THE CARE OF THE SEA-SICK

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"Is there any cure for sea-sickness?" The oft-heard question, with its emphasis on cure, suggests a pathological disorder. Whether the condition be rightly or wrongly regarded as abnormal, it becomes in certain circumstances the rule rather than the exception. In fact, given appropriate conditions as to range of movement, its character and duration, and other attendant circumstances, it is doubtful if more than five per cent. of unhabituated individuals will remain entirely free from disturbing effects.⁵ If we accept the definition of disease as a deviation from the normal average condition,¹⁵ it follows that liability to sea-sickness is the normal average condition and not a departure therefrom. It is a normal response to an abnormal environment. The relief and ultimate immunity which tend to occur with repetition are likewise part of the normal response.

Adaptation

In the novice the normal response to adequate stimuli is sea-sickness. There is a world of difference between this and the equally normal response to identical stimuli on the part of the seasoned sailor. The gap is bridged by that miracle wrought in the nervous system by the process of adaptation. This consists essentially in the development of a series of what Pavlov^{11 12} called conditioned responses, whereby new nerve paths and connexions are established. An important corollary is that whether the afferent stimuli initiating the reflex responses of sea-sickness be vestibular, visceral, or vasomotor, cerebral or cerebellar, or due to chemical changes in the blood, or to the interaction of endocrine glands, or to some obscure cause not yet dreamt of in our philosophy, the salutary process of adaptation remains fundamentally the same.

The establishment of immunity is Nature's cure, achieved by the multipotent *vis medicatrix naturae*; and to expedite this process is the single aim of rational treatment. The details vary according to whether or not the disturbing stimuli arising from the movement of the ship are, in the beginning of the process, of a degree to which the nervous system is physiologically indifferent. Adaptation to "indifferent" stimuli consists in the gradual development of a series of conditioned reflexes whose responses are of a positive kind; interference with the process may occur from extraneous stimuli having an inhibitory effect, but in the absence of such interference adaptation will develop imperceptibly and the patient will never know the misery of sea-sickness. On the other hand, if the initial stimuli are not "indifferent," the responses of the conditioned reflexes will have to be predominantly negative—that is, inhibitory; extraneous stimuli interfering with the establishment of the desired conditioned reflex will hinder the development of inhibition.

The strength of stimulus to which the nervous system is indifferent varies with the inborn character of the individual nervous system and the combined effect of countless external conditions, some of which may be favourable and others unfavourable to the development of the desired conditioned reflexes. It is also determined to some extent by the strength of preceding stimuli. A slow, imperceptible increase in strength of stimulus marks the royal road to immunity, which unfortunately is seldom open. Conversely, one sometimes witnesses a gale at sea when the wind winnows the susceptible like autumn leaves; next day the sea is relatively calm, and many

venture forth fully recovered, unaware that, but for yesterday's storm, to-day's swell would assuredly have laid them low.

Conditions of Adaptation

Whatever the strength of the initial stimulus, the establishment of any conditioned reflex is subject to four fundamental requirements:

- I. The simultaneous action of the conditioned stimulus and the unconditioned stimulus already established as the activator of the desired reflex.
- II. The exclusion of all extraneous stimuli capable of producing responses antagonistic to the action of the conditioned reflex which it is desired to establish.
- III. An optimum range of intensity of the conditioned stimulus.
- IV. A receptive state of the nervous system.

I

The first requisite, the simultaneous action of conditioned and unconditioned stimuli, may be summed up in the common-sense axiom that one cannot expect to get one's sea-legs by lying in bed. It provides one reason why sea-sickness is less common among the crew of a ship than among passengers. If the sufferer is able to go about, he should be encouraged to walk *with* his feet rather than merely *on* them. The consequent increase in the range and intensity of proprioceptive stimuli reinforces the conditioned stimulus.

II

Stimuli interfering with the development of a conditioned reflex by producing their own antagonistic responses may originate either (a) in the conflict of sense impressions brought about by unaccustomed movement, or (b) in purely extraneous sources.

(a) The brain of the sea-sick patient is a welter of conflicting perceptions. Those derived from the retinae and oculomotor muscles record the position and movements of the head in relation to its immediate surroundings. But perceptions from other receptors, particularly the labyrinths, are simultaneously registering the position and movements of the body in space relative to the direction of gravitational force—movements in which the immediate environment (the ship) itself participates. These two groups of sense perceptions are incompatible, each competing for the nervous path of appropriate response. (If the patient, in spite of difficulty in balancing, is fit to walk on deck, and is consciously determined to adapt himself to his turbulent surroundings, it will often be found that some measure of harmony can be restored to his discordant perceptions if he can be persuaded to concentrate all his attention on the horizon while walking, keeping a "blind spot" for the intervening waves. The horizon is the only constant feature in a bewildering medley of perpetually varying forces—the sole remaining guide to the direction of the pull of gravity. If he succeeds in fixing his gaze upon this datum line of stability, he will find that his legs are now guided by his eyes in co-operation, not competition, with his labyrinths. Not only is discord resolved, but the establishment of a highly complex conditioned reflex is thereby aided through the reinforcement of an unconditioned one.)

(b) The extrinsic group of hindrances to the development of conditioned responses includes an infinite variety of disturbing stimuli, such as the thundering of a stormy sea, the creak of straining beams, or the malodorous emanations from galley ventilators. The most demoralizing of all is probably the dire example of other sufferers who have abandoned themselves to unrestrained vomiting. Rough weather at sea usually implies closed port-holes, and consequently, even in the best-ventilated ships, some interference with movement and exchange of air. It

seems reasonable to suppose that concomitant low barometric pressure may also affect the unusually sensitive. The main reason for the relative immunity of the crew of a ship as compared with passengers is that continued occupation sets up a barrier against all such extraneous stimuli. The disturbance caused by extraneous stimuli is much greater if they find a ready outlet. The patient with a history of dyspepsia, for example, is often (but not always) predisposed to sea-sickness, even though there be but scanty evidence that the stomach plays any important part in the production of the disorder. Similar predisposition is shown in the frequency with which sea-sickness afflicts those who have been guilty of dietetic or other excesses incidental to farewell parties before sailing. Not only do intrusive external stimuli hinder the development of a conditioned reflex (especially one so complex as that of adaptation), but they may actually disrupt one that has been previously established. Even the most hardened sailor may find himself disturbed by rough weather if his resistance has been impaired by anxiety, fatigue, or ill-health.

Extraneous stimuli have the effect of interfering with inhibition. The outcome is sea-sickness. But unusually strong stimuli produce a paradoxical result; their interference strikes deeper, and affects, not the inhibitory process, but the underlying reflex itself. This may be illustrated by a personal experience, where a storm at sea produced widespread sea-sickness, but where at the first suspicion of real danger many victims lost all the despondency of sea-sickness in an ecstasy of hymn-singing.

III

The third essential for the development of a conditioned reflex is an optimum range of intensity of the conditioned stimulus. If the movements of the ship never exceed a certain minimum, no conditioned reflex can be established. Conversely, if they exceed a certain maximum, the cultivation of appropriate conditioned responses becomes increasingly difficult. In this connexion it should be remembered that different parts of a ship at sea are subjected simultaneously to movements differing in character and extent.

IV

The final requirement is a receptive state of the nervous system. This depends upon both mental and physical well-being. The importance of the mental state is so well known that the stolid person, whose intellectual vision is apt to be as restricted as his reflex responses, would dismiss the whole subject as "all a matter of nerves." It is beyond doubt that previous experience of sea-sickness is so damaging to the patient's self-confidence that sometimes the recollection alone is enough to induce malaise on a subsequent voyage. Even without this past experience many impressionable people embark with profound feelings of apprehension. One of the concepts which many of us acquire very early in life is the dread alliterative association between "sea" and "sickness." Even before the ancient Greeks spoke of *ναῦς*, a ship, and *ναυσία*, sickness, the two ideas must have been inseparably linked together.

In rough weather many of the sea-sick exhibit signs of an instinctive fear bursting the bonds of repression. The mental state is doubtless induced partly by the impact of conflicting groups of sense-impressions already described. Mental confusion and a sense of bewildered helplessness dominate the field of consciousness. The emotions are disturbed by an instinctive fear of, and revulsion against, a sense of instability which the unconditioned brain can neither foresee nor counteract. This psychic disturbance is in line with the tenets of the behaviourists—that the only two sources of inborn fear, as distinct from fear born

of experience, are sudden unexpected noises and loss of support. A disconcerting commotion is certainly a frequent accompaniment when "the Atlantic's level powers cleave themselves into chasms"; and a sense of inadequate support is a constant source of distress. Ever since the first Palaeolithic man ventured afloat in a hollow tree-trunk, *Homo sapiens* has been striving to adapt his reflexes to movement in three planes. But his sapient mind travels with more ease and comfort in four dimensions than his human body does in three. Amid all the luxury of a modern liner the sea-sick sufferer yearns for the reassuring stability of terra firma. Gonzalo in his anguish expressed the intensity of this craving when he "would give a thousand furlongs of sea for an acre of barren ground; long heath, brown furze, anything."

The physical causes acting on the nervous system to delay its normal function of establishing conditioned reflexes are innumerable. Pain, fatigue, and other subjective phenomena fit more precisely into the category of disturbing extraneous stimuli already discussed. Their sources will be disclosed in answer to the first question that ought to enter one's mind, which is: "Are the present symptoms due solely to sea-sickness?" As to other sources of interference, it may be stated as a general principle that an indispensable preliminary to any mode of treatment designed to encourage adaptation is detoxication. Digestive errors, a loaded colon, glycosuria, or ketosis (so common in sea-sickness that it has been mistaken for a cause) will, if overlooked, frustrate all efforts to establish tolerance. Furthermore, the routine use of nervous depressants, whether for prevention or for treatment, defeats its own object when that object is the establishment of lasting immunity rather than temporary oblivion. Certain qualifications of this statement will be explained presently.

Varieties of Response

Much ink has been spilt in dissertations concerning the mode of origin of sea-sickness. The present hypothesis—that the condition is a natural consequence of man's two-dimensional being, and that immunity is acquired through the natural processes of adaptation—makes the effect more important than the cause. The clinical phenomena of sea-sickness manifest themselves in an endless variety of combinations, all of which are explicable only as disorders of the autonomic nervous system. Pavlov has shown how such disorders may arise from the conflict of incompatible reflex responses, in which excitation competes with inhibition. The response of the subject to environmental forces depends upon the outcome of this conflict, and this in turn is determined largely by individual temperament. "Temperament" in this context may be defined as the tendency of the nervous system to respond to conflicting stimuli in a manner which distinguishes the individual (or, more precisely, one group of individuals) from others. The nature of the response varies apparently according to whether excitation or inhibition is the predominant tendency.

The parallel between this condition in the human subject and the reactions of Pavlov's dogs is too seductive to be resisted. It is well illustrated in the classical experiment in which dogs were trained (by the establishment of conditioned reflexes) to respond positively to a circle of light thrown on a screen, and negatively to an ellipse. This achievement of discrimination was brought about by the gradual development of appropriate inhibitions. It was found possible to cultivate more and more delicate powers of differentiation—up to a certain point. Beyond that, there occurred a sudden and complete breakdown of the whole carefully elaborated system of conditioned responses. The further behaviour of the animals

seemed to be determined by their natural differences in temperament. The lively excitable type of dog showed impairment, and even complete loss, of inhibition. The docile inactive dog, on the other hand, had its positive conditioned reflexes gradually weakened and finally abolished; inhibition prevailed throughout all its responses.

There seems little doubt that sea-sick subjects show a similar tendency to fall into groups according to natural differences in temperament. The restless emotional type has been aptly compared to the "choleric" and "sanguine" temperaments of Hippocrates. It has equal points of resemblance to the "sympatheticotonic" type of a later epoch. In marked contrast is the "vagotonic" type—inhibited, negative, where the other is active, positive. These clearly marked types, however, are extremes, and therefore exceptional; the majority of cases fall into countless intermediate groups.

A second factor in the determination of the type of individual response appears to be the suddenness or otherwise of the onset of disturbing stimuli. My experience suggests that when the disturbance arises suddenly it arouses responses which are predominantly vagotonic, whereas if it begins gradually, and is continued for a relatively long period, the responses tend to be sympatheticotonic. This observation also is made with the reservation that most cases are of a mixed type.

Differentiation of Types

The pith of the matter lies in the words of Bohec: *C'est qu'il n'y pas de mal de mer: il y a des maux de mer.* In shipboard practice it is not the extremes of vagotonia and sympatheticotonia that are commonly encountered, but a host of intermediate types. Since the maintenance of life itself depends upon a perpetual interplay of these two complementary forces, vagus and sympathetic, it follows that, however dominant the one may be, it can never entirely escape the influence of the other. The various *maux de mer* show the same diversity of range as the orange tints of the rainbow, which, however yellow, still have a shade of red in them, and yet can never be so red as to lose all their yellow.

The cognate problems of differentiation and treatment are complicated by (a) the simultaneous activation of both vagus and sympathetic; (b) the occasional involvement of only a portion of each; (c) the association of increased tone in one division of the autonomic nervous system with raised or lowered thresholds in the other¹⁴; (d) the fact that a case may at the outset incline towards one end of the vago-sympathetic scale, and ultimately lie definitely at the other. It is commonly early vagotonia which gives way later to sympatheticotonia. Kuntz⁷ points out that when both vagus and sympathetic are stimulated simultaneously the heart responds first to the vagus and later to the sympathetic. This is explained on the assumption that the vagus is the dominant factor, but more quickly fatigued than the sympathetic. (e) Finally, the effects of stimulation of autonomic nerves are modified by the preceding tonus of the muscles supplied. Both vagus and sympathetic have the effect of raising tone when it is low and depressing it when it is high; their mutual action is therefore not wholly antagonistic.⁷

Clinical Interpretation

A question of very practical importance is how clinical signs and symptoms are to be interpreted as indicating the state of the autonomic nervous system. Thompson¹⁴ has recently described a simple method of estimating threshold values in terms of response to physiological stimuli, a method which still awaits application to the problems of sea-sickness. In the estimation of *tone* values,

I believe that reasonably accurate differentiation may be achieved; first, by attention to detail in the patient's account of the onset of his illness and his description of symptoms; secondly, by the careful assessment of the relative importance of all symptoms and manifest signs, and their correlation to form a composite picture.

As to clinical history, it must be admitted that it is often difficult to turn the patient's mind back to the earliest dim beginnings of his indisposition. Premonitory symptoms may have been trivial and transient; now they are swamped and submerged in subconscious memory by a flood of greater suffering which seems to him neither trivial nor transient. The question whether he felt slightly dizzy before his headache began is to him the height of irrelevance now that nausea has him in its melancholy grip and he is "vexed with a morbid devil in his blood that veils the world with jaundice."

Some Generalizations

The precise interpretation of symptoms is scarcely less difficult. For the sake of brevity I have condensed the study of several hundred cases into the following generalizations, which further experience may modify. They are not to be mistaken for either invariable rules or haphazard guesses.

1. *Pulse Rate.*—This is the easiest and earliest guide to differentiation of types. With the patient recumbent, it will often be found to be 50 or less in vagotonics, while in sympatheticotonics it is rarely under 80.

2. *Blood Pressure.*—Hypopietics are slow in acquiring immunity, and when sea-sick exhibit marked vagotonia, with a further fall in blood pressure. Sympatheticotonics show a rise of blood pressure in sea-sickness. When the weather is rough, but not severe enough to provoke subjective symptoms, blood pressure changes occur in the direction characteristic of each type. (Under the same conditions slight changes are found also in those who appear to enjoy complete immunity.) The difficulties and fallacies of isolated sphygmomanometer readings may be to some extent avoided by reliance on a sign noted by Price¹⁵ as indicative of low blood pressure—namely, "an increase of the cardiac rate by more than ten per minute on standing after lying down." This is a very constant sign in vagotonia. But it must be interpreted with cautious reservations, because all the symptoms of sea-sickness are usually aggravated by standing and relieved by lying down. Irregular spurts of quickened pulse often coincide with waves of nausea and increased unsteadiness.

3. *Vertigo.*—Although this is a classical symptom in labyrinthine disturbances, whether due to disease or to rotation experiments, and bulks largely in textbook descriptions of sea-sickness, real vertigo is less common than is supposed. It is true that many patients complain of "dizziness," but it is difficult to get an accurate description of the sensations so described. What many suffer from is a confused sense of ocular imbalance, probably due to heterophoria and a conflict of sense perceptions. Others describe as "dizziness" symptoms which seem to originate in various forms and degrees of ataxia. The severer cases of (true) vertigo are vagotonic. In many sympatheticotonic patients it is not a primary symptom, but secondary to nausea and vomiting.

4. *Headache.*—Like vertigo, this is often an early symptom in vagotonia, but in sympatheticotonia it is more commonly a sequel to nausea and vomiting. Children and young adults rarely complain of it. Headache definitely associated with vertigo is likely to be of vagotonic origin, and may be occipital, vertical, or temporal. Frontal headache without marked vertigo is probably sympatheticotonic.

5. *Nausea and Vomiting.*—Although closely associated in sea-sickness, these symptoms are by no means inseparable.

able. Of 108 cases quoted by Maitland⁹ fifty-two suffered from nausea and vomiting; twenty-two had nausea without vomiting; thirty-four vomited without nausea. When both symptoms are present nausea almost always comes first; it may therefore be said that about 70 per cent. of cases of nausea are followed by vomiting and 30 per cent. are not. The extent to which vomiting relieves nausea is an important variant. The vagotonic often gives a history of vomiting on one occasion only or at long intervals. The act tends to be sudden and violent, not heralded by nausea or other aggravation of the general feeling of malaise. But the patient whose vomiting recurs frequently, although it brings little or no respite from nausea, is likely to be predominantly sympatheticotonic. It is usually taken for granted that the sea-sick person will not want to smoke. To the sympatheticotonic patient the very thought of tobacco is nauseating. Yet in stormy weather I have known sufferers from headache, vague "dizziness," malaise, and impaired appetite who could still find solace in a cigarette. These were doubtless extreme vagotonics, less liable to be disturbed by the pylorospasm generally attributed to tobacco.

6. *Lethargy*.—Sleep has an important bearing, so far unexplained, upon the problems of sea-sickness. It often has a strikingly recuperative virtue, the generalized inhibition which accompanies it favouring in some way the restoration of autonomic balance. This effect is not limited to the period of sleep, but usually continues for some time afterwards. Drowsiness, apathy, and occasionally mental hebetude without actual somnolence, are signs of vagotonia. The sympatheticotonic will often complain of broken, restless sleep, disturbed by dreams.

Treatment

When the ship's movement constitutes a stimulus to which the nervous system of the unhabituated individual is not indifferent, the adjustments involved are largely inhibitory. Sea-sickness results from failure of adjustment; recovery consists in the establishment of appropriate conditioned responses. It is a familiar observation, not confined to the study of sea-sickness, that the placid temperament (vagotonic) yields more readily than the excitable (sympatheticotonic) to the development of inhibitions. The profound lethargy of mind and body exhibited by sea-sick vagotonics suggests that inhibition in them is excessive, whereas in the sympatheticotonics it is plainly deficient. Thus the problem of treatment resolves itself into the encouragement of appropriate inhibitory responses.

Excessive Inhibition

Excessive inhibition may be attacked from one or both of two directions—by (1) depressing the inhibitory forces, or (2) stimulating the processes of excitation.

(1) The depressant action of the alkaloids of belladonna on the parasympathetic system is well known. There is still some controversy as to whether atropine or hyoscine is the more efficacious, or whether they are not in fact fundamentally identical. I have found the tincture of belladonna better than either of these alkaloids, which are best reserved for cases where the stomach rejects fluids of every kind. A recent authority⁶ states that "twenty minims of the tincture may be given three times a day without toxic effect and with relief of sea-sickness." I have usually found that if no definite relief follows a dose of thirty minims, spread over four hours, the patient will respond better to other treatment. When vomiting is readily provoked, a useful method of inhibiting the vagus is sublingual application of three or four drops of a 1 per cent. solution of atropine sulphate, which is equivalent to the now unofficial liquor atropinae sulphatis. It is rapidly absorbed, does nothing

to excite vomiting, and is quicker and more convenient than hypodermic injection. Suppositories containing hyoscine—for example, "vasano"—are also valuable.

(2) In the early stages of vagotonic sea-sickness there is undoubted value in stimulants such as strychnine or caffeine either medicinally or as strong tea or coffee. The effect of adrenaline is too transitory to be of much help. Ephedrine is useful in prophylaxis, especially combined with atropine, but I have not yet been persuaded of its curative value. Vigorous exercise, preferably in the fresh air and in the form of some deck game which offers distraction as well, has saved the self-respect of many a wavering vagotonic.

It is in these cases that the routine use of cerebral depressants is to be deprecated. The patient needs every encouragement to strenuous exertion in order to overcome his inhibitory tendencies. Vagotonics, even when frankly sea-sick, derive marked benefit from eating a little—greater benefit than is to be explained by the nutritive value of what they eat. Therefore nothing should be given which impairs appetite or digestion. (There are few greater offenders in this respect than the ever-popular chloretone.) Finally, if there is any drug which the vagotonic, usually lethargic to the point of somnolence, does not need and should not have, it is a hypnotic. His widespread inhibitions call for correction, not encouragement.

It is variously estimated that vagotonia is more common than sympatheticotonia. I have certainly found it more common among men, especially those who have been long at sea without acquiring immunity. But sympatheticotonia is more common among women and children. (Although infants, having not yet grown to orientation, are immune, I have not found the absolute immunity among older children that is commonly attributed to them. If the disturbing movement begins early in the voyage they are no less susceptible than the average adult; but given a favourable environment, away from sea-sick relatives, they become adapted with amazing rapidity.) The idea of vagotonic prevalence may arise from the fact that long before the description of vagosympathetic states (by Eppinger and Hess in 1910) belladonna and its alkaloids were used empirically in the treatment of sea-sickness. But there is no panacea to be found in "all the drowsy syrups of the world," or even all the alkaloids of belladonna. As recently as 1929 Pace,¹⁰ using the total alkaloids in twenty-eight cases of persistent vomiting and seventy-seven cases less grave, claimed successful results in all. He treated seventy-nine cases prophylactically, reporting only two failures. This makes 182 successes out of 184, or 98.9 per cent. But the problem is not so simple as these figures suggest. Although atropine in ordinary therapeutic doses is a specific vagal depressant, its pharmacological action is by no means confined to depression of the parasympathetic system. It has recently been shown³ that small doses (up to 0.25 mg., or 1/240 grain) have a stimulant action on both the sympathetic and, to an even greater degree, the parasympathetic. Conversely, large doses (to which tolerance can be rapidly acquired) paralyse both sympathetic and parasympathetic. When the vomiting of sea-sickness has been arrested by "persevering" with atropine until all gastro-intestinal activity has been abolished, the patient's mouth and tongue are parched, his throat too dry to swallow, and his field of vision a confused blur, the last state of that man is worse than the first. These cases are not true vagotonics.

Deficient Inhibition

The treatment of the excitable (sympatheticotonic), subject is in essence the reverse of that of the vagotonic. Inhibitory responses have to be developed and encouraged

in every possible way. Inadequacy of inhibition may be countered by (1) depression of sympathetic activity, (2) stimulation of the parasympathetic, or (3) a judicious combination of both methods.

(1) Depression of Sympathetic Activity

It is here that sedative drugs are of the greatest value. If the patient's type can be surmised before sailing, sedatives are doubly useful as a form of pre-medication to prepare him or her for the ordeal of the voyage, which is commonly approached with all the uneasy qualms of a patient prepared for the operating table. *Chloretone*, in the proprietary "mothersill," ranks high in popularity. It has been vaunted as a specific sedative for the vomiting centre.⁴ It is true that it often arrests vomiting, but in many of these cases nausea remains unrelieved, so that the patient feels (and is) no better. *Chloretone* should be used as an adjuvant to other remedies, and reserved for cases where vomiting is excessive.

In the absence of severe vomiting *alcohol* in various forms produces some transitory indifference to unpleasant movement. Brandy, gin-and-bitters, and champagne are the three favourites, but the choice is largely a matter of personal taste.

The *barbiturates* are useful and usually well tolerated, but some of them have an unsavoury reputation for toxicity. In sea-sick but otherwise apparently healthy sympathetotonic persons I have used veronal, luminal, gardenal, medinal, sodium amytal, somnosal, and nembutal, with satisfactory results. McLaughlin⁵ has reported favourably on the value of nembutal in seventy cases. He classified them according to whether the dominant symptom was headache (fifteen cases) or vomiting (fifty-five cases). The second group gave the better results; 88 per cent. are stated to have improved. It is a reasonable assumption that the first group, in whom headache was more prominent than vomiting, were vagotonic, and therefore not suitable cases for this treatment.

One serious disadvantage applies to most hypnotics in the treatment of sea-sickness: the benefits to the patient last only as long as the action of the drug, whereas natural sleep has a distinctly restorative effect. This objection applies rarely, if ever, to *bromides*, which are among the most reliable of all sedatives in sea-sickness. Pavlov found bromides to have a specific selective action upon the cerebral cells involved in his experimental dogs. Thus, when inhibition had been experimentally impaired, rectal administration of bromide not only led to restoration, but caused the conditioned responses to be even stronger than before. There is some doubt nowadays concerning the superiority claimed for triple bromides over equal doses of a single salt. In either form the drug is an invaluable sheet-anchor in stormy weather. Its favourable action on inhibition is usefully reinforced by prescribing half-hourly doses (amounting to 40 to 60 grains in four hours) and emphasizing the importance of punctuality in repetition. An attitude of vigilance so produced helps to distract the patient's attention from distressing subjective symptoms; but even more benefit comes from the frequent and regular (that is to say, monotonous) repetition of a stimulus, which Pavlov showed to be one of the surest ways of developing inhibition.

Even in the most obstinate cases bromides seldom fail if combined with chloral hydrate. Many highly excitable patients absorb *bromide* and *chloral* more quickly and surely by rectum than by mouth. It has been found that bromides have no effect on decerebrate animals, on whom chloral hydrate acts as well as on normal animals, or even better; presumably bromides act

upon the cortex, and chloral on the thalamus and/or brain-stem. This would explain their synergistic action, chloral favouring inhibition by obstructing extraneous stimuli, bromides by slowing down reflex activity.

It seems superfluous to add that all efforts at sedation must be reinforced by the careful exclusion of all disturbing (positive) stimuli which tend to interfere with the (negative) process of inhibition. But it is just in this respect that many efforts lead to failure and disappointment. Auxiliary measures include protection, for a time at least, from every visual, auditory, or other stimulus that it is possible to exclude.

Even when all efforts to check vomiting are fruitless, sedative treatment brings a certain degree of amnesia, so that the patient after recovery can contemplate the return voyage with fewer misgivings.

(2) Stimulation of the Parasympathetic System

This is often a more satisfactory method of overcoming sympathicotonia. Even the most excitable patient will in time become exhausted by repeated vomiting. It then becomes desirable to have some other weapon in one's armoury than varying degrees of narcosis.

Pilocarpine is often effective in doses of 1/8 to 1/6 grain hypodermically, provided that none of the usual contraindications are present. It is doubly useful if given early. In functional derangements such as seasickness it is always difficult to assess the true value of hypodermic medication. The needle is a potent vehicle of suggestion. But *pilocarpine* by the mouth, combined with bromide, and given in half-hourly doses amounting to as much as 1/4 grain in four hours, is not only well tolerated but wholly beneficial, with no unpleasant after-effects. I have similarly used ergotinine citrate, ergotamine tartrate ("femergin"), physostigmine and its isomer "prostigmin," but so far have not found any of them superior to *pilocarpine*, or so well borne by the stomach.

The most rational parasympathetic stimulant is *acetylcholine*. Dale² has shown that this is identical with a chemical substance produced in muscular tissue in response to stimulation of parasympathetic nerves. It is thus a specific vagal hormone, bearing the same relation to the parasympathetic system as adrenaline does to the sympathetic. It reduces blood pressure and slows the pulse. It is useless given orally, reputedly dangerous intravenously, and must therefore be administered hypodermically. ("Mecholyl," or acetyl-beta-methylcholine chloride, is said to be equally efficacious by the mouth, but at the moment of writing is not available for trial in sea-sickness.) Despite the mischievous influence of suggestion, a blessing to the patient but a curse to the detached observer, I have satisfied myself that *acetylcholine*, especially in conjunction with oral bromide and chloral, is of outstanding value in certain cases of seasickness. It seldom fails to relieve headache, and nausea often disappears in a very gratifying way. Patients have reported that it abolished their sensations of vague abdominal discomfort, symptoms which are very constantly present, even in the absence of recognizable nausea. Its specific value, in appropriate cases, is indicated by the restoration of that feeling of well-being which is noticed only by its absence, and the loss of which is the first hint the patient gets that all is not well with him.

(3) Combination of Both Methods

The most important single fact in sea-sickness is that nearly all cases are "amphotonic," combining both vagotonic and sympathetotonic elements. It therefore follows that the best hope of success in treatment lies in

a prudent combination of remedies suited to both extremes, particular attention being paid to that which predominates at the time. It must also be remembered that prolonged sea-sickness sometimes presents a kaleidoscopic picture which changes from day to day; and previous knowledge of a patient, even in sea-sickness, is not always a sure guide to the nature of his future responses. He may be taken unawares by his first attack, presenting a typically vagotonic picture; next time, under apparently identical conditions, excitement and apprehension so act upon his nervous system as to determine an equally characteristic sympathicotonic response.

Attempts have recently been made to meet the need for combined attack on both vagus and sympathetic by the introduction of compound preparations, such as "bellergal" (Sandoz), which contains belladonna alkaloids, ergotamine, and luminal. The simultaneous administration of belladonna and ergotamine is theoretically sound, but there are grave practical objections which must apply to any stock remedy combining two or more potent drugs with different (though not strictly antagonistic) actions. It must be remembered, when we speak of vagotonia and sympathicotonia, that fundamentally these are, in their extremes, pharmacological concepts rather than clinical entities, having been based originally on the effects of artificial stimulation or depression by drugs with a selective action, such as adrenaline (a sympathetic excitant), atropine (a parasympathetic depressant), physostigmine, pilocarpine, and ergotamine (sympathetic depressants). The term "sympathicotonia" implies undue sensitiveness to adrenaline, or to any other substance, condition, or circumstance having a positive action on the sympathetic system. It is evident that this includes belladonna and its alkaloids, which weaken the compensatory effect of the parasympathetic. Therefore in sea-sickness the sympathicotonic requires very much less belladonna and more ergotamine, just as the parasympathicotonic requires less ergotamine and more belladonna, than can ever be found in any combination devised for use in all cases.

Furthermore, the addition of luminal is questionable for two reasons: (1) Of most vagotonics it can be said that if a small dose of luminal does them no harm it certainly does them no good. (2) Individual tolerance in my experience varies more with luminal than with either belladonna or ergotamine. Luminal and its congeners are a popular form of self-medication among many Atlantic travellers, and I have encountered various degrees of addiction. Many of these could have got no cerebral sedative effect from "bellergal" until they were on the verge of alkaloidal poisoning. A still graver objection arises in the case of the patient not habituated to luminal if his symptoms and signs show pronounced vagotonia or sympathicotonia. "Bellergal" contains bellafoline 0.1 mg. and ergotamine tartrate 0.3 mg. to 20 mg. of luminal. Now, there are many vagotonics who require in one day as much belladonna alkaloid as is "balanced" (sic) in "bellergal" by 3 or 4 grains of luminal. The sympathicotonic who takes enough ergotamine to give him a chance of relief is in equal danger of becoming completely narcotized. The same practical difficulties apply to "cafinal compound" (Bayer), in which are assembled (1) luminal, (2) caffeine, (3) scopolamine, (4) ephedrine, (5) papaverine, (6) atropine, and (7) strychnine. Such a complex preparation cannot be expected to provide the best possible treatment save in the very rare case which shows neither symptoms nor signs that can be classified as either vagotonic or sympathicotonic, and where the patient's responses to the various alkaloids are balanced with the most incredible exactitude.

The well-worn aphorism that we are treating not diseases but patients is as apt in this context as in any

other. The wise physician, after a careful study of the clinical picture presented by his patient, sets out to treat sea-sickness with a pocketful of diverse remedies, which he will blend according to his judgement. Although it is a favourite gibe that the multiplicity of remedies proves the futility of them all, this cannot be truly said of sea-sickness, for the very evident reason that there is no single, invariable cause, but a large and very variable combination of causes. It is only chance (by which we mean a concatenation of circumstances which we can neither foresee nor explain) that determines which of these manifold combinations will play the leading part. Therefore a panacea against sea-sickness is but an idle fantasy.

Summary

Sea-sickness is a normal reflex response to disturbing stimuli. Immunity consists in the development of appropriate conditioned reflex responses. It is as natural for the novice to be sea-sick in stormy weather as for the toddler to stumble or the inexperienced golfer to fizzle his drive. In all three cases the reason is that the necessary conditioned reflexes have not yet been established. The effects of the disturbance are manifested in various degrees of autonomic imbalance. The care of the sea-sick consists in (1) careful attention to all the circumstances influencing the development of conditioned reflexes, and (2) evaluating in each case the relative preponderance of sympathetic and parasympathetic elements, aiming at the restoration of normal balance by a judicious combination of sedation and stimulation.

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A meeting of the court of directors of the Society for Relief of Widows and Orphans of Medical Men was held on October 7th, with the president, Mr. V. Warren Low, in the chair. Nine new members were elected, and the deaths of three were reported; also the death of a widow in receipt of grant whose late husband became a life-member in July, 1921, on payment of £26 5s. He died in June, 1922, when his widow and two orphans came on the funds, and received £1,390 in all from the society. Relief is only granted to the widows and orphans of deceased members. Membership is open to any medical man who, at the time of his election, is resident within a twenty-mile radius of Charing Cross. Three widows of deceased members applied for relief; one, 77 years of age, was voted a yearly grant of £75, and the two others, being under 65, were voted £60 a year each. The sum of £630 was voted as a Christmas present, each widow to receive £10 and each orphan £5. The directors desire to bring to the notice of young medical men and the newly married the advantages of joining the society, which in 1938 will have been in existence 150 years. The annual subscription for a member under 35 at the time of election is two guineas; if over 35 but under 45, three guineas; and over 45, four guineas. There are special terms for life membership. The secretary will forward full particulars on application at the offices of the society, 11, Chandos Street, Cavendish Square, W.1.