severe, and Riley states that two or more inflicted on a man at one time might easily endanger his life. It may certainly be counted as dangerous as the scorpion and ought never to be provoked to try its power.

Chlorion cæruleum Drury. A handsome blue species with dusky wings. It occurs very frequently around

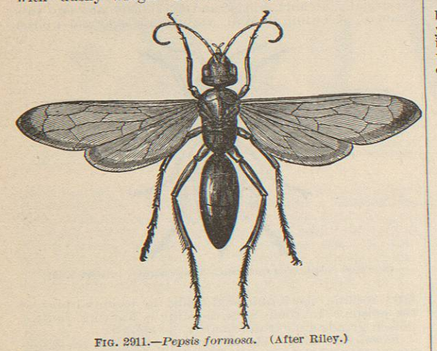

Fig. 2911.—*Pepsis formosa*. (After Riley.)

houses, seeking spiders which it captures, stings, and stores away in its nest for its young. Its sting, while not so severe as that of the preceding species, is by no means to be despised, and since it is a more frequent visitor in houses it is more likely to be incited to attack.

Sphex ichneumonea L. is a large species with brilliant golden markings. It frequents flowers and captures meadow katydids to store in its nests which are placed in gravelly walks or along roadsides where the ground is very hard.

Sphex pennsylvanica L. is another common species equalling the preceding in size, but of a brilliant blue-black color.

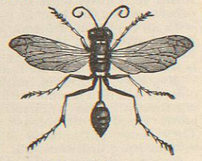

Fig. 2912.—*Pelopæus cementarius*. (After Riley.)

Pepsis formosa Say, "tarantula killer." A gigantic species, which occurs in the Southwestern part of the United States, where it is counted serviceable on account of its killing tarantulas, with which it provisions its nests. Its sting is very poisonous.

Pelopæus cementarius Drury, "mud dauber." A dark species, with yellow lunate spots and with a very slender petiole supporting a small abdomen. This species is very frequently noticed in houses, in attics, or even in much-used rooms, where it can gain access through some crack, and in barns, sheds, and tents. Its nest is constructed from pellets of mud, and the cells each containing a larva are stored with small spiders. They seldom molest people, even when passing very near them to reach the nest, but sting severely if provoked, and their presence is in itself annoying on account of the fear. There are many related species, some of which also build nests in houses.

Fig. 2913.—*Vespa maculata*. (After Riley.)

Vespidæ, paper wasps. Wings folding longitudinally when at rest; bodies rather robust, the abdomen attached by a short pedicel. All the species sting viciously when disturbed, and do not always wait for any serious provocation. Two species may serve as examples of the group.

Vespa maculata L., bald-faced hornet. A heavy-bodied species with light yellow, almost white face, and yellow spots on the thorax and abdomen. The large nest is built by degrees of a strong gray paper and contains, when fully formed, a number of combs one above another all enclosed within the large outer case. The

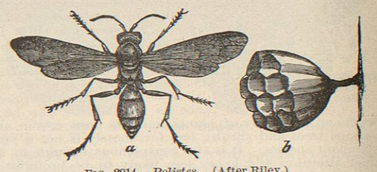

Fig. 2914.—*Polistes*. (After Riley.)

opening is at the lowest point and the whole nest is hung by a stout cord to a branch of a tree or the under side of a fence rail or other suitable support. If disturbed these hornets make a fierce attack on the intruder and a number of stings will cause pretty serious symptoms in the victim. Applications of ammonia, glycerin, bicarbonate of soda if made promptly will much relieve the swelling and inflammation.

The "yellow jackets," *Vespa vulgaris* L. and *V. germanica* F., are smaller, but similar in habit, and fully as vicious.

Polistes pallipes St. Farg. The more slender species included here also build paper nests, but only a single comb and this without any outer case; so the growing larvæ may be easily seen by any one with sufficient nerve carefully to inspect the nest. They are frequently built in houses in window frames and the wasps may become troublesome as the number increases and they grow irritable.

Apidæ, bees. Robust, usually hairy, the mouth parts with a long tongue adapted to lapping the nectar from flowers. This family includes the bumble bees and the honey bee as well as a large number of species less familiar. The sting is like that of the other *Aculeata*, and that of the honey bee may be noted as an example of the others. The principal parts are the three pieces of the normal ovipositor, the centre one of which constitutes a sharp lancet-like instrument. At its base is the large poison reservoir fed by the poison gland.

Fig. 2915.—Sting of Bee. Enlarged. *a*, Tip of lancet, still more enlarged. (After Gosse.)

Xylocopa virginica Drury, "carpenter bee." This species very much resembles a bumble bee, but has the abdomen polished and without hair. They bore into wood to construct nests and so may prove troublesome around houses, as their sting is very painful.

Bombus sps. The common bumble bees are very familiar objects, several different species occurring in almost any locality. They build nests in holes in the ground or, rarely, in deserted bird nests or other places at some distance above ground.

Apis mellifica, honey bee. The domesticated bee

now represented by several varieties. They are the most frequent source of stings since they are so commonly kept in the vicinity of houses. The sting affects different persons very differently, some suffering intensely from a single sting, while others suffer no inconvenience, after the temporary pain, from a number of stings. Inflammation, rapidly extending from a sting on the hand even so far as the length of the arm, and sometimes so as to close the eyes, may follow. Prompt application of ammonia, bicarbonate of soda, or even of moist clay will serve to give relief. *Herbert Osborn.*

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INSOLATION. See *Heat-Stroke*.

INSOMNIA is defined as the loss of the normal amount of sleep, and this involves a recognition of the fact that with different individuals different amounts of sleep constitute what is normal to each. Absolute loss of sleep is of much less frequent occurrence than the statements of patients would indicate. When such is the case, it is a *symptom* of serious import, and the statement impresses upon one the fact that as the absolute so also the minor degrees of this abnormality are to be regarded as symptoms. Often they are of great significance, but still rather as indications of the existence of morbid states, which it therefore becomes the duty of the practitioner to look for and treat, than as in themselves diseases which demand the direct application of remedies. In other words, the physician should not feel that he has done his duty by his patient in simply prescribing hypnotic drugs, though this may often be all the sufferer expects, but should search out the causes which underlie this symptom and endeavor to remove them and incidentally this one of their results. Of course there are many cases coming under our attention in which the chief object of treatment is the relief of the insomnia, in which, the habit of sleeplessness once broken up, we may expect the bodily functions to be restored and strength recovered; but he will probably achieve the best results who endeavors to ascertain the causes leading to the loss of sleep in each instance and to base his therapeutics upon a classification of such causes.

Recognizing that sleep is a normal and healthy function, it is quite in accord with the best traditions of medical science to endeavor to understand its mechanism and relation to other vital phenomena as a foundation for the study of its abnormalities; in other words, to make physiology the guide to pathology. It has proved, however, to be a difficult problem, and no conclusion seems to have been reached which is accepted as wholly satisfactory. The following statement by Professor Howells is an expression of recent views of an acknowledged authority. "We might therefore say that three factors combine to produce normal sleep. I. A diminution of irritability, caused by fatigue, of large portions of the cortical area. II. Voluntary withdrawal of sensory and mental stimuli involved in the preparations for sleep. III. A diminished blood supply to the brain, owing to a relaxation of tone in the vaso-motor centre and the fall of general arterial pressure thereby produced. The last factor is the immediate cause of sleep and explains its comparatively sudden and nearly simultaneous occurrence over the entire cortex."

As a foundation for a theory of therapeutics applied to insomnia, the view of a diminished blood supply to the brain as a feature of normal sleep has been very attractive, and many attempts have been made to explain the action of well-known hypnotics or to base new methods of combating the trouble upon the accepted or supposed action of such remedies in increasing or diminishing the blood supply of the brain. Such efforts have contributed to an intelligent study of the causes of insomnia, and analysis of the reasons why certain remedies succeed in certain cases, but have sometimes been less successful than their authors have expected, because the theories of the physiological causes of sleep have not been fully established (Granville, R. Ferguson). The former author adduces Bichat's view that general or complete sleep is the sum of the special sleeps or dormant states of the various faculties or senses, while Ferguson contends that hyperæmia is sometimes accompanied by sleep, which to be sure may not be very good, and likewise that anæmia leads to a sleep just as far from normal. Their arguments are against the routine use of soporifics. Insomnia as a symptom most constantly presenting itself for treatment, independently of medication demanded by the patient's other requirements, probably comes up most frequently before those whose practice is among the insane and patients with affections of the nervous system. It will be well to keep this in mind, in considering the classification of causes of insomnia, and their indications for treatment, for the general practitioner will find quite a different class of causes predominant in his daily experience from those met with by the asylum specialist.

A few words should be said on the results of insomnia. Manaceïne, for example, ascribes to the injurious effects of imperfect and broken sleep the interruption of the nutrition of the tissues. Duval says insomnia leads to emaciation and debility, and in sickness, when prolonged, is an unfavorable sign. Bulkley tells us of eczema appearing as a result of long-continued loss of sleep. These statements are of course quite apart from what might be said of insomnia as a precursor of insanity or cerebral disease.

Most writers on this subject give a grouping of the causes they recognize as predisposing to or directly inducing insomnia. Thus Tuke ranks among the predisposing causes the female sex, old age, nervous temperament, intellectual pursuits; while among exciting causes he mentions organic or functional diseases of the brain, worry, anxiety, grief and bodily pain, noise if not monotonous, fever, coffee, tea, etc. Sanger Brown divides insomnia into functional, symptomatic, and that of insanity, and states that neurasthenia is often sooner or later associated with the first of these. He also quotes Folsom as specifying the following causes or conditions of insomnia, viz.: habit, such reflex causes as indigestion and genito-urinary disorders, autotoxic causes, such as gout, lithæmia, syphilis, habitual constipation; then anæmia, vaso-motor changes, neurasthenia, hallucinations of sight or hearing, astigmatism, and the neurotic temperament. These brief quotations indicate in how many ways this question of etiology presents itself to different trained minds. Among them I find no more comprehensive and simple classification than that of Professor Bradbury in Allbutt's "System of Medicine." I cannot give it *in extenso*, but the following are its chief features: First, *Irritative Causes*, such as are due to pain and like uneasiness, comprising such various ones as teething in children, eye-strain, the irritation of an eczema, the discomforts often following a surgical operation, even when pain is absent, various affections of the respiratory organs, especially when accompanied by cough, acute inflammations of the serous membranes, many tumors and surgical diseases. Insomnia from many of these may involve other etiological factors, but *pain* is the predominant one and that which necessitates treatment.

Second, *Toxic Causes*. In many diseases a toxic agent is present in the blood. Such are alcoholism, the exanthemata, most of the zymotic diseases, dyspepsia and intestinal disorders, gout, Bright's disease. To these he adds, under this heading, heart disease and altered vascular conditions, though in them the insomnia may be

partly due to altered heart action and partly to a deficient blood supply. Certain drug habits, such as opium-eating and cocaïnism, also are included in this class.

Third, *Psychical Causes.* A nervous temperament, neurasthenia, hysteria, or hypochondriasis, often acts as a predisposing factor leading to a habit of insomnia. Grief, shock, worry, and mental anxiety are very frequent causes. The insomnia which occurs at the menopause is attributed partly to the accumulation in the blood of toxic products not eliminated by the catamenia. In cases of insanity, insomnia often appears both as a premonitory symptom and as a feature of the disease, also as a factor leading to its occurrence.

Fourth, *Causes Arising from Change in the Mode of Life.* Among the most noticeable in this class are changes in the time of the principal meal, changes in climate, especially to high altitudes, and such changes of occupation as nurses are liable to, from night to day duty.

Such considerations as the foregoing must be our guides in deciding upon treatment. The dermatologist, the pædiatrist, the surgeon, no less than the alienist, becomes familiar with those causes of insomnia which arise in his own specialty. The general practitioner must scan the whole field. In many instances, especially in acute disease accompanied by pain or fever, the treatment called for by the general requirements of the case will relieve the incidental insomnia without separate prescriptions for it. In fact the rule would be, in cases classed as symptomatic, to treat the main disease. A second most important principle of treatment is urged by C. K. Clarke when he says that drugs should be our last resort, after exhausting all accessory remedial agencies such as come under the head of hygiene, including matters of food and drink, exercise, bathing, ventilation, and habits of work. Sanger Brown also reminds us that drugs that abolish consciousness are not necessarily hypnotics. Still there is no safer rule for our guidance, especially in the irritative class, when pain is present, than to address our treatment primarily to its relief, and it is because opium in one form or another is still our great reliance as an anodyne that it is still considered a soporific, although its action is to engorge rather than unload the blood-vessels of the brain, and so far to antagonize the normal conditions of sleep.

Lack of space would forbid our taking up for detailed consideration all the therapeutic agencies to procure sleep, and there is the less need to do so inasmuch as they are mostly familiar remedies, with the exception of the more recently discovered chemical hypnotics, which still demand further impartial trial before they can be permanently classed. We must, therefore, refer our readers to the larger special essays on this subject, particularly to those of C. K. Clarke, E. P. Hurd, Sanger Brown, and Bradbury, in which full particulars are given. To these we may well add a few points which enforce the principles of treatment already enunciated and are of direct practical value.

As to electricity, Eskridge and Sanger Brown agree that its efficacy as a hypnotic is doubtful, but if used it should be in the form of a galvanic current of from 2 to 5 milliampères, which may be passed through the head for ten minutes or more, a large electrode being placed behind the ear. Trional has been so generally used, and with such confidence in its safety that we may make the following citations: R. Ferguson recommends that it be reserved for use in cases in which sleep may be well begun, but is liable to be broken off before the end of the night. It may be given at any time during the night, because its action is so prompt, as compared with that of sulphonal. Sanger Brown says that trional is not always safe even in small doses, which caution is enforced by a case reported by E. M. Thompson and by other reports published during the past year.

Discussing the management of insomnia in cardiac failure Alexander Morison says that we must attack the most evident cause in each case and then give the chosen drug in adequate doses. He values sulphonal most in cases in which emotional excitement is a prominent cause, and next to that opium, but sleep must be had.

As pointing to "the importance of anæmia of the brain for molecular inactivity and sleep," Fox claims almost certain success for the use of a long, narrow sinapism down the whole length of the spine; and the efficacy of Clarke's recommendation of a bath for twenty minutes at 104° F., with perhaps cold to the head in the insomnia of mania, evidently depends on the same principle. In addition to the works quoted, my readers will be glad to have their attention directed to the little volume of M. de Manaceïne, with its research into the physiology and pathology of sleep and a very extensive bibliography.

J. Haven Emerson.

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INTERCOSTAL NEURALGIA. See *Neuralgia.*

INTERMITTENT FEVER. See *Malarial Diseases.*

INTERTRIGO. See *Eczema.*

INTESTIN, bismuth naphtalin benzoate, is an intestinal antiseptic and astringent, which is given in dose of 0.5 to 1 gm. (gr. viij.–xv.) for dysentery, diarrhœa, and intestinal putrefaction.

W. A. Bastedo.

INTESTINAL MOVEMENTS.—The movements of the muscular walls of the intestine have a twofold purpose, since they serve in the first place to propel the food along as the processes of digestion and absorption take place and also aid those processes by intimately mixing the food with the digestive juices, and by bringing continually fresh portions in contact with the absorbing wall.

The muscular wall of the intestine is formed by two distinct coats separated by a thin layer of connective tissue in which ramifies the plexus of Auerbach, consisting of small ganglionated nodules of cells, from which pass strands of non-medullated nerve fibres, uniting the various ganglionated masses, and sending off terminal networks which ramify around the muscle fibres. The cells of the inner muscular coat are arranged circularly around the tube of the intestine, while those of the outer coat are arranged longitudinally, and there has been much dispute as to whether these contract synchronously or alternately. It appears most probable, however, from recent observations of Bayliss and Starling, that simultaneous contraction is the rule, and that the longitudinal fibres simply aid the circular fibres in evoking contraction of the lumen of the tube.

Two distinct types of movement occur in the intestine, namely, the true peristaltic wave of contraction, and the swaying or pendular movements, which are identical in rhythm with contractions of the wall taking place at a much more frequent rate than those concerned with true peristalsis. In addition to these a very pronounced and much more rapidly progressive wave has been observed under certain circumstances, such as exposure of the gut to cold, anæmia of the intestine, or presence of gaseous contents, to which the name of *vermicular* contraction has been given. Mall considers this a distinct type of intestinal wave, but according to Bayliss and Starling it is but a pathologically intensified form of that type of contraction which causes both the pendular movements and ordinary rhythmical contraction.

The velocity of the true peristaltic wave, of which the chief function is to move the food onward in the intestine, is very low, amounting only to about 2 cm. per second; so that in the cat it has been estimated that it would require about an hour and a half for this form of wave to travel from one end to the other of the intestine. The rate of progress is very regular, and, when the local nervous mechanism represented by Auerbach's plexus is in action, it passes only from above downward. But after the nerve cells of this plexus have been paralyzed by nicotine or cocaine, the contractions which are then purely myogenic pass equally, from a point directly stimulated, in either direction up or down the tube. This change in character after paralysis of the local nerve centres demonstrates that the normal true peristaltic wave is a local reflex, and the same, it is stated, can also be shown for the other more rapid type of rhythmical contraction which is connected with the pendular movements.

Mall has shown that the local reflex consists of a relaxation of the wall in front of the advancing wave in addition to the localized constriction which travels down the tube, and Bayliss and Starling, who have recently investigated the subject, confirm this view, and style this combination of a contraction wave preceded by a wave of relaxation, "the law of the intestine."

The purpose of this diphasic wave is almost self-evident: the wave of contraction at and behind the advancing mass of intestinal contents gives the propelling force which drives the mass slowly forward, while the relaxation wave in front makes the passage easy by widening the lumen of the portion of gut into which the mass is being pressed, and so diminishes the resistance to its progress.

That true peristalsis, when under the influence of the nerve cells of Auerbach's plexus, passes only in one direction is beautifully demonstrated by a procedure due to Mall, in which a loop of gut is resected, and then, in one experiment is replaced in normal position, and in another experiment is replaced in a reversed direction so that what was normally the upper end is afterward the lower end. In the first case, peristalsis remains normal and no obstruction occurs, but in the latter the waves pass from lower to upper end in the resected portion so that obstruction occurs when the food is other than of a thin fluid consistence.

It may here be pointed out that this local reflex forms an important distinction between the peristalsis of the œsophagus and that of the intestine. The difference is illustrated by the effects of completely severing transversely the muscular coats of the two tubes and then exciting a wave of contraction above the section of injury; when, in the case of the œsophagus, the peristaltic wave passes the point of severance as if no disunion existed and without any period of delay whatever, while in the case of the intestine the wave is completely stopped and does not appear at all in the lower segment of the gut.

The pendular or rhythmic movements are best seen when the peritoneal cavity is opened under a bath of warm saline. They recur fairly regularly with a rhythm often to thirteen per minute, and are caused by contraction waves which travel many times more rapidly than the true peristaltic waves, viz., at the rate of 2 to 5 cm. *per second*, as compared with 2 cm. *per minute* (*vide supra*).

It is only comparatively recently that physiologists have reached the conclusion that the pendular movements first noticed by Ludwig and the rapid rhythmical contractions of the wall arise from a common cause, viz., the simultaneous contraction of both circular and longitudinal muscular coats. When inspected by the eye alone the pendular movements which cause oscillating translatory movements of the loops of gut as a whole, backward and forward, are not apparently connected with any change in the cross section of the intestine. When, however, a distended rubber ball connected with a recording tambour is placed in the intestine it is at once obvious that a synchronous rhythmical change in volume of the intestine accompanies the swaying movements, further that any factors which influence the amplitude of one form of movement similarly and correspondingly alter the other, and that both become completely inhibited together by stimulation of the splanchnic nerves. There is hence little doubt that the older view, which attributed these pendular movements to the contractions of the longitudinal fibres only, is erroneous, and that they are merely an accompaniment of the rapid rhythmic contractions.

The purpose of these rapid rhythmic movements is not, as in the case of the true peristaltic waves, to force the food along the intestine. Digestion would be almost completely prevented by them, if they forced the food along at the rapid rate at which they travel, for the food would then traverse the entire intestine in a few minutes. Further, examination by means of the Roentgen rays of food to which subnitrate of bismuth has been added, as it is undergoing digestion in the small intestine, demonstrates that several hundreds of such waves may pass over a long mass of food without causing it to move downward in the slightest degree. Onward progress takes place at intervals only, when the quite distinct wave of true peristalsis sets the contents in translatory movement.

Although the intestinal movements are co-ordinated by the local nervous mechanism, control is exercised upon them by the central nervous system, chiefly through the vagi and splanchnic nerves. Various opinions have been expressed as to the action of the vagus, but the most careful experimentation upon the subject is that of Bayliss and Starling, who found that the effect obtained increased with successive stimulation, and that the most typical result obtained was an inhibition with a latent period of less than one second, followed by an augmentation in amplitude of the rhythmic contractions, which augmentation develops after an interval of from ten to thirty seconds and lasts for some considerable time after the cessation of the stimulus. Stimulation of the splanchnic nerve invariably causes diminution of the rhythmic movements and, when the stimulus is sufficiently strong, complete stoppage of the movement, which lasts for a few seconds after the stimulus is removed.

The Roentgen rays were first utilized for the study of the effect of the rhythmic movements on the intestinal contents by Grützner, who administered insoluble pellets containing nitrate of bismuth with the food, and found that these were chiefly rolled about from side to side of the intestinal tube in an oscillatory fashion by the rapid waves, while their progress along the intestine was very slow and inconstant, being sometimes for a short interval retrograde.

This method of studying the effects of the rhythmical contractions upon the intestinal contents has recently been improved by Cannon, who, instead of administering insoluble pellets containing the bismuth salt, has mixed the latter, to the extent of ten to thirty per cent. in fine powder, with the food. Cats were the animals experimented upon, and the food used was powdered salmon mixed as described above with subnitrate of bismuth (see also *Stomach, Shape, Position and Movements of*).

Cannon's experiments demonstrate that the most important result of the rapid rhythmic movements is the segmentation and resegmentation of the food many times repeated, with the result that the contents are intimately mixed with the digestive juices and that new surfaces are constantly exposed to the villous wall, by which means the process of absorption is enormously facilitated and hastened. A large mass is almost simultaneously divided into many minute segments, each segment is then again divided and the parts of adjacent segments are combined to form a new segment. This process is continuously repeated many hundred times, so that the contents are in this way most intimately mixed up with the digestive secretions.

Movements of the Large Intestine.—The movements of the large intestine have also been investigated by Cannon, using the method which has been indicated above in connection with the movements of the small intestine. He finds that the usual movement of the transverse and