

explore one of these cysts, and almost immediately the contents of the tumour flooded the peritoneal sac, giving rise to intense pain. In my case, the cyst walls were very thin, and a blow might easily have caused a rupture and effusion of the contents into the connective tissue around, followed by inflammatory symptoms, possibly of an obscure or misleading character, like those in the case I have just quoted. Under such conditions a correct diagnosis could be made only by an exploration of the abdominal cavity, and this was certainly not justified under the circumstances described by Dr. Mackintosh.

The possibility that a tumour may be a pancreatic cyst would therefore appear to be a special reason for carefully considering whether it is practicable to cure it by surgical means and for making an exploratory incision at an early stage of the disease in cases of doubt.

Portman-street, W.

ON REST, SLEEP, AND WORK AND THE CONCOMITANT CHANGES IN THE CIRCULATION OF THE BLOOD.

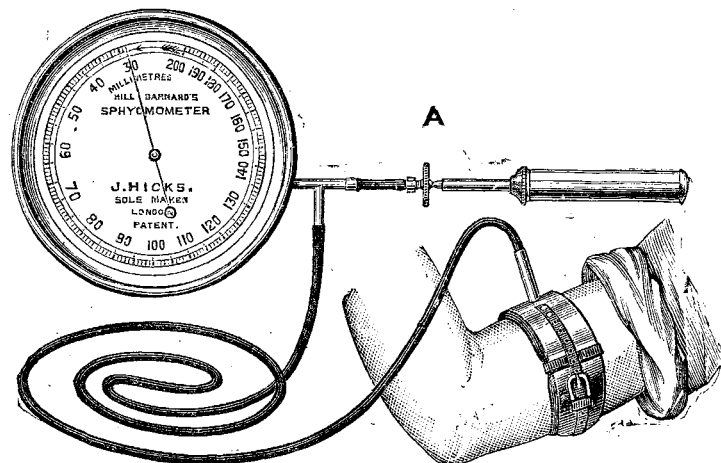
BY LEONARD HILL, M.B. LOND.,

LECTURER ON PHYSIOLOGY AT THE LONDON HOSPITAL.

IN a recent number of the *Journal of Experimental Medicine* Howell¹ has published some plethysmographic tracings. These tracings are of great interest since they were taken continuously during the whole period of a night's sleep. Preparing for the ordeal and to ensure the certainty of sleep overtaking him by previous late hours and hard muscular work he succeeded, in spite of the discomfort caused by enclosing his arm in the plethysmograph, in sleeping for some five hours. The tracings show that the arm expanded as sleep supervened reached the maximum of expansion in the course of the first hour or so and remained expanded throughout the whole period of sound sleep. It was only when the waking state was near that constriction of the limb became again evident. If, however, the awakening was partial and the professor, after a period of drowsiness, sank once more into sleep constriction failed to appear and the arm remained expanded. These experiments, confirming the previous records of Mosso,² prove that there is during sleep a determination of blood into the limbs. Taken in conjunction with the observations of Kennedy,³ Durham,⁴ Hughlings Jackson,⁵ Mosso, Hutchinson and Elder,⁶ and others on the cerebral circulation they support the conclusion that sleep is associated with a condition of cerebral anæmia. In children "during sleep the mean intracranial tension seems to be lessened, the fontanelle sinks and its pulse-wave is small." In adults with defects of the cranial wall the same observations have been repeatedly made. The pia mater and fundus oculi exhibit enlargement of the veins, arterial and capillary anæmia. Moreover, abundant evidence exists derived from experimental observations, which prove that sleep in animals is associated with cerebral anæmia. Tarchanoff's⁷ experiments on puppies may be specially mentioned. After trepanning the cranium he observed the condition of the pia mater both in the waking and sleeping state. Tarchanoff estimates that the arterial pressure in dogs falls from 30 to 50 mm. Hg during sleep. Regarding these well-established and striking facts Howell, like many others, is inclined to believe that sleep is caused primarily by the diminution of cerebral blood-supply which results from the relaxation of tone in the vaso-motor centre and the consequent fall of the arterial pressure. Fatigue of the vaso-motor centre is supposed to be induced by the constant in-streaming of sensory impulses during the day's activity. These impulses produce reflex pressor effects and keep up a constant excitement of the centre. When the centre is exhausted the tone of the blood-vessels relaxes, the arterial pressure falls, the brain becomes anæmic, and sleep ensues. I myself⁸ have maintained somewhat of a similar view. In

my book on "The Cerebral Circulation" it is stated that "the vaso-motor centre is the hub around which turns the wheels of a man's active mental life." I have shown that if the compensatory effect of the vaso-motor tone be deficient the blood is determined under the influence of gravity to the dependent parts and the circulation through the brain becomes in the erect posture deficient. My opinions were strengthened by those of George Oliver,⁹ who from the results of arteriometer measurements has concluded that the diameter of the radial artery is markedly diminished in the erect posture during fatigue.

Unfortunately the readings of the arteriometer are, as H. Barnard, J. H. Sequeira, and I¹⁰ have recently demonstrated, somewhat vitiated by the amount of distension of the venæ comites arteriæ radialis. If these veins be congested they may become larger than the radial artery. In such case the instrument does not give the true diameter of the artery. To gain further insight into this question I have been recently studying the effect of rest, sleep, and work on the arterial pressure. The observations have been made on healthy children and young adults by means of the Hill-Barnard sphygmometer. This instrument records with accuracy and is extremely simple and easy to use. By its means I have recorded my own arterial pressure hour



Hill-Barnard Sphygmometer.

by hour and from day to day. The instrument consists of: (1) a leathern armlet inside which is fastened a flaccid rubber bag; (2) a force-pump provided with an escape valve (A); and (3) a pressure gauge graduated in millimetres of mercury. In using the instrument the method is as follows: (1) the armlet is strapped firmly round the upper arm; the rubber bag is thus brought into close contact with the skin; (2) the exit tube of the rubber bag is connected by means of a T-tube with the pump and the pressure gauge; and (3) the pressure is raised within the rubber bag and gauge by means of the pump until the point is found where the index of the gauge exhibits the maximal cardiac pulsation. This point indicates the mean arterial tension. In taking the observations the right arm should be used as it gives the larger pulsation since in right-handed people the right brachial artery is the larger. The arm should be placed in a passive, half-extended position with the armlet in the same horizontal plane as the heart. The latter precaution is essential to avoid the hydrostatic effect of gravity which would otherwise introduce error into a series of comparative readings. When the mean pressure within and without the brachial artery is the same the wall of the artery is at the systole and diastole of the heart able to oscillate with the greatest freedom. Thus, theoretically, the maximal oscillation is an accurate index of the mean arterial tension. It is proved to be so by simultaneous records of arterial pressure being taken in the dog by means of the sphygmometer on the one hand and the mercurial manometer on the other hand. The instrument can in adults be applied, but not so well, to the leg just above the ankle or in children round the thigh. It is easy to determine by observations taken in subjects in the sitting position, both from the ankle and from the upper arm, that the arterial pressure in the former place is higher than in the latter by the height of the hydrostatic column of blood which separates the two points. This is an excellent proof of the accuracy of the instrument. The records taken by the sphygmometer in the waking and sleeping states prove that in the latter condition the arterial pressure falls very

¹ Howell: *Journal of Experimental Medicine*, vol. ii., 1897, p. 313.

² Mosso: *Ueber den Kreislauf im Gehirn*, 1881; *Die Temperatur des Gehirns*, 1894. ³ Kennedy: *Dublin Journal of Medical Science*, 1877.

⁴ Durham: *Guy's Hospital Reports*, vol. vi., 1860, p. 149.

⁵ Hughlings Jackson: *Medical Times and Gazette*, 1862.

⁶ Hutchinson and Elder: *Edinburgh Hospital Reports*, vol. iii., 1895, p. 280.

⁷ Tarchanoff: *Archives Italiennes de Biologie*, tome xxi., 1894, p. 318.

⁸ *Cerebral Circulation*, 1896, p. 148.

⁹ George Oliver: *Pulse Gauging*, 1895, p. 15-32.

¹⁰ L. Hill, Barnard, and Sequeira: *Journal of Physiology*, vol. xxi., 1897, p. 147.

decidedly. This is shown by the following typical result. At 11 A.M. when in full activity the pressure in one individual, when taken in the sitting posture, averages from 120 to 125 mm. Hg and the frequency of the heart beat 64. Asleep in bed at 11 P.M. the pressure averages from 90 to 95 mm. Hg and the pulse rate 60. At first sight it would appear that such result is confirmatory of the view that sleep is occasioned by cerebral anæmia, but on further examination it becomes evident that the fall of the arterial pressure is concomitant with sleep rather than that it is the cause of sleep. From personal observations made from hour to hour throughout the day it has become clear that the fall of arterial pressure is invariably associated with warmth and rest in the horizontal posture. Even in the sitting posture such a fall may occur given the conditions of rest and warmth. Moreover, when lying awake in the morning the fall of pressure is as great as when lying sleepy at night; that is to say, so long as the subject remains quiet and in the recumbent posture.

It is possible to sit working in the morning and to find one's pressure as low as it is registered to be when sitting overcome with sleepiness in the evening. The following results taken from typical days bear out these statements:—

Example I.

Time.	Condition.	Position of body.	Arterial pressure.	Pulse-rate.
			mm. Hg.	
7.0 A.M.	Awake, warm in bed.	Horizontal	95	62
7.3 A.M.	Sitting out on side of bed.	Sitting	108-110	64
7.5 A.M.	After walking a few steps.	Sitting	115-120	64
7.30 A.M.	Dressed; sitting quiet.	Sitting	105	64
11.45 A.M.	Working by fire.	Sitting	103	64
8.45 P.M.	Resting by fire; sleepy.	Sitting	103	64
10.30 P.M.	Warm and drowsy in bed.	Horizontal	95	64

Example II.

9.30 P.M.	Awake in bed.	Horizontal	108	60
11.0 P.M.	Sound asleep.	Horizontal	105	—

The arterial pressure, like the pulse-rate, is more affected by muscular activity than by any other cause except perhaps by mental excitement. That this is so is shown by the following observations:—

Example III., to indicate Result of Mental Excitement.

Time.	Condition.	Position of body.	Arterial pressure.	Pulse-rate.
			mm. Hg.	
1.30 P.M.	Before lunch; quiet.	Sitting	103-105	64
4.30 P.M.	Engaged in discussion and excited.	Sitting	130-140	84

Example IV., to illustrate Mental Quiet.

1.30 P.M.	Before lunch; quiet.	Sitting	103-105	64
4.45 P.M.	Quiet after mild exercise.	Sitting	103	74

Example V., to illustrate Mental Excitement.

3.40 P.M.	Reading an exciting book at a great rate.	itting	125	80
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Example VI., to illustrate Mental Quiet.

8.50 P.M. (following day).	Resting; talking quietly; unexcited.	Sitting	108	64
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Example VII., to illustrate Result of Muscular Activity.

11.0 A.M.	Reading; quiet.	Sitting	98	64
11.10 A.M.	After running 400 yards fast; panting.	Sitting	120-130	100
11.20 A.M.	Resting.	Sitting	110-115	100
11.30 A.M.	Resting.	Sitting	100-103	96
12.30 P.M.	Resting.	Sitting	90-95	80

After a short period of mild exertion, such as is caused by the act of standing up or lying down, the pulse-rate is accelerated momentarily by 10 or 15 beats. It rapidly returns to its former rate on resuming a position of rest. After a period of severe exertion the pulse-rate, as is well known, takes an hour or more to return to its normal rate. Example VII. shows how rapidly the pressure returns to its normal level. In twenty minutes this was accomplished whilst the pulse-rate was still high. Ultimately, as is always the case after muscular exertion, the pressure reaches a level lower than normal. As regards the normal activity of a working day, records taken from observations upon myself show that my tension in the morning is usually from 120 to 130 mm. Hg, while on a holiday it averages from 105 to 110 mm. Hg. On returning home in the evening after a hard day's work my tension at 6 P.M. is from 130 to 140 mm. Hg, while at the same time on a holiday it is from 115 to 120 mm. Hg. In the case of a mechanic, whose pressure is normally when at work at about 4 in the afternoon about 130 mm. Hg, after working all day long in fog and gas and feeling nervously strained I found that his tension had risen to from 140 to 145 mm. Hg. While the fall of arterial pressure is always concomitant with sleep the feeling of mental or bodily strain seems to be as constantly accompanied by high tension. Records have been made both by Mr. Soltau¹¹ and myself on the arterial pressure in individuals at intervals of a few minutes while they slowly sank into sleep. My wife has made similar observations on myself. No change of arterial pressure occurs; that is to say, the pressure is as low while the subject lies quiet and warm as when fast asleep. This being so it is not possible to ascribe the causation of sleep directly to the fall of pressure.

It may be at this stage useful to summarise the facts which are known concerning sleep. 1. *Respiration*.—(a) The number remains unaltered per minute; the movement becomes shallow and thoracic in type. (b) The amount of inspired air per minute is lessened by from half to two-thirds. (A man awake in bed inspired 5.6 litres per minute; asleep 1.75 litres per minute.¹²) (c) The output of CO₂ is diminished by from half to two-thirds. (A man resting and on moderate diet has a day's output of 533 grammes and a night's output of 395 grammes. A man on moderate diet doing nine hours work has a day's output of 856 grammes and a night's output of 353 grammes.¹³) 2. *Circulation*.—(a) The blood congests in the limbs; (b) the venous system is engorged; (c) the arterial pressure falls; (d) the pulse-rate diminishes; and (e) the velocity of blood-flow decreases. 3. *Temperature*. The temperature falls during the night. The production of heat is estimated to diminish by from half to two-thirds. 4. *Nervous system*.—(a) The blood-flow through the brain is diminished; (b) the acidity of the cortex decreases; (c) the excitability of consciousness to external stimuli steadily decreases during the first one to two hours of sound sleep, after that period the excitability rapidly becomes almost as great as it is towards the end of sleep;¹⁴ and (d) consciousness alone seems to be abrogated during sleep. The nerves and the special senses continue to transmit impulses and produce reflex movements. (Tarchanoff evoked reflexes from the lumbar cord of puppies as easily when asleep as awake. Any sense stimulus produces changes in the circulation of the sleeping man.)

It is obvious that the metabolism of the body is greatly reduced during sleep. This is only an extension of what happens during rest. From the recuperative effect of sleep it is clear that metabolism is greater than katabolism. In reference to these facts the more important mechanical theories which have been put forward concerning the origin of sleep may be examined.

1. *Chemical theories*.—(a) It has been held that sleep is owing to the collection of chemical fatigue products within the brain—e.g., lactic acid,¹⁵ poisonous alkaloid substances¹⁶; and (b) that exhaustion of the store of intra-molecular oxygen is followed by sleep.¹⁷ Consciousness has been supposed to depend on the atomic vibrations produced by the formation

¹¹ I am indebted for some of the observations on arterial pressure during sleep to the kindness of Mr. Harold Barnard and Mr. A. B. Soltau.

¹² Mosso: Archiv für Physiologie, 1878, p. 448.

¹³ Pettenkofer and Voit: Zeitschrift für Biologie, 1866, Band ii, S. 459. E. Smith: Philosophical Transactions, 1859, vol. cxlix., p. 715.

¹⁴ Kohlschütter: Zeitschrift für Rat. Medizin, 1863, 1869.

¹⁵ Preyer: Ueber die Ursache des Schlafes, 1897. Obersteiner: Allgemeine Zeitschrift für Psychologie, Band xxix., S. 224, 1872.

¹⁶ Errera: Sur le Mécanisme du Sommeil, Bruxelles, 1895.

¹⁷ Pflüger: Archiv für die gesammte Physiologie, Band x., S. 468, 1875.

of CO₂. Experiment fails to offer any support for these theories. Lactic acid when injected fails to produce sleep. It has been shown by Nabarro and myself¹⁸ that the consumption of O and the production of CO₂ in the brain is as compared with that in the muscles very small.

2. *That sleep is due to cerebral anæmia.*—This theory, based on the analogy between sleep and the conditions of anæsthesia or coma produced by cerebral anæmia, has been most widely accepted. A dog may be rendered stupid and somnolent by ligaturing all the cerebral arteries¹⁹ or by reducing the number of blood corpuscles to one-thirtieth of the normal—e.g., by bleeding and injecting serum in the place of blood withdrawn.²⁰ On the other hand, it has been shown in this paper by observations on arterial pressure that a fall of pressure is equally associated with bodily rest as with sleep. Howell himself found from the time he took up his position on the bed and attempted to sleep that the arm began to swell. Since the arterial pressure is as low when lying in bed in the waking state in the morning as in the sleepy state in the evening it is not just to ascribe the causation of sleep to the fall of arterial pressure. We might with as much reason ascribe sleep to the fall of temperature or to the diminution of the output of CO₂, both of which are equally concomitant either with rest or sleep. Moreover, the fall of pressure is by no means great enough to produce a state similar to that found on ligaturing the cerebral arteries. Normal sleep is neither coma nor syncope and the analogy between the three states is false. It must be borne in mind that the vaso-motor centre is made for the brain and not the brain for the vaso-motor centre. When the brain is excited to activity the arterial pressure is raised; when the brain is lulled to rest the arterial pressure falls. These changes in the circulation follow on the stimuli which arouse or soothe the brain, they are secondary to, not primary causes of, the cerebral activity. If the vaso-motor mechanism be damaged and the carotid arterial pressure is neither maintained during changes of posture nor does it respond to the needs of the brain, a pathological condition arises owing to the deficiency of the blood flowing through the brain. The cerebral circulation can, however, be enormously reduced before such a pathological condition is set up. Thus I have found frequently in dogs that no symptoms arise after ligaturing at one and the same time both carotid and both vertebral arteries. The collateral circulation through the anastomosis of the superior intercostal arteries with the anterior spinal artery has proved sufficient for the needs of the organ. Likewise in the monkey no symptoms arise after ligatures have been simultaneously applied to one carotid and one vertebral artery. It is of importance to remember that experimental and histological evidence has failed to demonstrate the existence of any cerebral vaso-motor nerves. It has been abundantly shown that the cerebral circulation passively follows every change in aortic and vena cava pressures.²¹ Sleep cannot therefore be caused by any local constriction of the cerebral blood-vessels. More than this the application of a hot bottle to the feet, which is supposed to cause a determination of blood from the brain, is experimentally found to produce no noteworthy effect on the arterial pressure. Similarly cold compresses applied to the head prevent the onset of fatigue, but are experimentally found to produce no effect on the cerebral circulation.²² The effects which result from these agencies are nervous and not vascular in origin. Similarly, no connexion is to be traced between the manifold cures for insomnia and the circulation. Thus insomnia may be equally well relieved by cold compresses to the head as by hot bottles to the feet. In most of us the horizontal position induces sleep, while others may when sitting up feel sleepy, but be cursed by insomnia the moment they betake themselves to bed. Babies are lulled to sleep by warmth—thus it is the habit of nurses to hold them, if wakeful, in front of the fire. Lord Monboddo, on the other hand, stripping himself naked, paced the room with the window open and then returned to his bed and to sleep.²³

The expansion of the limbs during rest and sleep is to be ascribed to very simple causes. The return of blood from the veins is normally maintained by (1) the compressive

action of the muscles; (2) the action of the respiratory pump; and (3) the constant change in the position of the limbs. Normally when the veins of a limb are examined they are found to be soft and not congested with blood. If, however, a limb be kept in one fixed posture the turgescence of the veins increases; this is markedly so if the limb be held for some minutes in the dependent position. In profound sleep the depth of the respiratory movement diminishes and the limbs remain flaccid and motionless; thus the venous return is impeded. At the same time owing to the cessation of external stimuli, the condition of warmth, and the horizontal posture the rate of the heart is lessened and vasodilatation occurs. As the waking state is neared the turgescence of the limbs is lessened owing to the increased tone of the muscles and to the restlessness of the sleeper. Each movement or deep respiration expresses the blood and produces a lessening in the volume of the arm. This is shown to be so by the examination of Howell's tracings. Since each movement of the body momentarily raises the vena cava pressure the brain is congested thereby, for the cerebral circulation passively follows every change in vena cava pressure. The flushing of the brain is secondary to the external stimuli which provoke the movements of the body, accelerate the heart, and increase the vaso-motor tone. At the same time these stimuli may awake the dormant consciousness. Carefully reviewing all the above facts we must, I think, conclude that the anæmia of the brain is caused by rest of the body and the cessation of powerful objective and subjective stimuli. It is the cessation of the latter that produces sleep.

It is to be remarked in reference to the analogy between the conditions of anæsthesia and sleep, which is often insisted upon, that while the administration of chloroform produces a pronounced fall of arterial pressure ether is followed by but a small fall and gas and oxygen by no fall whatever. Thus it is evident that it is not essential that the arterial pressure should fall in order to create a state of anæsthesia. These observations on anæsthesia have been taken by H. Barnard and myself by means of our sphygmometer.²⁴

3. The remaining theories of sleep are based on histological evidence. It is held possible that the nerve-cell processes or dendrites are contractile and by pulling themselves apart break the association pathways and so sleep ensues.²⁵ In support of this we have the recent but not by any means fully substantiated observations that the dendrites are thrown into beaded contractions in morphia narcosis. These contractions are compared to those produced by anaesthetics on the pseudopodia of rhizopods.²⁶ Ramon y Cajal²⁷ holds, on the other hand, that the neuroglia cells are contractile and as sleep supervenes they expand so as to interpose their branches as insulating material between the association dendrites. Against these theories may be placed the fact that consciousness alone is abrogated in sleep. The sense organs and the nerves remain awake and reflex movements are executed. The somnambulist may walk, balance himself on a roof, or cross a plank with precision; soldiers may sleep on the march and postillions on horseback. It is clear, then, the association of those dendrites which are necessary for the reception of stimuli and the transmission of complicated movements cannot be broken. Nobody can locate consciousness to any particular group of nerve cells. All the theories of sleep are equally confronted with the fact that in order to induce sleep—and, indeed, to induce it easily—it is only necessary that there should be fatigue of a very limited kind. Over bodily or mental fatigue is, in fact, often antagonistic. "A pedestrian may for some hours in succession plod along the road and be guiltless of anything like consecutive thinking, or the mathematician may for the same period be engrossed by figures and symbols and have the minimum of muscular exercise; each has earned his rest, and to both sleep may be equally sound and refreshing, but in each the activity of a large part of the brain has been kept comparatively in abeyance. Yet this too must be put to rest during sleep; our lives otherwise would be a constant dream."²⁸

Sleep can be produced by a repeated stimulation of one kind such as the sound of running water or the dull voice of

¹⁸ L. Hill and Nabarro: *Journal of Physiology*, 1895, vol. xviii, p. 218.

¹⁹ L. Hill: *Cerebral Circulation*, 1896, p. 137 et seq.

²⁰ Von Ott: *Archiv für Physiologie*, 1882, S. 123.

²¹ L. Hill, loc. cit., p. 73 et seq.

²² *Ibid.*, loc. cit., p. 67.

²³ Boswell's *Life of Johnson*, Ed. Birkbeck Hill, iii., p. 168.

²⁴ L. Hill and Barnard: *Brit. Med. Jour.*, 1897.

²⁵ Duval: *Comptes Rendus de la Société de Biologie*, 1895, p. 85.

²⁶ Demoor: *Archives de Biologie*, tome xiv., 1896. *Vervormte Allgemeine Physiologie*, 1897, p. 382.

²⁷ Ramon y Cajal: *Archiv für Anatomie*, 1895.

²⁸ Crippie: *The Intracranial Circulation*, 1891.

a monotonous lecturer. It cannot be fatigue products that produce the sleep of the medical student at a 9 o'clock lecture. Children are lulled to sleep by rhythmical rocking or patting, by the monotonous cradle chant. Wordsworth in his sonnet tells how he endeavours to woo sleep by thinking of

"A flock of sheep which leisurely pass by,
One after one; the sound of rain, and bees
Murmuring; the fall of rivers, winds, and seas,
Smooth fields, white sheets of water, and pure sky."

On the other hand sleep is hindered by very slight external causes, such as change of bed, absence of habitual surroundings, presence of unusual slight noises. Not only the monotony of external stimuli but the absence of stimuli is powerful to provoke sleep; thus in Strumpel's²⁹ famous case a patient, an anæsthetic individual, was sent to sleep when his eye and ear, his two remaining sense organs, were closed. Further than this we seem to possess the power of putting the brain into compulsory abeyance. "Indians have a wonderful faculty of going to sleep. They seem to shut themselves up at will with a snap like slamming down the lid of a box with a spring and they are fast asleep in a second." Many men of great intellectual power possess this same faculty—noticeably we may quote Lord Brougham and Shelley. Other men, like Johannes Müller, have only to take up the recumbent position to immediately fall asleep. It seems then that consciousness can be abrogated either by a repetition of monotonous stimulation or by the voluntary withdrawal from stimuli, objective and subjective. In the dullard to produce sleep it is only necessary to either withdraw all external stimuli or to harp on one. On the other hand, the over-excitable intellectual man is kept awake not only by the intensity of the present but by the recollection of the past. He attempts to woo sleep not only by withdrawing from external stimuli, but by monotonously reviewing over and over again some one memory picture. Thus Southey records: "I listened to the river and to the ticking of my watch; I thought of all sleepy sounds and of all soporific things—the flow of water, the humming of bees, the motion of a boat, the waving of a field of corn, the nodding of a mandarin's head on the chimney piece, a horse in a mill, the opera, Mr. Humdrum's conversations, Mr. Proser's poems, Mr. Laxative's speeches, Mr. Lengthy's sermons. I tried the device of my own childhood and fancied that the bed rushed with me round and round. At length Morpheus reminded me of Dr. Torpedo's Divinity lectures, where the voice, the manner, the matter, even the very atmosphere and the streaming candle light were all alike soporific; when he who, by strong effort, lifted up his head and forced open the reluctant eyes never failed to see all around him asleep. Lettices, cowslip wine, poppy syrup, mandragora, hop pillows, spider's web pills, and the whole tribe of narcotics, up to bang and the black draught would have failed—but this was irresistible; and thus, twenty years after date, I found benefit from having attended the course." Our bed and bedroom and other habitual surroundings all impel us to sleep. The slightest change is sufficient to inhibit its onset. Howell could with difficulty fall asleep with his arm in the plethysmograph. I myself am effectively hindered by the strapping on the armet of the sphygmometer. It is impossible to conceive that the monotonous repetition of a weak stimulus can either by exhausting intermolecular oxygen or by producing fatigue products within the brain produce sleep. It is equally difficult to believe that the influence of fatigue products if existent could be hindered by similar slight causes. At the same time there can be no doubt that fatigue does normally exhaust and predispose us for sleep. Moreover, fatigue must exhaust in some local way brain structure, for we daily fatigue ourselves by the contemplation of one subject and yet turn with fresh zeal to some entirely new form of mental activity. There is one fact that should not be lost sight of, that is the need of the bodily organs for rest. The heart, the respiration, the muscles of the eye, work on with greater activity whether we walk during the day or calculate. Sensations arising in these organs may help to produce fatigue of consciousness and lead us to seek rest. Consciousness may leap to life within the brain, but it is conditioned by sensations arising in every part of the body. If consciousness be a state of vibration produced in the atoms of brain structure by the impulses which stream in

from the senses it is possible to conceive that this particular state of vibration should be inhibited by either the withdrawal of stimuli or by the monotonous repetition of external or internal stimuli. But such speculations do not carry us far and the causation of sleep must still be regarded as metaphysical.

Frognaal, Hampstead, N.W.

SOME REMARKS ON RECTAL SURGERY.¹

BY THOMAS BRYANT, M.CH. R.U.I.,
F.R.C.S. ENG. & IREL.,

CONSULTING SURGEON TO GUY'S HOSPITAL; SURGEON EXTRAORDINARY
TO HER MAJESTY THE QUEEN.

By the death of a valued surgical friend and enthusiastic artist, Mr. P. Y. Gowlland, who after being a surgeon to the London Hospital found his life's work in a speciality, I have become through his widow the distributor of a large number of drawings of anal and rectal diseases which are not only of great artistic and surgical value but at the same time of rarity, for the nature of the speciality does not readily lend itself to pictorial representation and it was only by an enthusiastic surgeon with artistic tastes that such a subject could have been adequately illustrated. The best of the late Mr. Gowlland's drawings are now in the possession of the Royal College of Surgeons of England, where they will always be open to the inspection of the Members of the College; but many are still in my hands to be disposed of according to my discretion. The possession of these drawings has therefore induced me at the present time to write the following notes on anal and rectal diseases and to anticipate the intention I had formed of adding at some future date a chapter upon these important affections to those I have already published under the heading of "Gleanings from Surgical Practice," for with my late friend's drawings to illustrate the subject my remarks may be made more useful.

And first of all it must be asserted, and most dogmatically so, that anal and rectal surgery is not as a rule well treated by the bulk of the medical practitioners of this country, for by the public most anal troubles are diagnosed as "piles" and the practitioner, when consulted, is too apt to accept the diagnosis of his patient and to treat him or her without making any local examination by which alone a correct diagnosis of the case can be made and a line of treatment laid down which may be expected to be successful. Under such circumstances cases are too often allowed to drift and although trivial cases may get well by such a process some become serious and the bulk of them pass into a chronic condition, entailing much unnecessary suffering and often serious consequences. It need hardly be added that the practitioner in so acting is not doing his duty or his best for his patient. When therefore a patient experiences so much anal or rectal distress as to induce him or her to seek advice it should be the invariable rule of the practitioner consulted to make a local examination and this should be of such a character as to afford sufficient information to allow of the laying down of a rational treatment from which benefit can be anticipated.

An examination need be neither a painful nor a humiliating proceeding; it may always be conducted decently and should be so conducted. The position I prefer to place a patient in is on a bed or couch on the left side with the thighs flexed. In this position, with the patient's buttocks well separated, a good view of the anus and its surroundings can be obtained and much knowledge can be acquired by mere inspection. If the skin about the anus and anal fold is healthy pruritus as a local affection may be dismissed with other external local troubles; if the skin be inflamed or irritated local rectal trouble should be suspected. If the anus is patulous some prolapse of the rectum may be present and it will be at once seen whether the prolapsed tissue is simply mucous membrane, hæmorrhoidal or polypus structure. If there is redundant skin about the anus and it is loose the antecedent prolapse of some tissue is suggested, and if the redundant skin is oedematous or otherwise infiltrated the recent prolapse of hæmorrhoidal or other structure or some lower rectal

²⁹ Strumpel: Deutsches Archiv für Klinische Medizin, Band xxii.

¹ Read before the Medical Society of London, Monday, Jan. 24th, 1898.