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FLATULENCE AND SHOCK

CROOKSHANK

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BY

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PREFACE

I HAVE been asked that these two papers should be printed, rather, I suspect, for the sake of the bibliography—such as it is—than for any other reason. Still, I confess to surprise at the interest that has been evoked, and have been almost startled at the really large number of isolated facts, bearing on the subjects discussed, that have been brought to one's notice. Thus Dr. Spilsbury, who tells me that he has not always found the cœliac axis degenerate when there has been pretty widespread arterio-sclerosis, says that nevertheless in such cases there is often marked hypertrophy of the muscular coat of the vessel. The relevancy of this point to the suggestion of spasm and excessive adrenalism is obvious. In respect of the second paper, during discussion both Sir John Tweedy and Dr. F. J. Smith narrated some cases that were very *à propos*, and I have heard since of many others. Mr. Roland Burrows, himself a lawyer, raised the interesting point whether indeed the neurasthenia of twentieth-century males may not be a consequence of "repression," and whether the emotional displays of our eighteenth-century heroes and statesmen—who lived in shocking times—may not have been physiologically justified. Such suggestions give an even wider significance to the Freudian doctrines.

The comments of the anæsthetists are very interesting.

The declaration by not a few that "surgical shock" is very often a matter of overdeep anæsthesia seems based on sound clinical observation, and should be correlated with Verworn's masterly elucidation of the phenomena of narcosis.

Again, it is impossible to ignore the theoretical importance of the marked success that Dr. H. M. Page and others have enjoyed with the prolonged administration of nitrous oxide

gas and oxygen. It has been suggested that this method of producing anæsthesia not only avoids the paralyzing effect on the oxygen-carriers, postulated by Verworn, but has something to do with checking the loss of carbonic acid gas, which, whether by the lungs or from the open abdomen, is the essential factor in the production of acapnia.

Certainly Embley, whose paper in the *Australian Medical Journal*, for August 17, 1912, deserves careful study, recognizes respiratory depression under anæsthesia as connected with loss of carbonic acid gas. He finds shock to be less when nitrous oxide and oxygen are given with ether by the closed method than otherwise; and commends the therapeutic administration of carbonic acid gas itself when the respiration is depressed under chloroform or open ether.

In the *Lancet* for October 26, 1912, there is given, on p. 1167, an account of a case of "intestinal obstruction, the result of abdominal injury," in which, at the necropsy, no relevant lesion was found. There are also valuable references to Nothnagel's Encyclopædia, and to a case reported by Drs. Kempe and Browne, wherein the early meteorism and constipation passed off, to return later and necessitate laparotomy. In the same issue of the *Lancet* there is a letter from Dr. Donald Hood, which is deeply interesting. Dr. Hood insists that we are apt to overlook the fact that, in many cases, the maximum effect of arterial disease is purely local.

F. G. C.

53, Welbeck Street, W.
October, 1912.

FLATULENCE*

THERE is a line in Horace which has been translated, though with doubtful accuracy, " It is difficult to speak with propriety of common things." Jack Wilkes, as all who care for Boswell know, illustrated this notion by referring to the embarrassment of a poet laureate who should describe her most Gracious Majesty Queen Caroline as engaged in washing teacups. Alike, too, was the difficulty which tradition in Mortlake tells us was felt by a worthy local physician, called to attend that august lady, when in residence at Kew and suffering from what charwomen call the " windy spasms." How to devise a signature to his prescription, at once respectful to his sovereign and yet likely to be understood by the local apothecary, gave him pause. It is said that in the upshot the appropriate carminative draught was ordered to be taken " quum Regina habet ventum." This may not be true ; but I have some diffidence in commending the vulgar subject of flatulence to you. Yet it is one of great practical importance and no little theoretical interest. Occasion is not always adequately met by the perfunctory exhibition of Mist. Carminativa ; and, though in Casualty one may be able successfully to fob off a vexatious patient, yet, in private practice, one who is suffering torments has little satisfaction if his doctor deems him a neurotic nuisance, and, like Dogberry, thanks God when rid of a pestilent knave.

Should we ask point-blank whence comes the gas eructated in flatulence, or distending the abdomen in cases of meteorism, the answer usually is, " From fermentation." If we press, it may be admitted that, certainly, there are also some " neurotic " cases. But to label the condition of one in distress either " neurotic " or " functional " does not carry us far ;

* A paper read before the Medical Society of St. Mary's Hospital, London, October 23, 1912.

and so others take refuge in saying that the gas is really swallowed air, though surgeons who have experience of ileus know full well that this will not do. They, as a rule, frankly admit that there is at work some influence that has not yet been " precised."

Physicians are somewhat less candid.

In cases of chronic gastric dilatation without organic obstruction at the pylorus, there is, of course, a definite formation of lactic and butyric acids, with evolution of carbonic acid and hydrogen. It is accepted that these processes are the result of microbic fermentation, and also that, when yeast is present, the alcoholic and acetic fermentations may proceed with like evolution of gas. It is also seemingly true that, when certain articles of food have been ingested, sulphuretted hydrogen is produced in the bowels, or more rarely in the stomach ; and that when leguminous foods containing much cellulose have been eaten, marsh gas and hydrogen are evolved on a quite extensive scale.

As you know, those who concern themselves with the disorders of children have lately been at pains to distinguish between the putrefactive and the fermentative organisms, associating the former with decomposition of proteid food, and the latter with that of carbohydrates ; recognizing, moreover, the putrefactive process as inhibitory of the fermentative. So that one has to be a little careful in the use of words. But, speaking broadly, we admit a group of cases in which there is production of gas in the stomach and bowels as a result of disintegrative processes due to microbic activity. Sometimes there is gross error in diet ; sometimes there is special importation of special organisms ; but in any case an atonic condition of the digestive organs is present, and considerable delay in the passage of food from the stomach, so that the organ becomes dilated. There is a vicious circle ; atony and deficient juices favour fermentation ; gas production distends the stomach and sets up dilatation. And the gas that is eructated is, as the patient will say, neither odourless nor flavourless. It may even be inflammable.

But there are the cases, not so easily disposed of, where neither yeast nor the *Bacillus butyricus* occurs in the stomach contents, and, rather curiously, even lactic acid is not always present. Such cases fall into two groups : one called " neurotic," with which I am most concerned ; and another, that

I will call "dietetic." In the first the gas is almost always odourless and flavourless; in the second the odour or flavour is that of the food that has been taken. In neither is there odour or flavour suggestive of fermentative or putrefactive bye-products. How many of us, normally eupeptic, do not sometimes suffer after a meal, perhaps a little more hearty than usual, and into which certain articles of diet have entered disparately, from some temporary distension and eructation, that does not recur if the cause of offence be avoided? Is it credible that such flatulence is due to a special microbic infection, and fermentation of the stomach contents? Of course, if dietetic irregularities continue, if the stomach begin to weaken, if the teeth be carious and the gums suppurate, a bacterial decomposition may be superimposed; but I speak of the ordinary flatulence that occurs when potatoes, peas, or beans are taken in relative excess, and which may be disposed of by a single belch. What is the source of the gas? Not bacterial activity; for there is no culture that will produce any volume of gas in the course of half an hour. Indeed, ordinary stomach contents may be kept for hours *in vitro* before gas formation takes place. It is likely that the mechanism which is at work in purely "neurotic" cases has something here also to do, though not preponderatingly; but I wish to point out that, just as cases in the first group are admittedly benefited by antiseptics and by mineral acids, though not relieved by the administration of alkalies, so those in this "dietetic" group are not notably helped by antiseptics as such—are certainly not helped, as a rule, by acids and pepsin—but are relieved by the administration of alkalies after meals. They are sometimes called "acid dyspepsias." But you do not find butyric acid in the stomach contents, although you feel you ought to; and, indeed, one is almost inclined to say that some of these cases of acid dyspepsia are so called rather because they are relieved by post-prandial alkalies than for any other reason. It has seemed to me that these occasional flatulences following dietetic indiscretion are connected, not with actual hypersecretion of hydrochloric acid, but rather with what one may call "relative hyperchlorhydria." That is to say, the normal combination of the hydrochloric acid with the albumin does not occur; and an interesting point is that Hoppe-Seyler long ago declared the evolution of hydrogen and of marsh gas from food containing cellulose to be aug-

mented by the presence of hydrochloric acid, the very substance that is lacking in the fermentations of chronically dilated stomachs. At any rate, it seems, from the purely clinical point of view, that in these occasional flatulencies which are not simply neurotic, and which are, with equal certainty, not due to the *B. butyricus*—which are relieved by post-prandial alkalies, and which may be "cured" by attention to diet—there is some derangement of the normal mechanism of digestion that is not yet manifest. I would suggest that opportunity be taken to examine carefully the stomach contents, both gaseous and liquid, in some of these cases of "dietetic flatulence" that, at the risk of repetition, I say do not fall either into the purely neurotic category or in that where there is definite dilatation and retention. It is possible that the explanation is chemical rather than bacteriological; perhaps enzymosis is involved.

Concerning the complex group of flatulencies in which the "neurotic" or "nervous" element is generally admitted, the experience of physicians seems curiously unequal. Yet one clinical value they have in common: they are not appreciably relieved by alkalies, or always by dieting. Antiseptics and lavage are seldom of avail.

Some cases are in the old, others in the young; some in sober men, others in silly girls; some of the patients are normally eupeptic, others habitually dyspeptic; a few of them have organic disease, others are sound. Some cases occur after shock, others after operation, or during convalescence from acute specifics, and, very curiously, not a few during pneumonia. Many either have, or afterwards develop, acute duodenal or pyloric ulcer.

Sometimes there is great distension of the abdomen, and death ensues. But the common denominator is eructation, or, as some would say, the seeming eructation of odourless and flavourless gas. The first attack may be sudden and of great violence. Sometimes there is a spell that lasts for a day or two, but without return. Sometimes the eructation or quasi-eructation continues, almost without intermission, for days at a time. Sometimes it is periodic or recurrent. Sometimes it is associated with migraine. Sometimes it follows an accident, or may be reckoned a part of traumatic neurasthenia. Sometimes it seems to stand in relationship with tea or tobacco. Sometimes it follows "mental shock."

And, though I do not wish to spend time on the cases of meteorism and tympanites that are seen in surgical wards, it is obvious that there is an intimate relation between gas in the bowels and gas in the stomach. Indeed, the amazing thing is that this " neurotic flatulence," or these forms of neurotic flatulence (if I may use the phrase without begging any question), occur under so many different circumstances that probably none but those whose experience has been promiscuous appreciate its significance. It is only thus I can explain the diverse views held by those whose experience, great in particular directions, has yet been curiously restricted in others. Those who have once lost a patient by death, after a hasty diagnosis of " air-swallowing," are a little chary of prognosis ever after. Those who have themselves suffered (and to them I extend my sincere sympathy) know how difficult it is to obtain really helpful advice. The subject stands in need of elucidation, and there are two ways in which we may attack it. One is to group cases according to their clinical associations ; the other, to clarify our notions as to the sources of the gas that distends the stomach, or is eructated, or seemingly eructated, and then to connote our conclusions with the various clinical associations. Now, of the two kinds of explanation put forward, one suggests that the gas is produced in the stomach (or bowels) ; the other, that only air is swallowed or spuriously eructated. To me it seems that there is some force in both explanations—that they are not necessarily and always opposed.

You will agree that when, to take an extreme case, a fasting person drinks a cup of tea, and within a few minutes is in such distress from abdominal swelling that he loosens his clothes and pants for breath, while eructation sets in and continues for hours, all notion of microbic fermentation must be discarded. Nor can sudden fermentation explain the belching of gas that may terminate a bout of angina pectoris. I do not say that mixed cases never occur, but for the moment we must set the microbic fermentations on one side. So, too, must we set on one side the dietetic flatulencies relieved by alkalies, in which some chemical process may be at work. We must concentrate on those in which the so-called " nervous " spasmodic, hysterical, paralytic, or emotional element predominates.

It does not follow, because we dismiss both the microbic

and the chemical hypotheses, that we are bound to fall back on the notion that the eructated gas is either air that has been swallowed, or only seemingly swallowed. We have an alternative: that the gas is produced in the stomach, but by a process of actual secretion. This is the doctrine of pneumatosis: unfashionable nowadays, though old. The classic reference is in that lecture on dyspepsia wherein Graves tells us how, in 1823, he read an essay before the King and Queen's College of Physicians, in which he pointed out the "true source of the acidity and flatulence observed in dyspepsia, and proved, contrary to the accepted opinions, that it was the result of a morbid secretion." In fact, he says: "I showed that the stomach has the power, when in health, of secreting acids and air, essentially necessary for the solution of the alimentary mass, and proved that, in dyspepsia, this power is morbidly deranged in such a manner as to give rise to a supersecretion of acids and air."

It must be acknowledged that, though Graves believed the normal and effective acidity of the stomach to be due to lactic acid (and not to hydrochloric, as now affirmed), he clearly recognized what we did not till lately know—that many gastric disorders are due to hypersecretion of the normal acid of the gastric juice. I hesitate to hint it, but are we quite certain that the traces of lactic acid sometimes found in the contents of healthy stomachs are no indication that lactic acid may be an accessory factor in normal digestion? The absence of lactic acid in hyperchlorhydria rather suggests that we ought not always to look on lactic acid as a morbid constituent of stomach contents, like pus or blood. At any rate, we all know that sour milk may be a very present help in time of hyperchlorhydria. This is, however, a digression.

Trousseau adopted Graves's theory of pneumatosis. He said: "Flatulent dyspepsia is characterized by the secretion in excessive quantity of the gases which are normally developed in the intestinal canal. Immediately after the ingestion of food these gases are produced, more or less abundantly, in the stomach and intestines, which they distend; and this distension leads to such increase in size of the abdomen as obliges the patients to loosen their clothes. An attempt has been made to explain this phenomenon by supposing that there takes place a rapid fermentation of the

ingested feculent substances; that there is a production of carbonic acid gas, the result of a fermentation in the intestinal digestive canal exactly similar to that which occurs in a wine-maker's mash-tub. Matters do not, however, proceed after that fashion. As Graves remarked, persons subject to flatulence have gas developed in the intestinal canal with almost equal rapidity, whether they eat food that they can ferment or whether they confine themselves to almost exclusively animal aliment. In the latter case, one cannot say that there has been fermentation. That some gas is always produced from the alimentary mass during digestion is, however, a fact which is certain; but the principal source of the gas is secretion from the alimentary canal. A proof that this secretion is independent of the coction of the elements is afforded by the fact that an hysterical woman will sometimes become tympanitic in ten minutes. Under our very eyes and hands we see and feel the abdomen attain a great size. Consequently the formation of gas is the result of disturbance of the nervous system, an increased secretion taking place in exactly the same way that there is, under similar influence, an increased secretion of tears, saliva, or urine."

Furthermore, " this flatulence may occur when the stomach is empty," and " while measures prescribed on the fermentation notion are useless, baths, cold effusions, and ether are all useful."

If one may speak with any disrespect of such giants as Graves and Trousseau, it is obvious that, whatever we think of the notion of gas secretion, both attempted to prove too much. Yet it is interesting to note that by implication Trousseau recognized three kinds of cases in which flatulence may arise—those in which there is fermentation, those in which there is excessive gas-forming during " coction," and the " nervous " or " secretory " cases. Trousseau's first group corresponds to that in which we now admit microbic fermentation. The cases of excessive gas formation during coction may be identified with those I have called " dietetic "; the third group is that which I have called " nervous."

It is interesting to note, by the way, that Grayson has suggested recently that gas is, as Trousseau and Graves believed, produced normally during digestion.

But the epoch that succeeded Trousseau's was a materialistic one: it was that of the great German chemists and biologists

—of Liebig and of others—and the notion of normal or abnormal secretion of gas under nervous influences was dropped. Well, the great era of "fermentation," and, later, of bacterial action, set in; and if any poor clinician hinted that there were patients whose cases were not thus to be explained, he was told that such were wretched hysterics. As time went on, however, it was felt by a few that this attitude of Podsnappery was hardly just, and the doctrine of aerophagy was revived. Now, the doctrine of aerophagy lays it down that the distension is due to air that has been swallowed, and is eructated on occasion; or, in the alternative, as the lawyers say, that there is no distension, and the air is not really swallowed, but is gulped backwards and forwards in the throat. Of this doctrine Dr. Wyllie of Edinburgh is an able exponent, and a discussion of his views is imperative. But for myself, I do assert that there is, in a good many cases, actual pneumatosis, or secretion of gas from the stomach. That the practice of aerophagy in some form or another exists is true, but sometimes it is a habit induced by the presence of gas in the stomach, and sometimes it is purely mimetic. In explaining this phenomenon of flatulence we have not to pin our faith to fermentation, or to gas secretion, or to aerophagy as a sufficient explanation of all cases, but to distinguish the degrees in which each of these processes may obtain. Yet, just as Graves went to one extreme in ascribing all flatulencies to secretion, and the great chemists went to the other in saying all worth notice are due to fermentation, so Dr. Wyllie goes too far in suggesting that, whenever air swallowing or gulping occurs, no gas is being produced in the stomach.

Some may think the notion of air secretion fantastic; but let us see on what basis it may rest before we consider Dr. Wyllie's views.

My interest in the subject dates back to conversations of years ago with Dr. Muir Evans, of Lowestoft, who used to express his disbelief that cases of sudden tympanitic distension could be due to either fermentation or to air swallowing. He has made some valuable investigations, to which I will presently refer; but what has chiefly struck me is his reference, in support of the idea that gas can be secreted from the stomach wall, to the swimming-bladder of fishes. Now, this point cuts the ground from beneath the feet of those hard-headed persons who, *a priori*, deny the possibility of gas

secretion. Gas *exchange* is, of course, admittedly physiological. Now, although in some fishes the swimming-bladder is used as a lung, in many of the Teleostei its function is that of a float ; and it is provided with a mechanism whereby gas is produced by secretion, and not by mere diffusion. This secretion of gas has been shown by experiment to be controlled by branches of the vagus and sympathetic nerves " in an exactly similar fashion to the secretion of saliva in a salivary gland." Moreover, the swimming-bladder, whether homologous with the lung, as some believe, or not, arises in Teleostei as a diverticulum of the gut wall, and is supplied with blood, not from the aortic arches, but from branches of the dorsal aorta. Its blood-supply, then—and the point is not without relevance—corresponds with that of the human stomach.

It might be thought that the question whether the eructations of " neurotic " patients are secreted gas or swallowed air could be immediately settled by analysis. But this is not so, for the gaseous contents of what may be thought a normal stomach are equivalent to atmospheric air in which the oxygen is entirely replaced by carbonic acid ; so that even those who, like Dr. Wyllie, hesitate to admit that in health or disease the stomach wall can secrete gas, are compelled to acknowledge that at any rate the stomach can exchange carbonic acid for oxygen. Dr. Evans, who has made many analyses, maintains that some of the nitrogen in normal stomach gas, as well as in nervous eructations, is given off from the blood, and that some of the carbonic acid may be secreted otherwise than in mere exchange. He has certainly shown that we have no right to assume that the nitrogen is derived directly from the air, since, in the sound of the codfish, this gas occurs in the proportion of 85 per cent. or so by volume, without any question of its production otherwise than by secretion. I am not concerned to labour the details of gas analysis, for since Dr. Hutchison admits that the hypothesis of gas secretion from the stomach is not disproven, and I can find no other that is adequate, I am inclined to think that the weight of evidence is in its favour. The ultimate mechanism of this gas secretion is another point on which two American physicians—Drs. Woodgate and Graham—have, I believe, done some experimental work, though I have not, as yet, been able to obtain any complete account. But, before passing to this and a

consideration of the doctrines of aerophagy, some brief citations from current textbooks that will serve to show the dearth of leading that we have on the subject may not be without interest.

Sir William Osler does not discuss the general significance of flatulence, but, using the words "nervous eructations" and "aerophagia" as synonymous, says that the "hysterical nature of the affection is sometimes testified to by the occurrence of several cases in a household." Surely one might as well say that epilepsy or chorea is hysterical because mimetic cases occur in a household. But he goes on to declare: "The expelled gas in these cases is atmospheric air, swallowed or aspirated from without. Sometimes the whole process may be clearly observed, but in other instances *the act of swallowing may be almost or quite imperceptible.*"

Sir Lauder Brunton exhibits all the resource of the Scots minister who, when confronted with a difficult text, looked it boldly in the face, and passed on. He does, however, say that sometimes a little air is swallowed with food.

Sir Clifford Allbutt toys gracefully, as is his wont, with the topic, and exhibits all his literary charm and command of peregrinate phraseology. But he is a little elusive. He admits that with tremendous gusts of wind there may be no obvious distension; he seems to agree that there may be—at least, in hysterical subjects—some source of wind other than decomposition of food. He says it is possible that wind may be poured into the alimentary canal from its own walls. But he will neither aver nor deny that this may be an explanation of the strange phenomena sometimes occurring "when a hard-working and sensible professional man will wake in the small hours and belch forth wind boisterously for hours." That hard case has been my own, and I confess I find it unsatisfying when Sir Clifford goes on to say that "though the flatulence may have associated with it disturbance of the heart, to follow this symptom beyond its mechanical causes would lead us into a general discussion of hysteria and neurasthenia."

A most pregnant suggestion, and for which I am thankful: but an odd excuse, surely!

Dr. Soltau Fenwick comes a little to grips. He says very little is known concerning the escape of gases from blood in the walls of the stomach, but he admits it to be a sound

clinical observation that quantities of carbonic acid gas are often expelled from a stomach that is devoid of food ; and he states, without comment, that the contents removed from the stomach of a healthy person exhibit no signs of gas formation for at least twenty-four hours.

Dr. Frederick Taylor judiciously says that flatulence sometimes develops so speedily that its explanation on chemical grounds is difficult, and even its association with neurosis does not always make its mechanism clear.

What, now, have the professed aerophagists to say ?

Dr. Wyllie, their protagonist, after giving a luminous account of that flatulence, arising from the fermentation of food, which he calls " true gastric flatulence," goes on to speak of that which is false—which, in other words, he believes to be only the eructation of atmospheric air that is either actually expelled from the stomach (after having been introduced into it in one or other of certain ways), or that is only seemingly so expelled. He makes allusion to the classical " secretory " theory, and admits that the normal stomach has the power of exchanging carbonic acid gas for the oxygen of intaken air ; he also alludes to the possible production of gas from the stomach walls in cases of failing heart with pulmonary congestion, as if by a kind of vicarious respiratory process. Moreover, he says it is best, for the moment, to consider the question of the secretion of gas from the stomach under nervous influences an open one. But he clearly does not believe in it ; and he seeks throughout his paper to establish the predominant influence of two elements—hysteria and habit. His observations are most acute, certainly ; but he takes no notice of the hard-working, and I hope sensible, professional men like myself, who give Sir Clifford Allbutt such uneasy qualms, and who have an unfortunate habit of dying just after they have been told they are neurotic. Nor does he take any heed of the flatulency in angina pectoris, and of those deaths that are ascribed to that cliché of the coroner's court—pressure of the stomach on a fatty heart. He does not explain the case of ileus or that of volvulus ; but he distinguishes three varieties of false flatulence—air gulping, air swallowing, and air suction.

Air gulping is a process by which air is introduced into the œsophagus by application of the tongue-tip to the teeth, as in pronouncing the letter T, the cavity of the mouth and pharynx being filled with air from the larynx, while shut off

from the nares by elevation of the palate, and from the larynx by closure of the glottis. Dr. Wyllie says that the air, while thus shut off, is put under strong and sudden compression by elevation of the larynx and the dorsum of the tongue, and under this pressure is forced into the œsophagus, entering with a slight noise. The subject then, making a slight expiratory effort with the glottis closed, puts pressure on the œsophagus, and expels air with a slight sound of eructation. Or, if he choose, he can go on gulping the air till so much is introduced into the œsophagus that it finds its way into the stomach. The process can be repeated, and it then seems as if long-continued eructations from the stomach are going on. This process I have recognized clearly in myself and in others. But one point Dr. Wyllie overlooks: the air in the mouth and pharynx is shut off from the œsophagus by spasm or hypertonus at the junction of the pharynx and œsophagus. This must indeed be so, else "strong compression" would not be needed to drive the air into the œsophagus; a simple swallowing movement would suffice.

Now, Dr. Wyllie thinks that quite a number of cases of flatulence can be explained away by degrading them to the level of habit actions of this nature. I do not deny that some of the neuro-mimetic cases may be thus explained, nor that, if the subject of gas production in the stomach contracts the habit of air gulping, he may continue it, just as a neurotic child who learns eye-twitching because of conjunctival irritation may continue it as a tic long after the primary source of irritation has been cured. But most air gulpers contract the habit because it enables them, by overcoming œsophageal spasm, to eructate gas imprisoned in the stomach. Air gulping is, primarily, a semi-purposive action designed to overcome involuntary spasm either at the pharyngeal or the cardiac end of the œsophagus, or both.

True air swallowing, however, apart from the swallowing of inconsiderable quantities of air with food, is another affair. It is performed, like ordinary swallowing, by the aid of a wave of contraction from the dorsum of the tongue backwards, and is not opposed by œsophageal spasm. Though babies brought up by hand may suck in air through their bottles, and hand-reared calves are said by veterinarians to become "hoven" in like manner, it is rather a rare accomplishment, like wagging one's ears, and not really relevant to the present

discussion. But there is another form of air swallowing, as Dr. Wyllie calls it, which needs analysis. When adult cattle, in feeding, get portions of turnip arrested in the gullet, what is known as "choking" supervenes. The rumen becomes distended with air, and, unless relief be afforded, the animal speedily dies. A very usual plan of treatment is to push the lump down with a probang. Now, Dr. Wyllie says that the enormous distension of the rumen with gas is due to the fact that the animals make convulsive efforts to swallow the lump, and in so doing swallow air, which gets past the lump into the rumen. This may or may not be so ; for myself, I do not see how the air can get past, but Dr. Wyllie finds support for his notion in the fact that some Lowland farmers treat choking animals by using a gag or bit which separates the jaws, and in the observation that some of these choking animals indulge in a kind of eructation like that of the air gulpers. Now, a great many veterinary surgeons think differently—that the gas is actually produced in the stomach—and they allege cogent reasons. Personally, I agree with them, but think that the œsophagus becomes applied to the lump by spasm, as does the urethra to a catheter, and that the convulsive swallowings and gulpings are semi-purposive attempts to inhibit the spasm. The putting of the bit or gag in the mouth inhibits the spasm, just as does a similar procedure have similar effect when anæsthesia is being induced. It is obvious that when spasm is inhibited, and proper action of the œsophagus is resumed, the food can be swallowed easily. Has not each of us, when a child, had a lump of food "stuck in the throat" successfully coaxed on by swallowing water? And, according to some veterinary surgeons, if the rumen be cut into, letting out the gas, which, as they believe, is secreted from the stomach wall under nervous influences, the spasm may be overcome.

There is one other kind of "hoven" which must be mentioned : it is the case of those animals who, after feeding on damp clover, get enormous distension, and die, as is so graphically described in "Far from the Madding Crowd." Dr. Wyllie refers to this, but does not explain it, as, indeed, I do not see how he can, on his air-swallowing theory.

We have now discussed air gulping and air swallowing. Air suction has no necessary connection with the stomach, as everyone accustomed to gynæcological work knows. When a Sims' speculum is passed on a fat woman, or the vagina is

opened, with the patient in the Trendelenburg position, air rushes in with a squelch as negative pressure comes into play. Barry, too, has reported cases of air entering the bladder, almost audibly, in women with lax muscular tone while walking about. This is air suction. But in horses who are crib-biters, as in some human beings, it is brought about, in respect of the œsophagus, by fixation of the inspiratory muscles, resulting in negative pressure which opens it, and allows air to enter. Air thus introduced into the œsophagus may be passed into the stomach, or "expelled with machine-like regularity and a kind of sob." The trick is easily learned. The jaw is thrust out, and the larynx elevated. A deep breath is taken. When tension is relaxed, the air is let out with "eructation." A biggish or emphysematous chest and a lax tone of the involuntary muscles seem to help in the accomplishment, just as in the gynæcological analogue. Dr. Wyllie, with admirable consistency, looks on air suction as a sort of habit, or vice, as grooms say. But it is not always so. It may be an involuntary accompaniment, in the type of person I have described, of that curious physical sign of profound attention noted by Ribot—the holding of the breath. At other times, as in a case mentioned by Dr. Mackenzie, it seems associated with such muscular effort as walking up a hill when the breath is held and the mouth is opened. But, of course, habit may easily be established.

The position, however, that I would take up, after some curious personal experiences and the observation of a good many patients, is that in flatulency we may have to deal with :

1. Disintegrating processes, due to microbic activity.

2. Such cases as Trousseau thought due to excessive gas-production during coction, and which are perhaps dietetic, chemical, or enzymotic.

3. Gas "secretion" from the walls of the stomach or bowels.

4. Gas secretion to which air gulping is added, to overcome the spasm that prevents eructation.

5. Cases in which air gulping occurs as a trick accidentally learned : as a form of neuro-mimesis ; or as a manifestation of hysteria, in association with globus hystericus.

6. True air swallowing, in babies fed from a defective apparatus; and occasionally in adults.

7. Air suction, analogous to the suction of air into the vagina or bladder, occurring in persons with hypotonus of

involuntary muscle, and under circumstances that fix the respiration. This also may be continued as a habit, possibly alternative to air gulping.

It is really with the third and fourth classes only that I wish now to deal, for these have points of clinical and physiological importance in common, and it is they that give rise to the difficulties of practice.

By great good fortune, only the other day I came across an article by Mr. Begg (a veterinary surgeon who practises in Lanark) dealing with " hoven " or " choking " in cattle. Mr. Begg evidently believes that the gas is really produced in some way or another in the rumen ; sometimes, perhaps, by fermentation, and sometimes not. He does not discuss how or why it should be produced ; his aim is purely clinical, or stabular, as I suppose one should say. But he distinguishes two types of " hoven." The one is the classical kind, where a lump is impacted in the œsophagus. In this he says that the gas goes on being emitted rhythmically *after* the obstruction is removed ; and, if the obstruction cannot be at once pushed down, he recommends opening the rumen—doing a gastrostomy, in fact. These points seem clearly on my side, and not on Dr. Wyllie's. The other type is represented by what occurs when animals have a debauch of damp aftermath of clover ; then the gas is intimately mixed with the mass of fodder, and is not evacuated easily by mere puncture of the rumen. This seems rather to suggest " coction," or some rapid enzymotic change ; but Mr. Begg goes on to remark that cases conforming more or less to one or other type are also apt to occur (1) when an animal has eaten poisonous plants ; (2) after exposure to chill ; (3) when sudden feeding follows fasting or over-driving ; (4) after taking of very cold water : and, inclusively, in animals predisposed to indigestion. Finally, it is laid down as a general law that *the particular condition of the animal may be a major factor in the presence of the less potent of the recognized causes.* This seems to me an admirable statement that we may apply directly to human beings. For so-called nervous flatulence occurs when there is obstruction, or spasm after ingestion of certain foods ; as a result of poisoning from tea or tobacco ; in cases of shock, exhaustion, or exposure ; and in those subject to previous dyspepsia. And, again, the particular condition of individuals accounts for the occurrence of very severe symptoms, when,

apparently, only the less potent external causes may be at work. If to this we add the recognition of purpose in air gulping, we have very nearly covered the ground. But not quite: for distressing flatulence may occur under some other conditions. Before, however, alluding to these, I must return for one moment to the question of œsophageal spasm in its relation to air gulping. There is no need for me to adduce the work of Dr. Hertz and others in proof that, with various irritative and so-called functional disorders of the stomach, spasm may occur at the pylorus, at the cardia, or midway indeed, and also at the junction of the pharynx and œsophagus. But my thesis is that, given the production of gas in the stomach otherwise than from fermentation, simple or multiple spasm does occur, imprisoning the poured-out gas. The mechanism of the spasm is probably intimately connected with the mechanism of the gas production; but that it does occur I am convinced. I once was fortunate enough to get a regular air secreter and gulper examined on the screen during one of his bouts. We gave him a bismuth drink—a rather hazardous proceeding for those who were standing by, as he was spluttering like a geyser—and I shall never forget the radiologist's bewilderment as he saw, first a stricture at the upper end, and then one at the lower end, of the œsophagus. Of course, as the sequel proved, the strictures were spasmodic only; but the fact remains that there is spasm, that this spasm prevents the eructation of the gas, and that the air gulping is a device to overcome the spasm. It gives relief, but it does not necessarily stop the gas production. Hence the need for repetition of the act. Should anyone have doubt as to the association of spasm with eructation, I would ask him to read a paper by Meunier on its occurrence in duodenal ulcer. You will remember, too, how when a patient under an anæsthetic is going to vomit, he first of all swallows—an automatic device to inhibit the spasm that is keeping back the food chucked against the cardia; and you will agree with me that, by manipulating the jaw, it may be possible to stop the threatened vomiting. But opening the mouth assists vomition, just as does Dr. Wyllie's use of the gag, which he has borrowed from the farmers and applied to human beings, inhibit spasm even better than the gulping which it supplants.

Dr. Guthrie Rankin was very near the truth when speaking recently of the wretched people with neurotic dyspepsia who

indulge in air swallowing and so forth to obtain fancied relief from their sufferings. But one might, with equal wit, speak of the wretched neurotics who, when deep under ether and inclined to vomit, persist in swallowing, as if that could do them any good ; or the foolish persons who, when so ill-advised as to have acute perforative peritonitis, insist on contracting down their recti on the intestines—an habit most annoying to the surgeon in attendance, and quite futile if intended as any real protection to the leak.

Setting on one side the mimetic cases, and admitting that in others air gulping is only secondary, it remains for us to consider the clinical aspects of pneumatosis itself in greater detail.

It is not unseldom found, when a patient comes for advice, that the first attack was a violent and very distressing one, and that subsequent attacks have been less severe, though more prolonged. And, as Sir Clifford Allbutt has pointed out, often they disturb the patient at night, and persist during the small hours. Another feature is the not infrequent alteration of other secretory functions : sometimes little urine is passed, even for days, yet when the attack subsides there may be an abundant flux of limpid fluid, as after hystero-epilepsy and angina pectoris. Two noteworthy sources of distress are cardiac irregularities and dyspnœa. It is usual to explain the cardiac irregularity or embarrassment as due to pressure of the distended stomach on the heart. No doubt this has its importance, but it is a mistake invariably to attribute death, when it occurs, to this cause alone. For I would remind you that death does occur in these cases ; even Dr. Wyllie describes one fatal event, wherein the stomach was so distended with gas that the peritoneum was actually cracked. He expresses himself as frankly puzzled by such an ending to what he believed to be a simple affair of air gulping. But I have seen several such, and on the occasion of my own first attack was for some little time in a very distressed condition.

Another source of cardiac distress is imprisonment in the œsophagus of gas escaped from the stomach. In this event, until the spasm relaxes, permitting eructation, the patient may be very uncomfortable and look very queer, the pulse becoming very irregular. In quite a number of cases of recurrent flatulence of this nature there is arrhythmia from ventricular extra-systole. In the absence of organic change in the cardiac apparatus, it seems fair to regard the arrhythmai

as an expression of the underlying neurosis, and not as a mere consequence of the gastric distension ; it is certainly the truth that these cases are usually toxic ones, in which tea and tobacco play their part.

Again, there are cases in which both the flatulence and the cardiac affection seem to form part of what Sir William Gowers has called a " vaso-vagal " attack. In such, in my own experience, there is often a tendency to bradycardia.

For nearly twelve years I have known a gentleman who, now over eighty, is, for his age, one of the most vigorous men, physically and mentally, that I have met. His pulse has been, for the last twenty or thirty years, getting slower and slower. Without any heart-block whatsoever, it now beats normally about fifty times a minute. But, especially when he has been subjected to any annoyance, or has been exhausted in the prosecution of the public duties that he still performs, he gets appalling bouts of gas production, and his pulse falls even to forty per minute, although perfectly regular. In support of the notion that this is due to vagal neurosis, I may mention that about six years ago, when convalescent from a basal pneumonia, this gentleman had hiccough which lasted for two days without intermission.

Yet, again, there are cases in which there is actual cardiac disease associated with flatulence. To one group Dr. Wylie has referred—that of persons with failing compensation to mitral disorder—but a very important class is formed by those who have angina pectoris, or sometimes what is known as " angina abdominis." Other patients have aortic disease.

The significance of flatulence is, in these conditions, considerable. You will recollect the case of the late Premier, who, one night after making a long speech, was seized, according to the Press, with an attack of flatulent indigestion ; but he died of heart disease a few months later.

Still, by a sort of reciprocating arrangement between the heart and stomach, true angina pectoris may be precipitated by gastric irritation ; and patients who are the subject of veritable angina pectoris may have minor seizures induced through indiscretions in diet, in alternation with purely cardiopathic ones. And, this being so, it is not surprising to meet with such cases as narrated by Dr. Mackenzie, of people with classical heart-block, whose attacks are associated with pneumatosis.

Some neurasthenic patients with flatulence have false angina. These are toxic cases, as a rule, where tea and tobacco have their part. And I would remind you that tea and tobacco may be taken in moderation for years, and yet, quite suddenly, if the patient come under stress, will begin to exert so marked a toxic influence that the cause of the symptoms may escape recognition because the excess is so purely relative. Even so with cattle; the particular state of the beast allows a less potent cause to produce exaggerated effects.

The vaso-vagal cases must be connoted with those flatulencies that occur, in spite of careful feeding, during pneumonia; in which connection I would refer to papers by Mr. Turner and by Dr. Neuhof. And there are the cases that occur during convalescence from acute specific diseases, on which Dr. Campbell Thomson has made some shrewd remarks. We have not yet exhausted the possibilities. There are cases associated with precedent gastric disorder; and there are those into which the element of shock or exhaustion enters. To take the last first, I would remind you that, as Mr. Armour has shown, flatulent distension and eructation is a common manifestation in traumatic neurasthenia. But it has relation to trauma apart from neurasthenia, as is demonstrated by the occurrence of post-operative tympany, and such cases as that of a steady, sober, healthy gentleman who fell into a brook one night, picked himself up, went home, and died in a fortnight of "flatulent dyspepsia," with no lesion that was discoverable at the post-mortem. Such a case has a peculiar bearing on the question of shock, but it must suffice to say here that the element of shock cannot well be separated entirely from the fact that, just as the overdriven and chilled cattle most easily get hoven, so it is harassed, overworked professional men, as well as silly tea-drinking girls, who suffer from flatulence with which there is associated no cardiac or vascular disease.

Still, in human beings, as in cattle, it is from an harassed stomach, and especially from one which is subjected to irregular meals and to meals when exhausted, that gas production is to be expected. Even a telephonic summons may precipitate an effusion of gas when a tired man is at the table; mental agitation and annoyance have their share, and so do certain kinds of food. At the same time, some of the worst spells I have ever seen, and, moreover, quite uncontrolled by

washing out or by antiseptics, have been in association with malignant disease in or about the stomach. In all these the vagus plays its part. But the most fascinating connotation is with acute duodenal ulcer. The American surgeons (notably Starr) admit that, if we delve into the past history of him with duodenal or pyloric ulcer, we get an account of neurotic dyspepsia. And Binnie has pointed out that one factor common to all cases of duodenal ulcer is vascular change.

And Dr. Herschell, while reckoning—I think wrongly—aerophagy as purely neurasthenic, yet admits that pneumatosis or gas secretion, associated with complaints of spasm in the throat, does occur in close alliance with duodenal or pyloric ulcer. I would say this : that quite a number of these flatulent cases that go on for weeks at a time, that first improve and then relapse, ultimately develop chronic ulcer ; and there is reason to believe that very often spells of flatulence are associated with the formation of an acute mucous ulcer that heals up and breaks down again. Neuhof finds an intimate relation between the occurrence of flatulence, the formation of these acute mucous ulcers (as Starr calls them), and irritation of the vagus. And can we not now see dimly the relation between the shock of a burn, the acute duodenal ulcers of burns, and the flatulence and distension that so commonly follow extensive skin burns ? I think so.

Though all subjects of pneumatosis complain, in degree, that they cannot get their breath, yet it is often noticeable that there is no real dyspnœa. Indeed, in the very worst cases of pneumatosis the breathing may be infrequent and shallow, though for the patient the sensation of airlessness is most distressing. There is, too, a peculiar restlessness in these graver cases which I now recognize as equivalent to the restlessness of shock, and of impending death in diphtheria when internal respiration is abrogated.

It is not to be denied that the actual mechanical impediment to respiration from an enormously dilated stomach may be very great, and I do not decline to admit the intrusion of the element of cardiac distress. But, on the occasion of my own first and most severe attack, which occurred with almost ridiculous suddenness during convalescence from diphtheria, the sensation of air hunger was so distressing, and yet the respirations were so slow and infrequent, that I thought my respiratory muscles were paralyzed.

I now recognize the relation of this condition to what is known as "acapnia." You will recollect that Henderson of Yale has shown how there is a definite relation between shock, vaso-constriction, and that condition of acapnia in which there is such a diminution of carbonic acid gas in the tissues and blood that the respiration is slowed until the carbonic acid accumulates up to stimulating strength, and hyperpnœa or dyspnœa returns. I do not say that all Henderson's deductions will be maintained, but his observations are acute. Now, it has been proved by Crile that, if abdominal viscera are exposed experimentally, carbonic acid gas is given off rapidly from them. And the obvious inference is that in laparotomy such a loss of carbonic acid gas may occur in this way that acapnia is produced, and may be a factor in death under the anæsthetic; or afterwards, as others have shown.

Though Henderson thinks that acapnia is a cause of shock, I am more inclined to think that it is a part of "shock," especially since Crile has shown how, if the displaced viscera be covered with omentum, the carbonic acid gas is not given off. It is interesting to note that, in abdominal operations, Mr. Arbuthnot Lane covers the bowels with a vaselined silk sheet, and I have heard it said that his shock effects are remarkably slight. But I ask you, if carbonic acid gas be thus given off from the viscera in experiments, is it ridiculous to suggest that in states of flatulency it is given off into the lumen of the viscus? And I beg you to note this: that our veterinary friend at Lanark says he believes "hoven" cattle die of carbonic acid gas *poisoning*, and not of heart failure. Since acapnia leads to all sorts of curious asphyxial consequences, he is at least on the right track. Let us agree that the gases of the body are seriously deranged as a result of the pneumatosis, and he comes into line with us all.

Acapnia, moreover, may be produced by forced or by artificial respiration. So we can understand how it is that the hyperpnœa, caused by the mechanical pressure of a distended stomach, may help to induce acapnia and its consequences. And, again, a lack of oxygen without excessive carbonic acid in the blood sets up increased tonus of the circular muscle fibres, while in acapnia the tonus is lost. I now realize how it was that, when my acapnia became extreme, my spasm relaxed, and up came the wind!

The key to the understanding of these many different conditions is this : patients with true angina pectoris get flatulence and eructations, not because their coronary arteries are sclerosed, as Held has suggested, but because they have sclerosis of their cœliac axis.* We do not often examine the state of the branches of the cœliac axis ; but I have been profoundly impressed by a case of my own in which the patient, who had suffered for some time from angina abdominis and flatulence, developed necrosis of her pancreas, and died. She had a very degenerate cœliac axis, and her pancreatic artery was blocked. Dr. Bernstein tells me he has seen this several times. I put it to you that where there is chief incidence of the disease on the coronary arteries, the case will pass as angina pectoris ; where there is greater incidence on the cœliac axis, the case is one of angina abdominis. The flatulence in either case is connected with " intermittent claudication " of the gastric arteries, just as the heart pain is due to that of the coronaries. For we must admit that, in addition to the narrowing of the coronary arteries from disease, there is superadded, just as in intermittent claudication of the legs, either some spasm of the non-rigid parts, or, at least, insufficiency of the blood-supply for the occasion. The same sort of thing occurs in the brain, as Sir William Osler has shown ; and Sir Lauder Brunton has told us how, in migraine—which I remind you is often associated with some degree of flatulence—there is recognizable contraction of the peripheral branches of the temporal artery. But migraine is, if the expression be allowed, only the functional replica of the headaches of arteriosclerosis ; and a functional replica of true angina—pectoris aut abdominis—is, in measure, to be found in the flatulent disturbances that accompany migraine. I find it hard to resist the conclusion that the underlying mechanism of the processes that give us these wind storms is, in part at least, indicated by spasm or insufficiency of the arterial vessels. If you like to apply the same conclusions to ileus and to meteorism, I will not disagree, although, of course, fermentation and putrefaction have their share of the blame ; for Murphy and Vincent have laid it down that interference with the circulation is a vital factor in the production of ileus. Certainly Stone, Bernheim, and Whipple think that some unknown

* The recent remarks of Fiessinger, and of Robin, are of great interest. (Acad. de Médecine : Séance du 1er Octobre, 1912.)

poison is at work, and it is true that the interference with the circulation to which Murphy and Vincent look is that which follows venous congestion. But now we seem in touch with Dr. Wyllie's admission of possible gas secretion in failing mitral compensation. An essential point, however, is that of oxygen-carrying, and the suggestion may be hazarded that the unknown toxic substance that Stone and his colleagues have failed to isolate is one of those curious bodies, allied to catalysé and oxidase, that Verworn has explained so luminously to us, and that Strauss and Winternitz have worked with. If so, we have some glimmerings of light on the ultimate mechanism of gas production, both in acapnia and in flatulence. For the moment, however, it is to the fact that, in degree, in all these cases there seems to be some limitation of oxygenated blood-supply that I ask your attention. I will not exclude even the purely hysterical cases, in which there is evolved gas, and the globus hystericus.

In a recent admirable lecture by Dr. Campbell Thomson, stress is laid on the " vasomotor basis," if I may use the term, of neurasthenia ; and on the dissociation in neurasthenia, and also in hysteria, of what I may call "vasomotor units." Janet's dissociation theory of hysteria is, of course, a different matter, though physical and psychical analogies are not new. And this dissociation notion is but complementary to Sielig's theory of irradiation. The fact is, we have so long been under the spell of the cerebro-spinal neurologists that we have neglected the sympathetic. The idea of the autonomic nervous system, as set forth by Professor Sherrington, may redress the balance. Still, what we have to remember is that though in the old-fashioned cerebro-spinal system there is an hierarchy, in which lower centres are subordinated to upper ones, in the sympathetic we have a different arrangement, reminiscent of that stage in the history of the race in which there is segmentation, or a series of units, that are linked together, and of which none is subordinate to any other. But the efficient working of the autonomic system depends on such co-operation between the two elements as is secured at the synapses, subject to efficiency of the supreme head. When the synapses are disconnected, as they certainly are by nicotine, the various segments, or some of them, rebel. And so there are different " types " of neurasthenia—sexual, intestinal, gastric, cardiac, and so forth. But, you will ask, how does this concern those

cases in which pneumatosis is a consequence of shock, of emotion, or of acute infectious disorders ? The autonomic nervous system gives us a link between skin stimulation and visceral effect (probably in great part a matter of the vasomotor connections) that obtains equally as a justification for the use of poultices or counter-irritation in visceral disease, and as an explanation of the unhappy consequences of a winding blow below the belt ; while at the same time it explains the reverse effect, of visceral disease setting up superficial skin tenderness, and the extraordinarily good results of Franke's operation (avulsion of the intercostal nerves from the ganglia) in the gastric crises of locomotor ataxy. The nature of these sensory, visceral, and vasomotor connections is well explained in a recent paper by Watson Wadsworth.

Another link is found in a synthesis of the work of Cannon, Hoskins, Hemmeter, Meltzer, and many others, who have established the importance of the adrenal machinery in shock, in emotional stress, and in acute specific disorders. Their work has been both simplified and obscured by our realization that the adrenals themselves are not merely a pair of organs secreting a special substance, but almost an integral part of the sympathetic system at any rate so far as their medullary substance is concerned. Moreover, there is the as yet only half-suspected importance of that wonderful series of paired organs — the accessory adrenals or chromaffine bodies, coterminous with the chain of sympathetic ganglia. I say only half-suspected ; for, though Sajous long ago hinted at the function of adrenal secretion as an oxygen carrier, or, at any rate, as one of the active elements in the management of internal respiration, or tissue gas-exchange, it is only the other day that Falta and Priestley proved that the chromaffine bodies generally are active agents in the conduct of " internal respiration," and Fuchs and Roth showed how injection of adrenalin increases the intake of air and the output of carbonic acid gas by the lungs. It is possible that we may find oxidase or catalyse to take origin in these structures. Need I point out to you that these chromaffine bodies are very perfectly provided in those fishes that have swimming-bladders ? or allude to the breathlessness, the air hunger, and the notable flatulence of patients with Addison's disease, that you may agree that the hypothesis of gas secretion from the stomach is not foolish, and that Trousseau and Graves, our veterinary

surgeon at Lanark, and acute practitioners like Dr. Muir Evans, may now stand in line with the most eager workers in Continental and transatlantic laboratories ?

There is a maze of splanchnic effects and of sympathetic effects ; of tonus, hypotonus, and hypertonus ; of stimulations and depressions ; of inhibitions and of activations ; of oxidations and of oxidation arrests ; of reflexes this way and that ; of paralyses and spasms ; of checks and counter-checks to be explained. Most puzzling of all are the diverse effects of adrenalin itself. At one time we find it necessary to the maintenance of muscular tonus ; at another, that an excessive dose is destructive of tone. There is the suggestion of purely local action or selection, and there is Cannon's idea of sensitive spots ; but perhaps the nearest approach to a solution has been given by Hoskins.

The exact elucidation of the connection that undoubtedly does obtain in the various cases of pneumatosis between the arteries, the nervous mechanisms, and the chromaffine organs, is not yet for us. That there is such a connection, and that when we have it explained we shall understand both the gas production and the eccentricities of muscular and arterial tonus that are common to them all, I am convinced.

No doubt the chain, or vicious circle, composed of vascular, nervous, and chromaffine systems, may be commenced or broken at any point. In purely hysterical cases the determining influence is from above. In shock cases, in ileus, and in those arising during diphtheria and other disorders, the adrenal or chromaffine system is exhausted ; and so it is in these that, as we should expect, the gas secretion is most abundant, the internal respiration most affected, the acapnia most obvious, and death least rare.

In neurasthenia and in the anginal conditions, true and false, the effects are, as a rule, dependent on one or two of the vasomotor " segments " controlled by the autonomic system. In primary vaso-vagal cases, probably in the basal pneumonias, and certainly in many of the dyspeptics, irritation of afferent vagal fibres seems to start the ball rolling. So that the relation of duodenal ulcer to flatulence is twofold. When, as in shock from burns, and perhaps in other cases, acute mucous ulcer and flatulence develop, we have an intensive use of the mechanism that is employed when we put a mustard plaster or poultice on the skin by way of counter-irritation. When

a chronic ulcer of the duodenum or irritative ingesta set up flatulent attacks with irradiating and anginal symptoms, the " viscero-vasomotor " mechanism is primarily engaged. But in each case all three elements are involved, and we should not forget what Crile has called the " master key "—racial habit, or phylogenetic association. We may surmise that, just as the Teleostean fish, when it sinks to escape its enemies, adjusts its swimming-bladder and gains a different sea-level, so do we, when brought low by stress or exhaustion, unconsciously protect ourselves, or component segments from aggression, by the evolution of gases. Shock itself is protective; and, in fact, it is not easy to think of a single manifestation in either hysteria or neurasthenia which is not more or less defensive.

Perhaps hysteria is rather defensive against injury to personal interests, whilst neurasthenic manifestations are protective to physical stresses. That is to say, in the latter case the organs threatened with damage from abuse are thrown out of gear by segmental dissociation. And, just so, if an hysterical woman is called on to make some self-sacrifice, she finds her defence in dislocating the mechanism that should be employed in the ungrateful task.

The treatment of these various flatulencies is not always easy, but a few practical hints may be given.

It is clear that, when microbic fermentation is the predominant element in gas production, washings out, antiseptics, acids and pepsin, and a diet suitable to the occasion, are obviously to be prescribed.

In the great " dietetic " or " coction " group, one may have greater difficulty in finding what to order or what habit to correct; but alkalies after meals will help most.

In the complex group of flatulencies from " secreted " gas these measures will hardly serve. It is obvious that an etiological, or rather a pathological, diagnosis is required. By way of immediate treatment: remember Trousseau's " cold affusions and ether." Prescribe local vaso-dilators, rubefacients, anti-spasmodics. " Dry " meals are best.

But, in strictest confidence, I will tell you this: should any of you, from overwork, overmuch tea, overmuch tobacco, or what not, get a spell of neurotic flatulence, and eructations with air gulping, nothing will give you so much relief as a bottle of the very best crème de menthe, sipped slowly and steadily until you are better.

SHOCK*

THE discussion and understanding of shock, although of paramount importance to the clinician, the physiologist, and the lawyer, is involved in much obscurity. Perhaps it would be well to avoid, at any rate, terminological confusion by setting on one side, as distinct from shock, the condition known as "collapse." By "collapse" we mean that sum of bodily states which is associated with loss or draining of the vital fluids, as in hæmorrhage or cholera. Shock remains as the sum of conditions obtaining when the reaction by the nervous systems to afferent impulses is incompatible with the usual performance of vital functions, so that the patient may die without the necessary coincidence of any obvious lesion in itself inconsistent with life. But, of course, shock and collapse may coexist.

We cannot hope to estimate the intensity of the afferent impulses that is requisite to destroy life by shock; for, as Mr. Tyrrell Gray has said, we have to reckon with the shock value of the individual. Probably this shock value is a physiological "function," but there are racial values as well as individual values. In great measure these depend on the state of the internal secretions or their balance. Thus, the hyperthyroidal Bengalee has a higher shock value than the negro, and the lively Gaul is more easily perturbed than the phlegmatic Teuton.

Still, the shock value of an individual varies from time to time, and different parts of the body have different shock values. A tap below the belt may wind a man on whose thorax I could hammer without causing distress; and there are other elements—to wit, that of unpreparedness. A false step in the dark may momentarily shake the nerves of a man who will take the spills of a day's hunting without turning a

* A paper read before the Medico-Legal Society, October 22, 1912.

hair; and the late Mr. Dent pointed out how a policeman, suddenly injured when on duty in a street brawl, will suffer more severely from shock than a soldier wounded in action.

Again, the trauma may be what is called "psychical," as when a piece of bad news is communicated, or there is a sudden and terrifying sight; although there is always a physical process underlying psychical impression.

When these factors are considered, it must be agreed that, unless there be definite simulation, we have little justification for aspersing one who complains of serious perturbations on an occasion that may seem to us trivial. Many people have, indeed, as we say, died of simple fright.

I spoke just now of the nervous systems designedly; for we have not one, but three, nervous systems. We have the cerebro-spinal nervous system, the sympathetic nervous system, and also the co-ordination of parts of these two into a third organization—the autonomic nervous system. If, for the sake of legal members, I may hazard an illustration, I would say that just so in this country we have a fairly stable and organized aristocracy and a less coherent democracy; though the system on which the stability of the constitution depends is that formed by the co-operation of a part of the aristocracy and a part of the commonality. And, seemingly, in shock the maintenance of the functional integrity of the autonomic system is seriously compromised. It is certainly true that what doctors call "shock" (meaning thereby the consequences of a shock) is, in part, a defensive reaction of the autonomic nervous system against assault that has been committed.

It fails of its purpose at times, no doubt, and may even be too intense for the safety of the organism. But the fact remains that, as Crile has pointed out, the shock mechanism is one forged many generations ago in the history of the race, when some apparatus was necessary to secure instant preparation for flight or withdrawal on occasion of danger.

Poke a snail with a straw, and see it draw in its horns.

Such are the beginnings of the complexes of shock and of traumatic neurasthenia which so admirably contribute to the support of our twin professions. But just as a rifle may have too light a pull, so may the shock reaction be overdone, to the disadvantage of the organism.

It is perhaps somewhat unfortunate that, owing to the

possibly excessive attention paid to experimental work of late years, shock, to the minds of many medical men, has come to mean an affair of blood-pressure curves, and what not, that can be best investigated in dogs and on rabbits. And so some of the shock effects that can hardly be investigated save by observations on human beings have become a little discredited, and are almost treated as if they had no existence, or, at any rate, no right to be mentioned in polite professional society. It is to some of these shock effects, and particularly to those indicated by the term " delayed shock," once in some clinical favour but now a little in the shade, that I propose to refer.

If we have to state the most intense form of shock, we at once think of those cases of sudden death, where there is no precedent disease, that are brought about by events which produce no obvious lesion. Such deaths happen when there is sudden immersion in water, and the individual dies without having time to drown. Other examples are narrated by Brouardel in his book, wherein he, following Brown-Séquard, speaks of them as deaths from inhibition. Let me give you an instance.

Last summer a Sikh was cycling through a London street. He had a side-slip when opposite a hospital. He was at once taken in, but no injury was found save a dislocated thumb, which was reduced. He turned to leave the hospital, and died on the doorstep. At the post-mortem neither injury nor disease was found.

When, however, shock falls short of immediate death production, there may be a very serious condition lasting some twenty-four hours or so, which may be terminated by death or may end in gradual recovery. This is the common kind of shock, from which we say people suffer after operation or serious injury.

But there is a group of serious cases in which, after the infliction of some trauma, the subject displays emotional perturbation, rallies, seems to be doing well, and yet ultimately develops symptoms which may be indifferently severe or may terminate in death.

The cases from which there is recovery sometimes pass as " traumatic neurasthenia," in which, as all know, a definite latent period elapses between the symptoms immediately displayed and those that " come on " later, and give us so much

occasion for professional activity. The cases in which, after a latent period that may be long or short, grave and even fatal consequences ensue, are those to which I now refer as cases of "delayed shock," using a term that is, or was, consecrated by use.

Common to both traumatic neurasthenia and delayed shock are unexpectedness of the trauma, and high psychical, rather than physical, value of the causative incident.

The prolonged anxiety and stress of shipwreck is not so effective in producing traumatic neurasthenia or delayed shock as is a railway collision, or a prank played on a kitchen-maid with a turnip, a clothes-prop, and a candle.

Now, it is not an unreasonable deduction that the symptoms which follow the latent interval are perhaps due to the exhaustion of certain mechanisms in combating the immediate effects of the physical or psychical trauma. And, indeed, years ago Mr. Furneaux Jordan very acutely pointed out that many of the immediate manifestations of what we call "shock" are really efforts of the organism to combat the effect of the trauma.

When we have a sudden fright, if taken off our guard, we turn pale. The blood is diverted from the skin, where it is not needed, to the heart and lungs, so that these organs are well supplied for the immediate flight prompted by our ancestral origins.

Now, the experimental work of Cannon and his associates seems to prove that when animals have been subjected to injury, or deliberately frightened to death, the adrenal system (a part of the mechanism that manages the blood-distribution) may be so completely exhausted by its efforts that it becomes bankrupt, and death ensues.

In these experiments we seem to see the physiological explanation of the phenomena of "delayed shock" in human beings.

Cases of delayed shock are not very uncommon, but they are often masked. We all know how usual it is for an aged person to die a week or two after a slight fall that has involved fracture of the femur. This is "delayed shock." It escapes recognition as such only because there is, what sounds formidable, a fracture of the thigh.

Yet a fracture of the thigh is itself a trivial affair so far as life is concerned. It is true that sometimes a low kind of

pneumonia ensues, but not always ; and even when it does, there is a valid explanation. At any rate, the pneumonia itself is seldom so severe as necessarily to interfere with life. Again, after burns, death from delayed shock is not infrequent even when no vital organ has been implicated and there is little sepsis.

The point that I am anxious to establish is this : that when death occurs ten days or so after trauma, we should not hesitate to ascribe death to the " accident " merely because there has not been present such a totally irrelevant lesion as a fracture of the thigh or an extensive scald.

I do not say that such deaths are very common, for obviously there usually is a lesion ; but they do occur. I have met with several, and have had the opportunity of inquiring into others. Many have been recorded in forgotten papers ; but the modern textbooks ignore them in most remarkable fashion, and even so erudite a compilation as Mr. Knocker's makes no mention of their happening.

Though they present, as is only natural, points of individual difference, there are not a few symptoms from which we can construct a common denominator.

There is usually immediate manifestation of some psychical agitation ; but this may pass off. There is a longer or shorter period in which the patient may seem to be suffering hardly at all ; and there are indications of interference with the visceral functions. The blood-pressure is affected, and the heart tends to dilate, for it loses tone ; the urine is scanty ; the bowels are obstinately constipated ; flatulence and eructations are common ; and there is a good deal of shortness of breath. As it may be the respiratory, the cardiac, the gastric, the intestinal, or other symptoms, that notably attract the doctor's attention, so, if death occurs, it is ascribed to congestion of the lungs, to heart failure, to pressure of the stomach on the heart, to stoppage of the bowels, or even to suppression of urine.* Sometimes the flatulence, constipation, and distension are so marked that operation is proposed and carried out ; but no condition is found within the surgeon's ambit.

When after trauma there are continuing hysterics, the

* In a measure, the " shock mechanism " may be concerned in some " obstructive " suppressions of urine. The relation of Grave's disease to shock should not be forgotten.

patient will probably win through with little physical damage. When the early psychical disturbances have play, but are controlled, traumatic neurasthenia, or the more marked type of "delayed shock," may ensue. But sometimes there is no initial hysteria; the subject displays a peculiar apathy, and death is pretty sure to follow.

You will all remember how when—

> "Home they brought her warrior dead;
> She ne'er spoke nor uttered cry;
> All the maidens watching said:
> 'She must weep, or she will die.'"

In such cases the autonomic nervous system is thoroughly disorganized, probably by inhibition from above.

The connections at the synapses are broken, and unless contact is re-established death may ensue.

The warrior's lady had her fount of tears dried up, and probably she was obstinately constipated and passed no water; when her autonomic nervous system got to work again not only the tears but other secretions were doubtless abundantly established, with excellent results.

Mr. Clinton Dent once related how many years ago at St. George's Hospital a water-tank burst through a ceiling and the floor below, carrying with it in its career a bed in which was a woman convalescent from some unimportant affection. This woman, in spite of her precipitate descent to the lower ward, sustained no overt injury save a trifling scalp wound. But she passed into a curiously apathetic condition, like that exhibited by some patients who have been burnt. She was seen by the late Mr. Cæsar Hawkins, who said that, though he could give no reason for his opinion, yet his experience taught him that she would die. She did die, about three weeks after the accident, and at the post-mortem no lesion was discovered. Mr. Page recorded the case of a girl who was shaken in a railway accident. She was hysterical at the time, but rallied, then took to her bed, and died, without any obvious reason, in about five weeks. Sir Samuel Wilks has narrated other cases of the same sort.

Mr. Turner several years ago reported the case of a man who fell when crossing a railway track and broke his leg. That same night he developed retention of urine, absolute constipation, and abdominal distension. In two days he was lying in bed "like a ball." He had no peritonitis or other

indication of visceral injury. But he died on the tenth day. It is true that before he died some pneumonia developed, but, as Mr. Turner says in a pregnant phrase, this shows that the shock had affected other organs than the bowels.

Cases of what is called "traumatic pneumonia" are not very uncommon, and one—the case of Etherington—is a legal classic.

But the usual explanation given is that the accident or injury in some mysterious way lowers the patient's vitality, and renders him or her more susceptible to the pathogenic growth in the lungs of the pneumococcus, which is, of course, a very usual denizen of the mouth. This mysterious lowering of vitality seems to me a phrase which explains nothing.

It has some appearance of plausibility when the pneumonia follows a blow on the chest, but it loses force when we consider the case of a man with a broken leg; so that it is then usual to suggest that the pneumonia is hypostatic, the result of congestion of the lung from confinement to bed. Mr. Turner's case forces us to seek some other explanation, and his expression, that the pneumonia showed that the shock had affected other organs than the bowels, carries us some way towards an understanding.

Everyone knows that, in spite of the jeers of therapeutic nihilists, a poultice or a mustard-plaster applied to the skin does affect the functional state of deep-seated organs. And we know that disease processes in certain organs give rise to pain in correlated skin areas. Now, whereas till lately the notion of what is called "counter-irritation" had been a little discredited, the phenomenon, for instance, of abdominal pain and tenderness in pneumonia does show us that there is an active connection between the cutaneous nerves and the viscera, and no longer renders it foolish to think that an active poulticing may, through the nerves controlling the distribution of blood to an organ, so affect the vascular state of that organ as to favourably influence disease processes.

And we have physiological justification for assuming or believing that, let us say, the application of cold to the skin may, under certain circumstances, so affect the state of deep viscera, in respect of the local circulation of blood therein, as to pave the way for the establishment of an active microbic inflammation.

We know, too, that normally certain skin areas are corre-

lated with certain viscera for good or for evil. But we have to reckon with the phenomenon of irradiation, whereby the effects of an intense nerve impression spread to units of the autonomic nervous system (which is, indeed, a series of segments or units) other than the proper one. You may in some buildings see a telephone switchboard so arranged that different persons can be called, or can call, independently. Such is the normal arrangement of the autonomic system, whereby skin areas can call up visceral areas, and *vice versa*. But an arrangement may be made so that if a call of fire is received at the office a special switch can be thrown over, and the various instruments can be simultaneously rung. If the operator is a fool, this is done unnecessarily.

And in shock something of this sort seems to occur; so that we can see how it is that, as in Mr. Turner's case and others, a physical and psychical trauma may, given certain conditions, adversely affect the vascular state not only of the bowels, but the lungs. Neuhof, an American physician, has lately paid particular attention to this mechanism for the occasional production of pneumonia. He calls some such cases of pneumonia "vagus pneumonias," for physiological reasons.

A case of great legal and medical importance came under my notice a few months ago. The subject was a man well known to me by repute—healthy, sober, and active. His age was forty-nine. On the evening of November 14 last he left the house of a friend to walk to the station. In passing through the grounds he missed his way, and stepped suddenly over the perpendicular bank of a brook, or ha-ha, into the water below. The height of the bank above the water was 4 feet: the depth of the water about 2 feet 6 inches. He fell on to one knee, but was not immersed, so scrambled out and made his way back to the house in a state of some agitation. He was, in fact, at first hysterical. However, he got home, a distance of some miles, in a cab, and was seen by a doctor, who found no injury save a grazed knee. The next day the unfortunate gentleman went to his office as usual, but complained of shortness of breath and some pain in the loins. The hysteria had been controlled.

He began to suffer from what seemed to be flatulent dyspepsia; the wind was indeed incessant; he was obstinately constipated, and passed little water. He became worse, yet attended intermittently to business. On November 30,

sixteen days after the accident, he died suddenly after drinking a glass of water to relieve his " wind."

A claim was made on a company in which he was insured on the ground that death had resulted from the accident.

A post-mortem examination was ordered : no sign of any injury or surgical condition such as embolism was found. But there was recent dilatation of the stomach and some dilatation of the heart. Owing, however, to the undoubted fact that decomposition had advanced with extreme rapidity in a few hours, it was not, in the opinion of some who were present, possible to be definite as to the non-existence of fatty degeneration.

Therefore, the claim was disputed: apparently on the ground that the deceased died from heart failure, possibly in some measure due to a hypothetical precedent degeneration, but certainly in the last resort determined by the " flatulent dyspepsia," if not by the drink of cold water. It was also suggested that the flatulent dyspepsia was, together with the constipation, set up by lack of exercise, consequent on the slight knee injury and the rest at home.

In fine, death was not due to the accident.

At this stage my opinion was asked by the solicitor for the widow, and I gave it to the effect that if there had been no accident the fatal event would not have occurred—that, indeed, the case was one of delayed shock.

Learned counsel was then good enough to read me the case of Etherington, as illustrating the legal point that we might have to meet.

This case is one of a gentleman who had a fall in the hunting-field, went up to town the next day, fell ill, and presently died of pneumonia. It was claimed that the pneumonia developed as a result of the vitality having been lowered by the shock of the fall, pneumococci being present in the body at the time. The claim was disputed on the ground that the terms of the policy denied benefits if there should be intervening causes between accident and death, and it was asserted that the pneumonia was such an intervening cause. On appeal, the Lords Justices held that the insurance company were not entitled to relief if the intervening incident or cause were a link in the natural chain of events or causes developed between the accident and the death, inasmuch as the words of the policy were to be construed as applying only to the

fortuitous intervention of some other or fresh agency causing death. They held that the pneumonia was no such fortuitous intervention, but an incident in the natural chain of events, and gave judgment against the company. In our case I certainly thought that there was not the intervention of any fresh agency, and so we went to arbitration. But, after the hearing of witnesses as to fact, an offer of compromise was made and accepted, so that the question of delayed shock was never submitted to the learned arbitrator.

I think you will agree with me that it is important that the exact nature of cases such as these should be defined. In the case of Etherington there was a definite intervening illness, indicated at the post-mortem by the usual signs. Superficially it might seem that here the insurance company had a good case. But, apart from the luminous interpretation of the words of the particular policy by Lord Justice Williams, medically they had a bad one. Only the medical witnesses for the claimants might have put their case a little higher—"precised it," as the French say—and, instead of speaking generally of lowered vitality, drawn attention to the definite mechanism that exists in the autonomic nervous system for the production, in shock, of disturbance of function in special viscera. In my case, however, there was no gross or organic condition such as pneumonia to set up as an intervening agency; there was really no disease at all discoverable at the post-mortem, and until the time of death there had been no symptoms that required the assumption of what we call "organic change" to render them comprehensible. It was apparently because there was no more than functional disorder manifested that the insurance company hesitated to meet the claim. If there had been the fracture of even one bone, had there been a patch of pneumonia no bigger than a crown-piece that we could have sworn to, all would have been well. But neither the discovery of a fracture nor the existence of a pneumonia would have really made the case any stronger. And, after all, the man was dead. A healthy, sober man, who had never before spent a day in bed, died sixteen days after the accident while under treatment for flatulence and constipation. He died of "delayed shock," as it is called, truly and unquestionably, as did the persons whose cases I have already narrated, and as every day do people die who have broken a femur, or have been burnt, or suffer from post-operative ileus.

It is not necessary to labour the point that in this, as in other cases, the trauma was *unexpected*. But it links these fatal cases with the non-fatal ones, in which, equally, there is no symptom that may not be referred to functional derangement — namely, those of traumatic neurasthenia, wherein also it is clear that the protective mechanism of the body is taken "off-side." There is no time for preparatory adjustment of the blood-distribution in the body to the purpose. And it is then easy to understand how, given a high shock value, under such circumstances the protective adaptation may be out of all proportion to the occasion, as when the telephone operator is excited by a rumour of fire.

What the exact significance of the latent interval is, it is difficult to say, but it must be observed how generally there is some flatulence, which in slighter cases may pass as due to dyspepsia, and in the more grave may lead to such distension that the surgeon's aid is invoked.

Now this flatulence is not dyspeptic. It has, it is true, an intimate relation to the flatulence of what is called "neurotic dyspepsia," but, as I have tried to show elsewhere, this flatulence too is an affair of actual gas secretion from the stomach and bowels, and brings the shock cases we have been discussing into line with those of acapnia, to which so much attention has been directed by Professor Henderson of Yale, and Dr. Crile.

Now, in all these curious cases in which gas secretion occurs three systems are involved—the vasomotor, the autonomic nervous, and the adrenal.

The direct connection between the adrenal system and the production of gas in shock and in acapnia has, I think, had light thrown on it recently by Falta and by Fuchs, who have shown that the adrenal system not only provides, as we know, a substance that influences the tone of the bloodvessels, heart, stomach, bowels, and other organs, but a substance or substances that seemingly control the internal respiration—the exchange of gases between the tissues and the blood. If, then, Cannon is right in holding the adrenal or chromaffine system responsible for the adjustment of the body in cases of shock, we can understand how it is that the symptom of flatulence, though present in varying degree, is a thread linking many of these conditions together.

Whether this gas secretion is indicative of exhaustion of

the adrenal system, or whether it marks the excessive activity that heralds exhaustion, or whether it is sometimes or always an expression of perversion, rather than of excess or deficiency, it is hard to say. On the answer to these questions depends probably determination of the treatment that we should prescribe.

It is not my desire to pursue here the purely medical aspects of these questions; I have done that elsewhere. My object is to show that there is a definite connection between sudden death from inhibition; surgical shock as we see it every day in hospital; post-operative ileus; the apathetic death of a warrior's lady "without apparent reason"; cases of delayed shock; deaths from pneumonia after some injuries; and, lastly, traumatic neurasthenia.

The clinical manifestations of shock are, and must be, as various as the diverse circumstances that evoke it, and the natures of those in whom it is evoked. It seems certainly as if the visceral incidence of shock is sometimes in proportion to the psychical repression, and that an adequate fit of hysterics may be an excellent safeguard against traumatic neurasthenia. But it is a very practical lesson that, whether lawyers or physicians, we should hesitate to disregard "functional symptoms" merely because our dull eyes can find no organic lesion, which, if we did, would probably be quite irrelevant except as evidence that accident had occurred.

It is not an exaggeration, though it may seem a paradox, to say that people do not die of organic disease so often as of disturbances of function; although, after all, there can hardly be functional disturbances without alteration in cellular states.

Something may even be said for the malingerer. "I do not recollect," says Murri, "ever having come to the conclusion, in a case of so-called 'traumatic neurosis,' that the whole affair was a deception."

Be this as it may, if we are to recognize, as I think we must increasingly, that even the simple or apparently simple functional perturbations of which people complain or from which we see them suffer, after physical or psychical trauma, are really consequences not within their control, though possibly dependent on their personal equation, I can foresee a revolution in the attitude of insurance companies towards accident. I do not think that we doctors have any right,

except as citizens, to express an opinion as to who should or who should not be compensated by the State or the employer under certain conditions. We must stick to our last, and elucidate as honestly as we may the chain of circumstances in each case.

Lawyers will doubtless find a congenial field in devising formulæ which will secure that those receive compensation who public opinion determines should be compensated, and that others, who enter into private contracts with insurance companies, be justly dealt with.

Anyway, the responsibility for the enunciation of the principles of compensation does not, I take it, rest with either lawyers or physicians as such, though it is our duty to point out where existing statutes or usual forms of policy operate inequitably, or not as intended by those who have devised them.

When all is said and done, there is still the element of suggestion, and I do not see why we should hold anyone responsible for his personal "suggestibility." There is no doubt, too, that the effects of trauma, physical and psychical, are tending towards exacerbation as a result of the ever-present suggestion of compensation which operates, through the trauma, on the autonomic system. And it seems to me that the "suggestibility" of any person is not easily to be distinguished from what Mr. Tyrrell Gray calls his "shock value."

The practical notion that I put forward is that, just as we attempt to assay the life-value of any candidate for life insurance, so must we address ourselves to estimating the "shock value" or suggestibility of persons who are to be insured against accident.

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ERRATA

Page 37, footnote, *for* "Grave's" *read* "Graves's."
Page 46, line 16, *for* "Médical" *read* "Médicale."
,, line 30, *for* "YANDALL" *read* "YANDELL."
,, line 34, *for* "Wylie" *read* "Wyllie."
Page 47, line 6 from end, *for* "WATSON, WADSWORTH" *read* "WADSWORTH, WATSON."

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RC 860 C88

Crookshank

Flatulence and Stomach