of depression, and often complain of abnormal sensations about the heart. So wedded do they become to the pernicious indulgence, that sleep is quite an impossibility without the usual sleeping-draught. Some of the most difficult cases of sleeplessness to treat are those of persons suffering from this habit. The first duty of the physician in such cases is to seek to very gradually reduce the amount of chloral taken every night. The bromides may be given during the day. Mental distraction should be obtained at any price, as these sufferers are addicted to the most melancholy description of reflections, these latter often bordering on suicide. An interesting fact in connection with the chloral habit is this: that those long under its domination frequently succeed in obtaining marked benefit from certain exercises of a semi-passive character. Thus I know of a person, long addicted to the abuse of chloral, and quite unable to enjoy an hour's slumber without the aid of large doses of the remedy, who succeeds in obtaining a very fair amount of sleep by resorting to horse-back riding. Again, a gentleman long a slave to chloral, who came under my observation recently, tells me that when at sea he enjoys a very excellent type of sleep. These and similar cases serve to illustrate the necessity of pure air and certain mild forms of exercise in the treatment of this class of patients. The remedy should never be employed

except under the advice and personal direction of the physician himself, who, on his part, should guard against the formation of the habit by insisting on periodical discontinuance of the remedy, and never persisting in its continuous employment for too long a time. It should always be borne in mind in this connection, that the employment of drugs is at best but a temporary expedient, and that nothing short of a total revolution in certain nutritive processes — in short, a restoration of the equilibrium between waste and repair — will insure success. I usually begin with five or ten grain doses, increasing the amount as circumstances may require. The remedy may be administered shortly before retiring, and the patient should remain quietly in the same position until the supervention of sleep. Sometimes it is well to combine small doses (five grains) of chloral with the bromides during the day. Where there is pain, it may be combined with morphia, as the effects of the remedy are thereby enhanced. It may also be combined with the tincture of hyoscyamus. I have employed it in this way on numerous occasions, both in the treatment of the insomnia of the insane, as well as in that form of wakefulness consequent upon overwork, anxiety, etc. There are some persons, however, who cannot endure the remedy in any form whatsoever.

The great principles to be observed in the employment of sedatives are scientific application of these

remedies as means to ends, and caution in avoiding a too persistent continuance in their employment. Furthermore, we should not expect too much from them: there are no "specifics" here. Uncombined with rational constitutional treatment, they are worse than useless.

Hyoscyamus is a valuable hypnotic, especially in those forms of sleeplessness accompanied by more or less delirium. It has been recommended and employed in the treatment of acute and intermittent mania. I have employed it in this connection in a very considerable number of cases, and can bear witness to its excellent effects. Small doses reduce the capillary circulation, while large amounts of the remedy are said to cause paralysis of the vessels. In the form of the tincture, it may be given in doses of from 3ss to ʒss. A very good method of administration is in combination with chloral, — one or two drachms of the tincture combined with ten or twenty grains of the hydrate of chloral. The chloral should be kept separately from the tincture, and added to the latter when required.

Hyoscyamus is a good substitute for opium, where the latter is not well borne. There are some persons, however, who have the most violent antipathy to the remedy; and, when such is the case, it is well not to insist upon its employment.

The hypnotic effects of *hyoscyamus* are said to be more pronounced than those of *belladonna*.

Opium has long been recommended for the treatment of various forms of sleeplessness: it may be administered by the mouth, or injected into the rectum. When introduced into the rectum, it is often more effective than when administered *per orem*. In certain varieties of insomnia, attributable to gastric disturbances, it is often effective. The rectum should be carefully cleansed by means of an ordinary enema of warm water previous to introducing the laudanum into the intestine. It is very important that the rectal walls should present as large and as clean a surface as possible to the influence of the remedy; for absorption is thereby greatly increased. The dose required to produce sleep *per rectum* has been, I fancy, considerably over-estimated, at least when we assume that the precautions above alluded to have been observed. A quantity slightly greater than the medicinal dose is often amply sufficient to produce the characteristic hypnotic effects, when the preliminary precaution of cleansing the rectum has been observed.

Owing to the variability of the effects produced by opium upon different persons, it is well to begin with small doses, until the idiosyncrasy of the individual has been ascertained.

Opium should be given about one hour before the usual supervention of the drowsy impulse, whether the latter take place early or late. Nothing is more foolish than to *suddenly* attempt to break the morbid

habitude by administering the drug many hours before drowsiness usually takes place.

In those cases, however, where the primary sleepy impulse occurs late at night, or only in the early hours of morning, the remedy may *gradually* be administered at an earlier hour from week to week, until the normal rhythm between brain-activity and brain-rest has been restored. To obtain this result, however, the physiological action of the remedy must be supplemented by an enlightened constitutional treatment; and what has already been said respecting chloral applies here with equal force.

Of late years the hypodermic administration of morphia is universally employed, owing to the convenience and certainty attending this method of medication. It is well to begin with one-sixth of a grain, and increase the dose as circumstances may require. All diligence should be employed to guard against the formation of the opium habit; and the employment of the remedy should only be continued for as long a time as is deemed absolutely necessary. Opium may be given in combination with tartar-emetic; and the action of the drug is often excellent when thus employed.

Digitalis should be employed in cases of cardiac trouble; as, in cases of insomnia accompanied by heart-complications, the best efforts of the physician should be directed to this paramount source of circulatory derangements before much can be hoped for.

Belladonna is indicated in certain forms of sleeplessness, where there is well-pronounced weakness of the heart. In such cases atropia may be given hypodermically. Where there are well-marked indications of cerebral congestion, however, it is usually not advisable to employ this remedy.

Alcohol is indicated in cases where there is well-marked cerebral anæmia, and its action under these circumstances is often most marvellous. Where, however, there is the slightest tendency to congestion, it should be avoided.

In those cases of cerebral anæmia where it is desired to employ the bromides, it will often be found excellent practice to administer alcohol in small doses, in order to counteract the specific effects of the bromides upon the cerebral circulation.

Where the patient is accustomed to the use of beer, the latter may be employed with good effect. Beer has even been recommended, on account of the sedative effects frequently obtained by its employment, in maniacal excitement and delirium.

Ergot is an excellent remedy in certain cases where sleeplessness is accompanied by congestive phenomena and diffuse headache. Squibb's fluid extract is the best preparation with which I am acquainted: it may be given in doses of ten drops or more three times a day. There has been considerable difference of opinion expressed respecting the reliability of this remedy; but, while it is doubtless not infallible in its effects, I have found it very useful in many instances.

IX.

BATHS.

WARM baths cause congestion of the capillaries of the surface of the body; but, when the effects of heat are withdrawn, contraction ensues (unless the bath has been followed by severe friction). Cold baths, on the contrary, first cause contraction of the capillaries of the surface; and this is followed by dilatation of the same, when re-action takes place. Warm baths cause elevation of the corporeal temperature, because they prevent radiation of heat, and because they also bring a supply of heat to the body. Warm baths are longer borne than cold baths. Whereas warm baths draw the blood to the surface, cold baths are eminently calculated to provoke congestion of the internal organs. Both warm and cold baths are probably provocative of an increased oxidation, and consequent waste of the tissues. But the warm bath makes less demands upon the system; for oxidation in this case is dependent on extraneous heat-supply. In the case of the cold bath, however, the contrary state of things prevails. The warm bath is much more adapted to the treatment of exhausted condi-

tions of the central nervous system than the cold bath. When employed in this connection, the warm bath increases the amount of available vital energy. The calming effects thus produced are probably the result of this relief to the system; but, to my own mind, there is not a single theory which satisfactorily explains the soporific effects of the warm bath.

Cold baths excite the bodily functions, but hot baths calm the same. In the treatment of anæmic persons the warm bath is usually preferable to the cold, for the reason that it taxes the resources of the system far less.

Tepid baths, from 85° to 95°, have a great influence upon the peripheral nerves, but affect the central nervous system very little. This bath may be employed for hours, as there is no after re-action.

Warm baths, from 95° to 105°, affect not only the periphery of the body, but their action is propagated thence to the central nervous system. The blood-flow to the surface of the body is somewhat increased, as is also the frequency of the pulse. These baths are followed by a certain degree of re-action.

Hot baths, ranging from 103° to 110°, affect the central nervous system to a much greater extent, and in a shorter space of time, than warm baths. The skin becomes rapidly congested; respiration and the frequency of the heart's action are considerably increased; inspiration is also deeper. These baths are usually followed by profuse perspiration.

Very hot baths, of a temperature of 110° and more, can only be borne for a short space of time. They cause a considerable rise in temperature, as well as violent cardiac reflex. The congestion of the skin is very great, and the subsequent perspiration excessive..

The warm bath is one of the most valuable agents which we possess for the treatment of sleeplessness. Without it, we should often be at a loss how to proceed. Where the constitution of the patient is feeble, and the effects of re-action are feared, a tepid or a warm bath of 98° is to be preferred. Under these circumstances, there is no objection to allowing the patient to remain in the bath for several hours. There is no reason, also, why a person should not be allowed to quietly fall asleep in such a bath; it only being necessary to take the precaution of passing a broad linen band over the chest and under the arm-pits, and to secure the same to a ring, or other stable object, in such a manner that it is impossible for the head of the bather to slip beneath the surface of the water.

Where no effects are obtainable by the employment of the tepid and warm bath, recourse may be had to a hot bath of a temperature of from 104° to 110°, provided the constitution and individual idiosyncrasy of the patient will admit. Where, however, there is any cardiac trouble, or great bodily weakness and anæmia, hot baths are contra-indicated.

The time to take all kinds of warm baths is at night, just previous to retiring. The baths should be followed by frictions and massage, where the manipulations do not tend to excite the patient; otherwise, the bather, having previously been thoroughly dried, should step at once into a well-warmed bed, when sleep will usually follow speedily. When this is not the case, resort may be had to the various therapeutic resources described under the head of internal remedies.

The hot bath is one of the most effective means of counteracting those periodic cerebral hyperæmias, accompanied by symptoms of profound mental depression. In these cases the bromides will also be found valuable auxiliaries to treatment. Frictions with a pair of hair mittens, and massage, are excellent expedients in these cases.

The Turkish bath is one of the most important adjuncts in the treatment of sleeplessness. It cannot be employed in all cases, however, as there are some persons who are totally unable to endure the high temperature and subsequent re-active effects. Nevertheless, this type of bath is well borne by a very large number of persons; and, where there is neither organic trouble of the heart nor great bodily debility, there is no especial danger to be apprehended from its employment. Sometimes cases of insomnia are met with where every kind of sedative has been employed without avail. These cases are

often very much benefited by the Turkish bath, in connection with general faradization.

The best time to take the Turkish bath, when employed in the treatment of insomnia, is in the afternoon ; and the patient should betake himself to bed directly after the bath, and remain there, if possible, during the entire night. Sometimes sleep does not supervene upon the use of the bath. Under such circumstances, there should be no hesitancy on the part of the physician in resorting to sedatives. This is all the more necessary where the type of sleeplessness resembles the insomnia which precedes insanity, and where it is absolutely necessary to obtain immediate sleep, cost what it may. The good effects of the Turkish bath are not by any means evanescent : on the contrary, they persist for a very considerable time after cessation of treatment. Respecting the number of baths to be prescribed weekly, much will depend upon the constitutional qualifications and individual idiosyncrasies of the patient.

The Turkish bath may be combined with frictions, massage, general faradization, and central galvanization. It may be used conjointly with various internal remedies, more particularly with chloral, hyoscyamus, and the bromides.

Hardly enough can be said in praise of the Turkish bath as a means of treating insomnia with congestive cerebral symptoms. Caution, however, should always be exercised in its employment, particularly

in certain cases of brain-exhaustion with anæmic accompaniments.

Vapor baths are valuable as purifiers of the skin, and are preferred by some persons to the Turkish bath. For the majority of cases of insomnia, however, the Turkish bath will be found preferable.

X.

ELECTRICITY.

AMONG the various agents employed in the treatment of functional nervous troubles, there is none which is deserving of more prominence than the electric current. This is particularly true of that form of insomnia which is accompanied by more or less well-marked congestive phenomena, as well as of that variety of decrepitude of the central nervous system known as brain-exhaustion. The effects of electricity upon the central nervous system are both *tonic* and *sedative* in their nature; and there is little doubt that a very decided influence is produced upon the function of nutrition. Hence the applicability of the constant current to the brain and spinal cord, where it is desired to influence the intricate processes of intraganglionic metamorphosis.

The method of central galvanization, as recommended by Drs. Beard and Rockwell, is a most efficacious means of influencing the cerebro-spinal axis. A detailed account of this procedure will be found

in the admirable work of these gentlemen on "The Medical and Surgical Uses of Electricity."

In applying the constant galvanic current to the cerebral hemispheres, I employ a broad, concave sponge-electrode, which covers the entire superior convexity of the skull. This electrode is provided with a chamber of metal or India rubber, which may be filled with hot or cold water, or with ice. In cases of cerebral congestion, ice may be employed; and the effects of refrigeration are added to those of the galvanic current. In cases of insomnia, accompanied by symptoms of local or general anæmia, the electrode may be filled with hot water; and the sedative effects obtained under these circumstances are often most excellent. The application of this instrument to the treatment of congestive headache has been illustrated by me in a former paper. This electrode is held in place by a strap which passes under the chin, and is secured by a buckle, and should be connected with the positive pole of the battery, as this is less irritating than the negative. The negative pole should be applied over the epigastrium. Owing to the extent of surface covered by the electrode, currents of considerable strength may be employed. In cases of sleeplessness with congestive accompaniments, this method of treatment may be employed while the patient remains in the warm or hot bath. The best time for the application is at night, just prior to retiring.

General faradization is one of the most powerful means which we possess of combating the morbid systemic conditions prevalent in sleeplessness. In certain cases the soporific effects are visible during the first stages of treatment, but in others no marked improvement takes place till after persistent and prolonged applications. Where the condition of sleeplessness is complicated by more or less depression, general faradization is most valuable. Sometimes the exhilarating effects of the treatment are visible after the first application ; but, whether this be the case or not, improvement in general nutrition usually takes place if the treatment be followed with the requisite amount of persistency. With the increase of bodily weight a very remarkable improvement in the mental condition is observable. The condition of depression gives place to one of contentment and even exhilaration, and by degrees the individual is brought into harmony with his environment. This transition from a pessimistic tendency of mind to one of healthy optimism is one of the very remarkable effects of general faradization.

Frequent attempts have been made to formulate a theory which should adequately explain these remarkable therapeutic effects of general faradization. To my own mind none of these speculations afford very much satisfaction. But the explanation of the phenomena is of far less importance than the fact now corroborated by very numerous observers, that

general faradization is one of the most powerful methods of influencing the nutritive processes of the central nervous system, and indeed of the whole body.

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