doubtful case, but often only by means of the electro-cardiograph can its presence be definitely proved.

Pulsus alternans differs in many particulars from all of the forms of arrhythmia already discussed. It is essentially an irregularity of strength and volume and not of time, and even as such it is a regular irregularity, in which each second heart beat is a weak one. More often than not the differences in the volume of pulse wave are so slight as to escape detection by the finger, even when suspected, though a sphygmogram will render them plain enough. The condition depends on a physiological principle not as yet alluded to in this paper—the law, that is, that each cardiac systole uses up the whole available energy of which the heart is capable at the moment of contraction. In *pulsus alternans* the available energy is so reduced after each full beat that the succeeding systole is a weak one. The condition often occurs only as a terminal phenomenon and as a prelude to early dissolution, and as such it has, when recognized, a grave prognostic significance.

Rare and undifferentiated types of arrhythmia are alluded to in a special chapter by Mackenzie. Some of them afford problems for future investigation, and their complete elucidation may throw much light on the cardiac mechanism; for, far as we have travelled on this road of knowledge, all investigators agree that there is much still remaining obscure. The differentiated rhythms, though largely explained as to their mechanism, leave many problems as yet incompletely solved.

Mixed rhythms and changes from one type to another are known to occur, and have already been incidentally alluded to more than once. Deficiency of conducting power—in other words, partial heart-block—enters as an integral factor into most cases of flutter, and into the slower pulses of fibrillation, while the action of digitalis is largely operative in depressing undue conductivity. Extra-systoles may occur in children and be mixed up with respiratory rhythm. Again, extra-systoles of ventricular origin may occur in the course of fibrillation, or may even co-exist with heart-block, while not infrequently a damaged heart which has shown frequent extra-systoles for years may suddenly take on the rhythm of absolute irregularity, which proves that the auricles have passed into a state of fibrillation. These facts may somewhat disconcert the student at first sight, but a little thought will show that the general conclusions based upon the diagnosis of each type of arrhythmia are but little affected thereby. In two types only—sinus arrhythmia and extra-systole—is the prognosis quite reassuring, and should these co-exist the conclusion is not vitiated. As to extra-systole alone, the prognosis is only good where no evidence of heart disease exists; and in cases that eventually turn to fibrillation evidence of heart disease will certainly be present, very likely in the shape of presystolic murmur. Here, of course, the possibility of eventual fibrillation amounts almost to likelihood, but none the less does the rule hold good that the irregularity due to extra-systole may be ignored, and the patient allowed to exert himself as much as he can do without undue discomfort.

CONCLUSION.

Many aspects of cardiac pathology have received much elucidation within recent years, yet we and our patients have as much to look for in the work which is now being done and in that which lies ahead as in what has already been accomplished. But among the latter, Mackenzie's work on arrhythmia and its developments are of epoch-making importance, and form solid ground on which we can base more accurate opinions and more definite statements than were formerly possible. Two baleful influences in connexion with heart cases have long been at work—vague speaking, and the needless limitation of our patients' activities—and it was the recognition of these facts years ago that led me to take a somewhat special interest in the heart. I came across numerous cases where patients had been told they had "weak hearts," and in which, though there occasionally was a murmur, and sometimes a loud one, I could discern no more evidence of "weak heart" than one might discover in a biceps whose owner had been told that he must only use it with great caution. "The heart is a muscle," said Oertel; "by exercise a muscle becomes hypertrophied, and its functional power increased. Also for the heart

muscle exercise is the only means we have of strengthening it." What Oertel accomplished even for badly damaged hearts was marvellous, and only too often do we ensure that a weak heart shall remain weak by withholding from it its physiological opportunities for gaining strength. Yet we fear to be bold because we fear catastrophe. But many means are at our disposal for estimating a heart's reserve capacity; and among them a knowledge of the irregularities and their significance now occupies a prominent position. Ability to differentiate the rhythms will restore far more patients to activity than it will condemn, while in the case of those who may have to be restricted it brings to us the satisfactory assurance that our patients' lives will not be limited on insufficient grounds.

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SOME FACTORS CONCERNING AMPUTATIONS WITH REFERENCE TO THE PRESENT WAR.

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BEFORE the outbreak of the present war in August last operations for amputation of limbs had received little attention for many years. This was due to the fact that modern surgical methods of asepsis had rendered surgeons more and more conservative with regard to diseases and injuries of the limbs, so that the necessity for amputations but seldom arose; in fact, except in hospitals which, owing to their situation, dealt largely with accidents from large machinery works or railways, amputations were very seldom performed. I think it is no exaggeration to say that many of the large hospitals did not have more than half a dozen major amputations in the course of a year. Amputation had, indeed, become a very rare operation. War unfortunately results in injuries of such a nature that amputation is frequently necessary, and an enormous increase in the number of amputations performed has resulted from the present war. A good deal of the facility with which the patient will subsequently be able to make use of an artificial limb depends upon the method in which the amputation is performed, and I venture to bring forward the following remarks and suggestions in the hope that they may correct some fallacies which still appear to be prevalent in medical textbooks, and may so assist in rendering more tolerable the condition of those of our fighting forces who may have the misfortune to lose a limb.

It is often supposed that in the case of the amputation of the lower limbs the weight in standing and walking is borne upon the end of the stump. This is, of course, not the case. Where the amputation has necessitated saving through the bone the end of the stump will never be able to withstand the pressure which must be borne by the stump in standing and walking, no matter how cunningly the stump may be formed. In practice the weight of the body is supported upon the bony structures, around the joint immediately above the amputation. Thus, in the case of amputation of the leg, the weight is borne upon the head of the tibia and fibula and the sides of the stump, while in the case of amputations above the knee the patient practically sits upon the top of the artificial limb. The only stumps in which it is possible for the weight to be taken on the end of the stump are Syme's amputation at the ankle-joint and amputation through the knee-joint. With these exceptions the weight cannot be taken on the extremity of the stump. As a rule, the end of the stump is not allowed to touch the bottom of the bucket of the artificial limb as it is impossible for it to bear any useful weight, and if it does so it soon gets sore. No matter how much muscle flap has been left over the bone ends the resulting stump will ultimately be the same, as the muscle left over the end of the bone will, in time, completely waste, and there will be little more than

skin between the bone and the surface. The tendency is for the end of the bone in course of time to become pointed or at least conical, quite irrespective of what its condition was immediately after the amputation. Efforts to leave a good thick flap of tissue over the bone ends are wasted except in so far as they prevent the formation of an adherent cicatrix. The important point is to leave as long a stump as possible so that the patient may have plenty of leverage over the artificial limb for walking. This is of far more importance than the type of flap, position of the scar, or the way in which the end of the bone is cut. For the same reason there is no particular object to be gained by keeping the scar away from the end of the stump. As a matter of fact the worst place for the scar is where it will be subjected to pressure from friction in walking, and this is on the back of the stump in swinging the body forward (see Figs. 1 and 2). The

Fig. 1.

Fig. 2.

Fig. 1.—Full length leg. Dotted area shows parts on which weight is borne, and arrow where pressure comes in walking.

Fig. 2.—Below knee leg.

ordinary amputation at the "seat of election" gives a very bad stump for an artificial limb, as there is not enough length in the leg part of the stump to control an artificial limb, and also flexion of this short stump below the knee is apt to occur, and is difficult to correct. This stump is only of use if an ordinary peg leg is to be used of the type in which the patient kneels into a groove in the peg leg. This was a very popular type of artificial leg in the old days before the present instruments were invented; in fact, it was the only satisfactory artificial leg of those days, and hence the popularity of this particular type of stump.

Most men, however, nowadays, will prefer some better type of apparatus, which will allow of a movable knee, and which will not be unsightly, and for this type of apparatus amputation at the "seat of election" gives an exceedingly bad stump.

Another point often overlooked in choosing the situation at which to amputate a limb is the provision of room for an artificial knee-joint in the limb. It is obvious that an amputation through the knee-joint does not allow for the fitting of a joint in the artificial limb. The only way in which a joint can be fitted to such a stump is by making stout steel hinges on the sides of the limb and outside the line of the stump, and when proper allowance has been made for strength in the apparatus and for the prevention of any possibility of friction on the end of the stump in walking a very ugly and ungainly looking knee will be the result, the knee on the artificial leg being nearly half as wide again as that of the good leg. A patient will therefore often prefer an amputation through the lower end of the femur which will give room for a joint in the artificial limb.

The oldest form of amputation was circular amputation, and it has for a long time seemed to me that the reasons for this method of amputation being discarded were not sound. As already stated, there is no particular objection to the scar being on the end of the stump since pressure is not borne on this situation under any circumstances. As a rule it involves the least sacrifice of sound bone, it allows of the best possible drainage where the stump is likely to be septic, and it leaves the smallest possible scar. These are very great advantages, and it is interesting to note that there is a considerable tendency amongst those who are doing most of the amputations at the front to revert to this type of amputation. Their reason for doing so is that most of the stumps are of necessity septic, and this type of amputation leaves better drainage and consequently better chances of recovery, while it is also most rapidly done. I believe, however, that, quite apart from these advantages, it is the best all-round amputation in the lower limbs as well as in the upper. Another point in favour of circular amputation is the fact that the nerves are less

liable to be caught in a cicatrix. Where long flaps are made, even though the nerves are cut short, they still may be involved in the cicatrix, especially where the stump is septic. With circular amputation this is less likely to be the case. If nerves are involved in the cicatrix at the end of the stump considerable neuralgic pain, often lasting for years, always results, and it is very desirable that this should be avoided.

In the case of amputations of the upper limbs, circular amputation, except in special cases, will almost always give the best results. Here the best possible place for the scar is on the end of the stump, the sides being most exposed to pressure and friction in the movement of the limb, while length of the stump is again of primary importance.

Another point to which I should like to draw attention is the desirability of the patient being fitted with an artificial limb as soon as possible after the wound has healed and his being encouraged to use it at once. There is nothing to be gained by waiting, and, on the other hand, it is most important that the muscles which will have to move the stump should not be allowed to waste. If much time is allowed to elapse between the amputation and the fitting of an artificial limb, the wasting of these muscles may be a very serious factor in preventing the subsequent successful use of any artificial limb. It is quite surprising how rapidly a patient can learn to use an artificial limb if his muscles have not been allowed to waste. I had a patient under me recently who had had his foot amputated some 2 in. above the ankle. An artificial apparatus was fitted almost before the wound was healed, and in less than three weeks after the complete healing of the wound this patient was walking without the use of sticks, and with very little limp, although, of course, he was not able to walk for very long without the skin becoming rubbed, as it takes some time for the skin over the lower part of the head of the tibia to get used to the unaccustomed pressure.

It is often stated that much wasting of the stump will occur after the amputation, and that it is better to wait until this wasting has taken place before fitting an artificial limb, as otherwise a new limb, or at least a new socket, will very soon be required. This is true, but what is often overlooked is the fact that most of the serious wasting occurs only after the artificial limb has begun to be used, and is due to the pressure. Therefore there is nothing to be gained by postponing the time when the limb is to be used.

With regard to the artificial limbs themselves, it is often supposed by patients that there is some special patent limb which possesses peculiar advantages and is very much superior to any other. There is, however, nothing in the idea of these special patent limbs. It may be compared to the idea common among golfers that some special club which they see a professional using will enable them to achieve equally wonderful shots. It is not the club that matters so much, but the man behind it. And this is equally true of artificial limbs. The important factors in regard to artificial limbs are that they should be thoroughly well made of first-rate materials, that they should be as light as possible and yet, at the same time, be of sufficient strength to stand hard usage without breaking. Lightness is of particular importance where the stump is short, or where the amputation is above the knee; but the ease with which a patient will walk always depends very much upon the weight of the artificial limb. Light weight and a good fit are the only really important points.

Some very light limbs are now being made of an aluminium alloy. These are certainly an improvement upon wooden limbs, as for the same strength they are less than half the weight. They should, however, not be fitted in the first instance for the following reasons: Shrinkage of the stump is usually very rapid when the patient first begins to use an artificial limb, with the result that constant alterations have to be made in the socket, and at the end of a few months it is necessary to refit the socket or make a new artificial limb. With a wooden limb this is easily managed, parts of the socket being removed where rubbing occurs, or padding being put in as may be required; and, as a rule, considerable alterations have to be made during the first few months in which an artificial limb is worn. This is not possible with metal limbs, and

the best plan is for the patient to start with a good light wooden leg which he can change for a metal one after he has become thoroughly used to the artificial limb, and the stump has had time to assume a more or less permanent form. This is more particularly to be advised as metal limbs are very expensive.

One often sees a patient wearing an artificial leg which the instrument maker has taken great trouble to make as light as possible, with a heavy boot on the end of it. The weight of the boot does away with the advantages in the lightness of the limb. The patient should wear the lightest possible shoes—at any rate, at first, for by so doing he will learn to walk much more easily and quickly.

It is advisable to avoid limbs in which there are a number of joints; they should be as few in number as possible. Lateral motion, for instance, in the ankle-joint is not only of no value, but is a distinct disadvantage. The important thing in joints is that they should be strong and should move without noise.

It is an advantage for the patient to have a spare artificial limb, but it is better that this should not be made until the first one has been worn for about six months, as considerable alterations will probably be necessary, and at the end of six months these can be incorporated in the new limb.

It must not be thought that I am advising that patients' limbs should be trimmed to suit the convenience of the artificial limb maker. Far from it. But it seemed to me that some of the points mentioned here are not sufficiently well known, and that they might be of assistance to those of our surgeons who have a large number of amputations to perform at the present time.

▲ CASE OF ACUTE ANEURYSM OF THE SUPERIOR MESENTERIC ARTERY, WITH RUPTURE.

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PRIVATE W., aged 26, was admitted to the 2nd Scottish General Hospital on February 28th, 1915, at 1 p.m. He was complaining of severe abdominal pain, and was considerably collapsed. His temperature was subnormal, and his pulse thready and irregular. His bowels had not acted for three days. He had not vomited. His tongue was moist and clean. The abdomen was somewhat distended with gas; there was no abnormal dullness to be made out in either flank or elsewhere. Subjective pain was felt all over the abdomen, but tenderness on pressure was not noticed over any area in particular. A small enema was given, and this was followed by a slight normal evacuation of the bowels. After this he felt easier, and slept for a short time. The heart sounds were feeble, but not otherwise markedly abnormal.

At 8 p.m.—that is, seven hours after admission—he suddenly collapsed, and died at 8.30. It was considered likely that internal haemorrhage had taken place, but he was too collapsed during the few hours he was under observation for laparotomy to be performed.

NECROPSY.

A *post-mortem* examination was performed on March 1st. The body was that of a well nourished and well developed young man. Rigidity was marked in both upper and lower limbs. There was extreme pallor of the skin. Slight adhesions were present in the left pleura. The pericardial sac contained a considerable amount of fluid. The peritoneum contained a large quantity of fluid and clotted blood. The omentum and mesentery were also infiltrated with blood clot. The small intestine was to a great extent collapsed. The spleen was enlarged, firm, and showed a recent pale infarct. The kidneys and liver were pale but healthy. In the bend of the duodenum and around the pancreas there was a large amount of blood clot. All the abdominal organs were searched for a source of the

haemorrhage. Eventually a thin-walled aneurysm about the size of a walnut in connexion with the commencement of the superior mesenteric artery was found. This had ruptured into the substance of the mesentery and into the peritoneal cavity. The heart was enlarged and conical in shape. The cavities were uniformly dilated, and the muscle pale. The mitral valve was healthy. The segments of the aortic valve were thickened and covered with large friable vegetations. The lungs showed congestion and oedema. Cultures were made from the vegetations on the aortic valve and from the spleen. Those from the spleen showed no growth. The cultures from the valve showed a pure growth of a staphylococcus which failed to develop pigment.

Microscopic Appearances.

The vegetations showed a granular amorphous thrombus in process of organization; large masses of cocci were visible at the margin. The spleen infarct showed the usual appearances of an early pale infarct with large numbers of polymorphonuclear leucocytes infiltrating it, thus indicating its septic character. The kidneys, liver, and heart showed cloudy swelling, but no evidence of metastatic inflammatory foci in them. The portion of lung examined showed oedema and some catarrhal pneumonia.

Aneurysm and Mesentery.—The tissue of the mesentery is infiltrated with blood clot, which in parts shows distinct evidence of organization. In other parts there is infiltration with polymorphonuclear leucocytes. The larger vessels show well-marked infiltration of their walls with inflammatory cells, and in the aneurysm wall this is accompanied by marked thinning. No organisms were found in the aneurysm wall or in the tissues around.

REMARKS.

The chief interest about the case lies in the rarity of the condition. We have only seen one other example of an acute aneurysm in this situation. Apparently both the endocarditis and the haemorrhage had been in existence some days, as evidenced by the considerable amount of organization which had occurred. At the *post-mortem* examination we were struck by the absence of smell, pus, or other evidence of sepsis. Whether this is explained by the nature of the causal organism we are unable to say. The presence of the *Staphylococcus albus* may be quite accidental, but the large numbers of cocci in masses found microscopically in the vegetations indicates that the germ belonged to that group.

SOME GENERAL NOTES ON SUFFOCATION BY POISONOUS GASES, WITH DETAILED NOTES ON ONE FATAL CASE.

BY

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DURING the last two weeks we have had under our care in this hospital several cases of suffocation by poisonous gases.

We have attempted to divide them into clinical groups from the severity of the symptoms and physical signs.

GROUP I.—THE MILD CASES.

Class A.—In these the cough has been frequent, painful, and harsh; the physical signs in the chest were rough breathing with sonorous rhonchi, indicating an essentially "dry" condition of the chest, suggesting a reddened and roughened bronchial apparatus.

Class B.—The cough was frequent and painful in these cases, but the harshness was not so apparent; the sounds in the chest were moist, and there was some secretion of a greenish, viscid character which was expectorated by the patient.

In both these classes of Group I the patients complained of headache, pain in the eyes, and abdominal pain, but they were not cyanotic, and the symptoms tended to disappear rapidly with the exception of some increased