not invariably, associated with a curious but indescribable, often disagreeable, smell. To such cases Dr. Jackson applied the name "uncinate epilepsy," because in some cases in which such an aura was associated with convulsions, or at least with loss of consciousness, a lesion was found in the uncinate gyrus of the temporo-sphenoidal lobe.

In some cases the lesion was a tumour, in one case a small non-malignant cyst. In the case in which the cyst was found by Dr. Walter S. Colman the patient was a medical man who had been subject for many years to recurrent attacks ushered in with the "dreamstate." In this case the cyst was probably the result of some early, probably vascular, lesion, the effect of which was to produce a small area of unstable cells in that particular region. Here was a case characterized by recurrent convulsions of a particular kind, only differing from other cases of so-called idiopathic epilepsy in the character of the aura which preceded a fit. We know that in some of these cases the convulsion is associated with a structural change in a certain part of the brain. It is only reasonable to conclude that in all of them this same area is unstable—the cause of the instability in many is not proved—but the presumption is that in all the cause is a structural derangement.

There is another class of cases in which the convulsion is preceded by a visual aura. In some of these the aura is a somewhat elaborate one—a little woman in a red cape or some equally definite vision. In many the visual sensation preceding a fit is a simple one of flashes of light, and this causes the convulsion. In one case, which I have related elsewhere, the fits were left-sided, preceded by an indefinite disturbance of vision. These fits had come on rather suddenly and unexpectedly in an old lady sent to me by Mr. Fisher, and they were associated with definite homonymous hemianopia. The fits gradually ceased, the hemianopia persisting but gradually and completely disappearing. This lady made a complete recovery, and remained well for several years. In such a case one is justified in assuming that there was some vascular lesion—in the occipital cortex—which was at first irritative, but when the irritability of the cortex had subsided or been controlled resulted in temporary interference with the functions of the area in the cortex subserving the fields of vision of the opposite side. Such a case suggests that in cases with similar visual phenomena associated with fits the fits are due to some disturbance in the same area, and the fact that the convulsions are recurrent merely shows that the irritation is a persistent one, and not transitory, as in the case just related.

There is another class of cases that have to be considered—those, namely, in which attacks may have been present for years, associated with convulsion and loss of consciousness, but yet in which no sign of gross disease has been discoverable. I have elsewhere related two cases of this nature—one a patient who had been attending at the National Hospital, Queen Square, for seventeen years suffering from recurrent convulsions, but who unexpectedly developed headache, and was found to have optic neuritis. This patient died, and was found to have a large cerebral tumour. Another patient was under my own care, and had been attending for four years on account of occasional convulsion with loss of consciousness. He had no headache and no optic neuritis, and his convulsions were few in number under treatment; but he suddenly found himself suffering from severe headache, was found to have optic neuritis, and the headaches became so severe that decompression was undertaken with the hope of relieving him. There was intense intracranial pressure, and he died after a few weeks, and a large growth was found in one hemisphere. These two cases are, I believe, examples of a group—not perhaps a very large one—but they illustrate the thesis, so far at least as such a group is concerned, that such cases—apparently for years cases of so-called idiopathic epilepsy—are really cases in which early slight structural changes are almost certainly the cause of the fits.

It is well known to all who are interested in cases of recurrent convulsion, and who see many patients suffering from these, that there is a large class of cases in which the fits occur only during the night, so it is said, and these cases are named "nocturnal epilepsy." I think most observers will agree with me that it is not the time of day which determines the onset of convulsion in these cases, but the condition of sleep, for it is not uncommon for a

patient who suffers from such convulsions to have a fit during the day if he happens to fall asleep. So that it is sleep that really determines the attack, and the presumption is that it is some condition of nutrition or circulation associated with sleep which gives rise in certain cells to discharge which results in a convulsion. What the actual condition is we need not at present inquire. It is sufficient for our present purpose to note the fact.

In another class of cases the fits always occur in the early morning while the patient is dressing. In one case the fits only occurred if the patient had an early cold bath, and always occurred in the bathroom. In such a case it would seem as if the change of posture from the recumbent during the night to the upright in the early morning was the determining cause, and it seems natural to presume that the accompanying modification of the circulation was sufficient to give rise to the conditions determining a discharge in unstable cells.

Such considerations as those I have set out and the study of cases of a nature similar to those I have mentioned, seem to me to indicate clearly that epilepsy should not be regarded as a disease but as a symptom. The convulsions of what is called epilepsy are not in their manifestations to be distinguished from the convulsions of uraemia or from those occurring with heart-block and in other conditions. It is only the discovery of associated conditions which reveals the true nature of the convulsions, and the more one sees of these convulsions in what is called ordinary epilepsy the more is one driven to the acceptance of Hughlings Jackson's dictum that "there is no such thing as a case of ordinary epilepsy."

Each case of recurring convulsion must be studied by itself. The origin of the convulsions, their nature, the march of the discharge, and especially any premonition or "warning," must be most carefully considered. By such study the cause of the convulsions is most likely to be revealed, and if this is disclosed, treatment, either surgical or medical, may be undertaken with some hope of success.

REFERENCES.

¹ *Brain*, vol. xliii, pt. 1. ² *Med. Times and Gazette*, October 14th 1874. ³ *Ibid.* ⁴ *Brain*, vol. xxi, p. 580.

An Address

ON

THE HOUR-GLASS STOMACH.*

(With Special Plate.)

BY

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A DESCRIPTION of this well-known condition—hour-glass stomach—is hardly necessary, and in its typical form the x-ray picture is dramatic to a degree (Fig. 1). The picture of such a typical condition, after a test barium meal, shows the upper sac or cardiac end full of the food, and the lower end of this shadow has a clear cut margin, which as a rule comes down below the level of the narrowed outlet. At the site of the outlet on the lesser curvature is the ulcer cavity, with its lower part full of the food and with a gas bubble above it. A narrow stream of food passes downwards into the lower sac. This lower sac is half filled or more than half filled with food, and in this lower part, as watched on the x-ray screen, normal stomach contractions are seen and food going through the pylorus. This is the typical picture, but its x-ray varieties are very numerous, and scarcely any two cases are exactly alike in all their details. I have a record of 151 cases in which radiography showed an hour-glass condition of the stomach following on a test meal. An analysis of these cases brings out certain facts and shows certain fallacies and the possibilities of errors. The many variations which occur will depend upon, for the most part:

1. The size of the upper sac.
2. The size of the constriction.
3. Whether or not an actual ulcer cavity exists and fills up with food, and, if so, its shape and size, and whether there are adhesions to neighbouring organs and tissues.

* Given before the Manchester Medical Society, November 1920.

FIG. 1.—Typical hour-glass constriction from ulcer of perforating type on lesser curvature.

FIG. 2.—Hour-glass stomach; small and non-adherent ulcer on lesser curvature. Tight constriction. Eight hours after meal.

FIG. 3.—Hour-glass constriction. Perforating ulcer. Definite constriction with large opening.

FIG. 4.—Hour-glass constriction and ulcer cavity. Immediately after meal, no food in lower sac. Coin on umbilicus.

FIG. 5.—Hour-glass constriction. Ulcer cavity full. Food in constriction. Traces of former meal in descending colon.

FIG. 6.—Five hours after meal. Shows upper sac, ulcer cavity, and a trace of food in the lower sac. Extremely tight constriction; no food entered lower sac until five hours after meal.

FIG. 7.—Simulation of hour-glass constriction by pressure from gas-distended colon.

FIG. 8.—A real hour-glass constriction from ulcer on lesser curvature masked by pressure from gas-distended colon.

FIG. 9.—Spasmodic hour-glass constriction in a male. The spasm was permanent during a long examination, repeated at intervals. Compare Fig. 10.

FIG. 10.—Second examination. Same case as Fig. 9. Spasm not present.

FIG. 11.—Early hour-glass constriction (true) from small ulcer on lesser curvature. The ulcer had previously perforated, and the patient had been operated upon.

FIG. 12.—Hour-glass constriction in a woman with typical history. At operation considered to be malignant.

4. The condition of the lower sac.
 5. The presence of pyloric obstruction in addition.
 6. The presence of adhesions generally.
- (See Figs. 2, 3, 4, 5, 6.)

FALLACIES AND POSSIBLE ERRORS.

If the definite typical appearances are seen no possibility of error presents itself, and the diagnosis is certain. In less typical cases, however, there are certain possibilities of error which must be reckoned with and guarded against. I will allude to a few of the more common possibilities.

1. *Gastroptosis*.—In this condition the stomach may be much elongated; food on entering collects in the cardiac end, extends downwards in a straight or more or less thin line, and then fills up the lower portion of the stomach. The appearance of an hour-glass constriction is thus simulated by the drawing out, and so drawing together, of the central portion of the stomach surfaces. However, no error of diagnosis should arise in this condition, since (1) the pressing up of the food from the lower part by the hand when viewed on the screen, and (2) the examination of the patient in the lying down position, will at once obviate any possibility of making a mistake.

2. *Malignant disease* will not unfrequently give rise to appearances simulating hour-glass constriction from old simple ulcer; but as a rule this disease causes other alterations in the shape of the shadows which will at once give rise to suspicion. Additionally the history of the case—the more rapid onset of symptoms—rapid loss of weight, and so on will indicate the real nature of the case.

3. *Pressure from Distended Large Bowel*.—A large collection of gas in the splenic flexure or its neighbourhood pressing into the greater curvature of the stomach will occasionally (1) cause the food shadow to simulate an hour-glass constriction, or (2) may mask a real hour-glass stomach. If this gaseous distension—easily recognized on an x ray plate—is seen, the bowel should be again cleared out and a second examination made. This, and the screen appearances seen on pressing food upwards from the lower part of the stomach, easily leads to the differentiation. (Figs. 7 and 8.)

4. *A Small Ulcer on the Lesser Curvature and Spasm*.—These may be considered together. The former may set up spasmodic contraction, or spasmodic contraction may be present alone without any definite stomach lesion. In the latter case it is as a rule associated with bad teeth, the appendix, gall-bladder trouble, duodenal mischief, or more remotely the pancreas. These spasmodic contractions are always atypical. They differ entirely from the appearances seen in the typical case described. Both causes give rise to a definite drawing in of the greater curvature, which, at any rate for a time, will sharply divide the stomach shadow into two well-marked portions—an upper and a lower sac. (Figs. 9 and 10.)

Sometimes a true hour-glass constriction will give rise to the same x ray appearance and take this form of a sharp drawing in of the greater curvature on quite a small area, and it is this true hour-glass stomach which has to be differentiated from the pseudo-type. (Fig. 11.)

To do this, and when this appearance is seen, very great care must be taken. Sometimes massage of the stomach will relax a spasm and clear up the diagnosis. Sometimes pressing the food in the lower part upwards will open a spasm up and prove that the constriction is temporary. If any further doubt exists, a second test meal on a future date may show the absence of any constriction. Examination in the lying-down position, the administration of belladonna, and so on, may be of help. At the same time, if we have to deal with an ulcer of the stomach which gives rise to spasm that simulates a true hour-glass constriction, then the results as regards the symptoms of the patient and the treatment required will in reality be the same. The obstruction is there and potential, whether it be due to spasm or a definite cicatricial narrowing. I emphasize the point—when an ulcer is actually present—if the spasm is due to reflex causes then its effect on symptoms will vary according to whether it is present or not, and of course no operation on the stomach itself is indicated.

SEX OCCURRENCE.

It is a very remarkable fact that—at any rate, in my experience—true hour-glass constriction from old ulcer

occurs with far greater frequency in females than in males. In my whole series of 151 cases it occurred in females in 123 cases and in males in 23, but many of the males on analysis should not be classified as hour-glass constrictions of the stomach, due to simple ulcer—a point I shall refer to later on—and in a few of the females also this is the case. This means that the total number of true cases is less than 151.

It is a very curious point—I cannot offer any likely suggestions as to its cause—that, taking out all those cases in which there can be no doubt about the condition—namely, those cases of hour-glass contraction undoubtedly due to simple, as contrasted with those due to malignant, disease—and the huge majority of these are in females. This form in males is seen so unfrequently that it may almost be said to be rare. Perhaps there may be some connexion in the wearing of and pressure from corsets, but I am not very satisfied with this as an explanation.

Analysing the males in more detail, I find that—

1. Although nine of them presented an hour-glass appearance, either clinically, under the x rays, or at operation, or by all three methods, they were in reality cases of definite malignant disease. In all these cases the history—and I take it that this is a point of great importance—was a very short one, extending over months only.

2. Five were cases in which a gastro-enterostomy had been done some years previously, and these appeared to be due to the late effects of the gastro-enterostomy.

3. One followed on a very severe abdominal crush.

Therefore only 8 out of the 23 males can be classified as typical hour-glass stomach caused by simple ulcer—and of these 5 were proved by a later operation. The history of these cases was the same as that in the females—the salient point being that symptoms had been present over a number of years, extending from a few years up to, in one case, twenty years.

As a considerable number of the cases occurred during the war, complete records are unobtainable, but I have the records of 73 operations, and it seems to me that this number is enough to establish the important points.

In two of these cases only (both females) was it decided by the surgeon at the operation that there was malignant disease, and they were closed up without anything being done. (Fig. 12.)

In two cases (Mr. Thomas) at the operation enlarged glands were present, and the cases on the table were considered to be probably malignant. In both the operation was proceeded with, and a removed gland was later reported on as being "simple." The after-history of one case is not known; the other is known to have been alive and in good health six years later.

In the remaining 69 cases, at the operation nothing was found to give rise to any suspicion of malignant disease. Many—again I regret that I cannot supply exact figures—have been seen again so long afterwards that malignant disease was out of the question. I have not any record that it is known that in a single case any later suspicions of malignant disease have arisen.

Referring in detail to a few of the more interesting cases which came under observation: In one at the operation a constriction two to three inches long was found; there was no evidence of any old ulcer except some very slight cicatricial tissue along the lesser curvature. This was a female, aged 31 years, with a history of attacks of pain and vomiting for ten years. There were no adhesions; the food came away from the upper sac from its lowest point in a thin stream corresponding to the size of the constriction, which hardly admitted a small probe. This is possibly a case of congenital hour-glass stomach. A second case showed two distinct ulcer cavities on the lesser curvature. Another case showed all the food in what was obviously the upper, cardiac, end of the stomach; a thin stream tended to percolate downwards; no ulcer cavity and no lower sac was made out. The history was that eight weeks previously she had swallowed a wineglassful of oxalic acid; no doubt the lower part of the stomach had been practically destroyed. A fourth case must be one of the rarest possible occurrence: a woman of 40 years of age, the usual prolonged history of digestive disturbances, but also associated with acute colic attacks in the left abdomen just below the costal margin. It was discovered that she had transposition of viscera, which an x-ray examination showed to be complete—the stomach was on

the right side and the colon transposed. She had a typical hour-glass constriction from an ulcer on the lesser curvature.

At the subsequent operation Mr. Kelly confirmed the x-ray findings absolutely, but he also found a collection of gall stones in a gall bladder on the left side. It is unfortunate that we had not examined her for gall stones—they might have shown. The combination of transposition of the viscera, *plus* hour-glass stomach from ulcer, and *plus* gall stones, must be one of the rarest pathological conditions ever reported.

FREQUENCY OF THIS CONDITION.

It is obvious from the number of cases I alone can report that it is a comparatively common condition—151 cases spread over a period of ten years in the x-ray department of one hospital, in which only in-patients are examined as regards the stomach, prove this. Before the days of x rays it was looked upon as comparatively rare.

DIAGNOSIS.

The exact demonstration of this condition must be looked upon as one of the many triumphs of radiography—a triumph almost, if not quite, as fine as the demonstration of kidney and ureter stones. It is not too much to say that the accurate diagnosis is entirely one of radiography, and a consideration of the symptoms, etc., and their bearing on the case, prove this to the hilt. At the same time, of course, too much must not be expected by the surgeon, and in many points of detail it may fail to indicate certain features found at operation.

If we take into consideration the main features of a case, the difficulty—or even the impossibility—of accurate clinical diagnosis becomes evident. In its classical form you have a stomach with an ulcer of long standing somewhere about its middle, and usually on the lesser curvature. This ulcer is frequently of the slow penetrative type, and it becomes adherent to liver, pancreas, or other neighbouring structures. As a result of cicatrization the stomach, at the site of its occurrence, is so narrowed that there is a stenosis, and the food passes through the stenosed portion with more or less difficulty, according to the amount of the stenosis, or according to the amount of the stenosis *plus* some additional spasm. The latter—spasm—is of purely secondary consideration, as, if it is present, its effective action is precisely the same as a permanent cicatricial stenosis. Now, if you have an ulcer at or near the pylorus causing pyloric constriction, exactly the same potentials are present, except that the food block in the latter condition is at the pylorus instead of in the body of the stomach, and the only essential difference is the passage of the food from the stomach into the bowel instead of from one part of the stomach into the other.

The point is that the ulcer will give rise to the same symptoms in whichever place it occurs if it produces a stenosis, and you will get precisely the same history from the patient—namely, a very long history of attacks of indigestion usually associated with pain after food relieved by the vomiting of food. Sometimes there is vomiting of blood—we have a record of this in 51 of the cases only. The attacks get worse and worse, the intervals between are less and less free from indigestion, and then an attack which persists for a long time without relief, often with considerable loss of weight—due to malnutrition and inability to take food—and the patient is finally x rayed and the diagnosis made clear.

The history, the physical signs, the condition of the patient, will not, in the vast majority of the cases, distinguish between pyloric stenosis from ulcer and the hour-glass contraction from ulcer.

We used to hear much of the importance of gurgling on palpation—caused by pressing the fluid contents from one sac to the other—and of obtaining sour and stinking stomach contents by means of washing out, and so on, and it was said that these were diagnostic signs. To my mind they are of little or no importance, and they will not be obtained in the huge majority of the cases, but only in those cases in which hour-glass constriction and pyloric stenosis are present *in the same case*.

It is rare to find that the upper sac does not (1) allow its contents to pass on even if slowly, and it often empties quite rapidly, or (2) that it will eject its contents after an interval by vomiting. It is also rare to find pyloric

stenosis associated with hour-glass stomach, although I have seen this on occasion, and when it does occur it can almost always be determined by the x-ray examination.

I say, therefore, that the clinical diagnosis is always one of extreme difficulty, and as a rule one can go even further and say that it is practically impossible. The diagnosis is an x-ray one, and, always admitting limitations as to detail, it is extraordinarily accurate.

I have taken a note as to the provisional diagnoses entered on the papers which are sent to the x-ray department when an x-ray examination is asked for. They include dilated stomach, pyloric stenosis, gastric spasm, gastric ulcer, malignant disease, oesophageal stricture, viscerotaxis, intestinal obstruction, and, lastly, "cause of symptoms" and "no diagnosis"—the latter is undoubtedly the safest. In only five cases of the whole series has hour-glass been mentioned on the papers sent with patients to the x-ray department and the diagnosis been confirmed by the x-ray examination. On the other hand, when first these cases began to turn up somewhat frequently in the x-ray department, we got a number of papers marked "hour-glass stomach," and in practically none of these was the condition found.

I am not making these statements in order to criticize in any way the ability of many accomplished physicians and diagnosticians, but merely to emphasize my point—namely, that the exact diagnosis is almost an impossibility, and that the distinction between hour-glass contraction and pyloric stenosis cannot as a rule be made.

Simple Ulcer and Carcinoma.

The final point I wish to raise is the bearing of these records on the much vexed question of the cause of gastric carcinoma and their bearing on the probability of simple ulcer being a frequent predisposing cause of stomach cancer. It must be, of course, understood that I am speaking entirely from the limited experience of the x-ray department and the impressions which the x-ray examinations have made.*

Examination of the records of 151 cases of hour-glass contraction, in which it may be taken that the large majority were caused by gastric ulcer, yields the following results:

We must eliminate cases definitely proved before operation to be due to causes which do not come within the scope of this paper; we must eliminate also 9 of the male cases in which, although they presented an hour-glass appearance, the diagnosis was one of malignant disease, and in which the histories were so short that there was no reason whatever for supposing them to be cases of long standing; they were obviously recent malignant disease with no previous symptoms. We come then to this: That we have some 120 females and 8 males in whom an hour-glass contraction existed and in whom the history extended over years, and of these cases 73 females and 5 males can be recorded with their operative findings. Five of the females had a history of less than one year; all the males and the rest of the females had histories of anything from two to thirty years, the longer histories largely predominating.

In these cases, as I have said before, the typical history is repeated attacks of acute indigestion *plus* pain and *plus* vomiting, and in less than half a history of haematemesis; a long history of gastric ulcer, mostly of a type in which there is obviously the greatest possible amount of local irritation due to a chronic ulcer over which food is constantly passing, and in many cases an ulcer cavity adherent to, and its walls partly made up of, neighbouring tissues. If ulcer is the usual predisposing cause of gastric cancer, then surely this is the very type of case in which it should occur frequently. Yet what do we find? In 128 cases (120 females and 8 males) only one female and two males were proved to have cancer, and in all 73 operations recorded, and with 3 on the operating table thought to be malignant, but whom the later history or the pathological report proved them to be not.

Again, and from the x-ray point of view, we see a large number of huge, dilated atonic stomachs due to pyloric stenosis, and without being able to give you the actual figures, I am sure that in our department they are equally frequent in men and women. The history is again one of many years' duration; the cause is practically always pyloric ulcer. So few of these are afterwards reported as

* See *Liverpool Medico-Chirurgical Journal*, January, 1914, p. 107.

showing any evidence of malignant disease that, although in an occasional case malignant disease is reported as having been found at the operation, it is so rarely that I have come to look upon these cases as so certainly non-malignant as to warrant an optimistic pre-operative prognosis.

On the other hand, an *x*-ray experience of the malignant stomach is that it is far more frequently seen in males; that on going into the history carefully, the very large majority state that the symptoms have been present for a matter of a few months only; and that never in their lives have they had any "indigestion" before this attack. There is nothing in the history to suggest in any way a pre-existing ulcer. I say that this is the common history, and that only a comparatively few relate a long-continued history of intermittent attacks of digestive disturbance.

There are also other facts bearing on this question. Duodenal ulcers are extremely common; they are continually irritated; they are rarely malignant. Cancer of the oesophagus is so common that I have seen literally hundreds of cases in the *x*-ray department. The symptoms are sudden and the history almost invariably that of a few months at the most—nothing to suggest previous ulcer.

These facts have produced a very distinct impression and raised very great doubts in one's mind that gastric ulcer is a common antecedent to malignant disease of the stomach. I suggest that these *x*-ray facts will require a lot of explanation before such a cause for cancer of the stomach can be accepted in the vast majority of cases.

SUMMARY.

1. Hour-glass contraction from simple ulcer is a comparatively common condition—frequent in females, rare in males.
2. Its symptomatic history is a long one.
3. It is almost entirely an *x*-ray diagnosis.
4. It rarely ends in malignant disease—especially in females.
5. An hour-glass condition is found in a few cases, mostly in males, and with a short history, and which is caused by malignant disease. Its *x*-ray appearances generally differ considerably from those seen in the non-malignant type, and are suggestive.
6. The experiences of a large *x*-ray department are strongly opposed to the theory that it is usual for cancer of the stomach to be preceded by a simple ulcer.

MESSAGE OF THE HEART AND RESUSCITATION.

BY

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In a paper published in this JOURNAL (November 6th, 1920) Mr. W. E. Fisher describes cases of "Resuscitation in Death under Anaesthesia," and in regard to cardiac massage he says that "it will be of great help if an understanding of the processes concerned is quickened by a clear pronouncement by physiologists, to whom we must look for guidance and more definite directions." I feel sure that he is not aware of a paper published in 1915¹ by P. A. Martin and myself, in which we attempted to give clearer directions for performing cardiac massage than had hitherto been done, and anticipated some of the observations that he has made on the human heart. Since this paper has escaped the attention of others who have subsequently written upon the subject of cardiac massage—as is almost inevitable with the multiplicity of medical journals—I think one may be excused for recapitulating, in a journal more accessible to clinicians, some of the results there recorded, the more so as I may take this opportunity of adding some other observations on the subject of resuscitation based upon unpublished experiments.

I may first state part of the conclusions arrived at by Martin and myself.

"In performing massage of the arrested heart with a view to reviving the spontaneous contractions, the following points are of importance:

"Compression should be gradual and relaxation abrupt. The rate of compression should be at most less than half the normal

heart rate. Massage should be regularly interrupted at short intervals for a few seconds to allow the spontaneous beats to develop. When the heart is arrested, massage, properly performed, acts both as an artificial circulation and as a mechanical stimulus to the heart muscle.

"Massage can be performed in the following ways, arranged in order of efficacy: (1) By direct compression of the heart through an opening in the thoracic wall; (2) by compression of the heart above the diaphragm through an opening in the abdominal wall; (3) by simple compression of the abdomen; (4) by simple compression of the thorax.

"Direct thoracic massage combined with intrapericardial injection of adrenine can revive the heart in practically any case of chloroform poisoning in the rabbit, even though the treatment be not begun until fifteen minutes or more after the heart has completely ceased to beat.

"In about 70 per cent. of cases recovery can be obtained if treatment is commenced ten minutes after arrest of the heart by the following procedure: artificial respiration through a tube in the trachea; intrapericardial injection of adrenine; massage through an opening in the abdomen. If, when the heart has been started, the blood pressure continues low and the heart beats remain (chiefly as a consequence of this) feeble, speedy and permanent improvement of the heart and blood pressure can be obtained by intravenous injection of either adrenine or pituitrin.

"Treatment on these lines is suggested for cardiac arrest in the human subject, occurring either in chloroform poisoning or in other conditions in which general recovery might be anticipated to result from resuscitation of the heart."

Before the publication of our paper the expression "massage of the heart" had been used as if the manner of performing it were indifferent, but we found experimentally that attention to points of detail may make all the difference between success and failure in difficult cases of resuscitation of the arrested heart. The grounds for certain of the conclusions given above may therefore be of value.

One question of the first importance is this, that "rhythmic compression of the heart effects in the first place an artificial circulation; it produces movement of the blood in the vessels to an extent which depends upon the way in which it is done." In animal experiments such as we performed an indication of the mechanical efficiency of massage in effecting a circulation of the blood could be obtained (the blood pressure being at zero) by the amplitude of the wave of blood propelled into the aorta by each compression of the heart. A record of this wave was obtained by a mercury manometer connected with a carotid artery. But a more direct proof of the fact that massage of the heart acts, to begin with, as a substitute for the spontaneously beating heart in causing a circulation of the blood was obtained in the following way: A solution of a blue-green dye "was injected into the cavity of the right ventricle of an arrested heart. Cardiac massage was then performed, and after a few compressions the blue-green colour appeared first in the lungs and then in the carotid artery. Massage had therefore propelled the blood from the right ventricle through the lungs and left side of the heart into the systemic circulation."

Fisher describes this action of massage as "an influence upon the circulation that I have not seen previously observed." It is all the more interesting that he has described independent observations on the same phenomenon but judged by different effects—namely, flushing of the skin and rise of intraocular tension occurring as the result of massage prior to spontaneous beating of the heart.

This action of massage has an importance not merely academic. I have started the heart beating an hour after it has been arrested by chloroform. I have perfused the exsected heart of a stillborn child four hours after the child was born, and started the heart beating again. The difficulty is not so much in starting the heart, though this may of course be difficult, but in starting the heart sufficiently soon that the other tissues have not meantime been rendered incapable of recovery by stoppage of the circulation. So far as is known, it is the cells of the central nervous system that are most susceptible to stoppage of the circulation, so that, from the practical point of view, the circulation must be started before the cells of the central nervous system are irretrievably damaged. The current opinion is that after complete stoppage of the circulation for about fifteen minutes the cortical cells cannot be revived. While my own experiments have also pointed to this conclusion, I am not convinced that it is true; and, for reasons that I need not enter into here, I should not be surprised if some day it were shown that even the cortical cells can survive arrest of the circulation for a much longer period. What is