Oliber-Sharpen Lectures

ON

THE NATURE OF FLUTTER AND FIBRILLATION OF THE AURICLE.

BY

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LECTURE I.—AURICULAR FLUTTER.*

MR. PRESIDENT,—May I first thank you, Sir, and the College which you represent for the honour you do me in appointing me to this lectureship—a lectureship founded to promote physiological research by observation and experiment and to encourage the application of physiological knowledge to the prevention and cure of disease; a lectureship founded to commemorate a great physiologist, and founded by a physician whose work in this very field is known to and admired by all of us.

The request which you have made, and which I have gratefully accepted, has come at a moment which to me is opportune. This lectureship carries with it a responsibility of no little weight; no lectureship could possess a more serious or far-seeing purpose than the welding together of Physiology and Experimental Medicine. I have said that for me the moment is opportune, for it comes at a time when observations in which I have been deeply interested for many years have grown to a state of some maturity. The observations of which I shall speak are essentially of a physiological kind; the investigations are reaching a point when their applicability to the practice of medicine cannot long remain in doubt. The subject chosen is the only subject which I could choose for these lectures—the work upon which my collaborators and myself have now been engaged for many years, a subject upon which we have been almost exclusively engaged during the past

two years. These researches have comprised an attempt to solve the meaning of certain grave disturbances of the human heart beat, and it is my good fortune to be able to say to-day that we are at the end of this task.

It is a long story, and, if it is to be told intelligibly in these two lectures, it must be told connectedly. With your permission I will try and place before you the leading facts

and arguments; I will narrate these, not in their historical order, but in the order most suited to my purpose, namely, to show you where our knowledge of auricular flutter and auricular fibrillation now stands. If I am to do this in the time at our disposal I shall be unable to bring before you anything but a small part of the evidence upon which our conclusions rest. Assuring you now that I shall draw no conclusion lightly nor without most closely weighing all the evidence, I must, from the force of circumstances, ask you to take much for granted. In another direction, also, and for similar reasons, I crave indulgence. It will be impossible for me suitably to bring into the compass of these lectures the names of many contributors to this field of knowledge. This historical aspect has been dealt with recently and fully in another place. In so far as I have myself contributed during the last two years, I have contributed with my immediate collaborators; we have worked as a team under the auspices of the Medical Research Council; the names of my co-workers are

Dr. Thomas Cotton and Dr. A. N. Drury of this country; Dr. H. S. Feil, Dr. W. D. Stroud, and Dr. H. A. Bulger of the United States, and Dr. C. C. Iliescu of Bucharest. From these introductory remarks I may proceed to my subject.

SOME NORMAL FEATURES OF THE CONTRACTION PROCESS.

Let me first briefly describe the relevant events when normal heart muscle contracts in response to a natural or artificial stimulus. The first event of which we possess knowledge is that it passes into what is termed the *state of excitation*. By this we mean that the muscle develops a charge, just as a battery develops a charge, and that currents flow through it and the surrounding tissues. The charge is such that the active muscle becomes relatively negative to that which is still inactive, in the sense

that the zinc terminal of a copper-zinc battery is negative to the copper. These electrical changes, associated with muscular activity, are of sufficient magnitude to be recorded by means of sensitive instruments, and they yield the pictures now spoken of as electrocardiograms. The electrical change in the muscle is the immediate precursor of contraction:

first the muscle becomes excited (or charged), secondly it contracts. The two events are separated in the mammalian auricle by a small time interval of three-hundredths of a second or less.

Now the process of excitation is not simultaneous in all parts of the muscle; it begins at the point first stimulated

FIG. I.—A diagram illustrating the progress of a single wave passing through a ring of muscle as a result of stimulating it at *a*. The black portion of the ring represents the refractory state, and the figure shows its progress through the ring till it involves the whole (4); later the figure shows its subsidence.

FIG. II.—A second stimulus enters the ring while it is in the condition shown in Fig. I. 4. While the first wave is subsiding the second wave spreads.

FIG. III.—A diagram to illustrate the establishment of a circus movement in a ring of muscle. The ring is stimulated in its lower quadrant and the wave spreads to *A* and to *B*. At *A* it is blocked, but from *B* it continues around the ring. When it arrives at *E* the refractory state at *A* is passing, and so the wave continues to travel around the circle (5-10).

* Delivered before the Royal College of Physicians of London, April 12th, 1921.

* That the electrical change precedes the contraction is at the moment the accepted view, though the interval is acknowledged to be very short.

and spreads from this point. Stimulate a point in the centre of a sheet of muscle and the wave spreads concentrically, as does the ripple on the surface of a pond into which a pebble is thrown. It is conducted from one muscle element to the next as a wave, which is termed the *wave of excitation*. Similarly with the contraction process itself; this also spreads as a wave which accurately follows the course travelled by the wave of excitation. It may be likened to the second ripple on the pond. For our present purposes and to simplify the conception, we may regard these waves as one, signalling itself as it proceeds, first electrically (first ripple), then mechanically (second ripple). When, therefore, I speak of the wave of excitation in the auricle and of the course it takes, you may picture in your minds the wave of contraction without fear of serious misconception. Nevertheless, I should, perhaps, be guilty of inaccuracy if I spoke of the wave of contraction, because our studies have been mainly, though not exclusively, directed to the wave of excitation; for movements of the latter are to be recorded with far greater accuracy than movements of the former.

Movement of the excitation wave is recorded by connecting a sensitive galvanometer directly to the surface of the muscle. As the wave passes the chosen point, the galvanometer yields a sharp deflection, and this may be photographed and accurately timed against the events in some other region of the muscle. I do not propose in the present lectures to enter upon a detailed description of this delicate method, but am content to declare that we can time the arrival of this excitation wave at any point of the muscle surface with such accuracy that the error is no more, usually it is less, than one thousandth of a second; that by using two or more recording instruments simultaneously we can trace out the paths taken by waves of excitation as they travel through the muscle; and that we can estimate very accurately the time lost in the passage from point to point in different circumstances.

The wave of excitation, the first of the contraction process, travels until it involves the whole surface of the muscle; it travels in every available direction until it has exhausted all tracts of responsive muscle. Starting in the centre it travels until it comes to the boundaries; there it ends, for at the boundary it finds no further tracts of responsive muscle through which to pass. Appropriately you may liken the spread of the excitation wave to the flame of a prairie fire. It spreads concentrically wherever it finds inflammable material; it cannot return over its scorched wake, neither can it proceed when it reaches the bounds of the dried acres. The wave of excitation leaves the muscle over which it passes in a non-inflammable, or, as it is termed, *refractory state*, and that muscle is incapable of carrying a second wave of excitation until its original inflammable state is restored. The period during which this restoration is effected is

called the *refractory period* of the muscle; in the natural beating auricle of the dog it lasts from a fifth to a tenth of a second; its duration is approximately the same as the duration of the contracted state of the muscle.

From these preliminary observations I pass to what may be termed the "ring experiment."

THE RING EXPERIMENT.

The ring experiment was first performed by Mayer in 1908; he used the contractile bell of the jelly-fish and

subsequently he utilized rings of muscle cut from the ventricles of turtles. His experiments were repeated and amplified by Mines in 1913 upon rings of muscle cut from the auricles of teleostean fishes. In 1914 both Mines and Garrey reported that they had obtained similar effects in rings of muscle cut from the dog's ventricle.

The experiment from our present standpoint is fundamental; I shall describe it, therefore, in some detail.

Suppose that we stimulate a ring of muscle, such as is depicted in Fig. I, at *a* the centre point of its lowest quadrant, and start in it by means of a single shock a wave of excitation. This wave, as soon as it has involved the whole cross section of the ring, develops two crests, which travel rapidly along the two limbs of the circle until, as shown in the serial diagrams (Fig. I, 1-4), they meet at point *b*, the centre point of the highest quadrant. At the instant the crests meet the whole ring has become involved by the wave; the whole has passed into a state of excitation; it has all become "refractory." When, therefore, the two crests meet at point *b*, movement is

brought to an end; like two waves of flame, two waves of excitation meeting do not override, each crest forms an impassable barrier to the other. The ring of muscle remains in this state of excitation for a period and then recovers. It recovers in the order in which it has become involved, it begins to be "responsive" in its lowest quadrant (at *a*) first of all. The

wave of "responsiveness" travels similarly as two crests along the two limbs of the ring (Fig. I, 5-8) until they also meet and coalesce at *b*, the centre of the highest quadrant. The ring of muscle has now returned to its original condition; it is once again wholly in the responsive state.

Such is the series of events when the muscle of the ring responds to a single stimulus. If the ring is stimulated by means of slow rhythmic shocks, each shock awakens a like series of events, providing that the intervals between the shocks are amply sufficient to permit recovery. Each stimulus yields a double-crested wave of response, which ultimately involves the whole ring. It will be evident that, if in rhythmic stimulation the second shock falls upon the ring while it is in the condition represented by Fig. I, 6, a fresh wave may be propagated at *a* before the response to the first shock has subsided at *b*. In such circumstances two waves will

FIG. IV.—Examples of auricular flutter, clinical and experimental. The upper or clinical curve was taken from a patient in whom flutter was continuous. The auricle (P) is beating at a rate of 228 per minute and regularly; the ventricle (R) at half that rate. The ventricle responds to alternate beats of the auricle; the beat of the auricle to which there is no response falls with the beat of the ventricle. The lower or experimental curve shows the end of a period of flutter and the return of the normal rhythm. The first half of this curve is to be compared with the upper curve. During the period of flutter the auricle (P) is beating rapidly and regularly; the ventricle (R) at half the rate. The ventricle responds to alternate beats of the auricle; the beat of the auricle to which there is no response falls with the beat of the ventricle.

FIG. V.—Examples of auricular flutter, clinical and experimental. The upper or experimental curve was taken from a long period of experimental flutter. The auricle (P) is beating regularly and continuously at a rate of about 350 per minute; the ventricle (R S) is beating much more slowly. The lower curve is from a patient in whom flutter had persisted for many months. The auricle (P) is beating regularly and continuously at a rate of about 270 per minute; the ventricle (R S) is beating much more slowly.

be moving through the ring at one time, as depicted in Fig. II, 6-8.

We come now to a different form of reaction; it is that which especially concerns us. It happens when the rate of rhythmic stimulation is raised to a critical point—namely, when the intervals between the shocks are such that each falls on the muscle at a time when responsiveness in this muscle has not wholly recovered. In such circumstances the wave propagated by stimulation may be unable to travel with its usual freedom in all directions. From time to time it is found that a wave propagated from the point of stimulation can pass in one direction only. It starts well enough, perhaps, and reaches two points of the ring *A* and *B* (Fig. III); but at *A* it finds the muscle still insufficiently responsive, while at *B* recovery is more advanced. At *A* progress comes to an end, while at *B* the crest continues to move. Suppose that at this instant stimuli are withdrawn; the conditions are peculiar. Instead of two crests, advancing to meet and interfere,

FIG. VI.—Three electrograms recorded simultaneously from the taenia terminalis of a dog while the auricle was fluttering. The top curve (1) was taken from the inferior caval, the bottom curve (3) from the superior caval, and the centre curve (2) from the mid region of the taenia. The record corresponds to five cycles of flutter (*a-e*). As each excitation wave passes, it signals itself by means of a sharp upward movement of the three recorders. Recorder 1 moves first, recorder 2 a fraction of a second later, and recorder 3 a fraction of a second later still. The order of excitation is 1, 2, and 3; the wave is passing up the taenia.

there is now but one, and it is free to circulate, for as it comes to each new segment (*C, D, E*) of the ring it finds this segment excitable (Fig. III, 2 to 4). The single crested wave consequently progresses around the whole ring, and, coming back to its starting point, finds that this muscle also has recovered (Fig. III, 5); it proceeds so long as the conditions remain unaltered; it continues its course as a circulating wave which has no ending (Fig. III, 6 to 10). Thus it has been shown that, the conditions being nicely controlled, the last stimulus of a series may originate, not a single response of the ring, but an unlimited series of responses. Mines saw the wave continue to circulate for minutes, Mayer saw it continue for very many hours; this is what is meant by circus movement; it is constituted by a wave of response which travels continuously along a re-entrant path of muscle.

AURICULAR FLUTTER.

We may now examine a condition of the mammalian auricle, to-day called auricular flutter. Flutter as we now understand it was first clearly described in a patient by Hertz and Goodhart in 1909; they studied their case by means of venous curves, showing the auricle to be beating continuously and regularly at a rate of 234 per minute.

Their description was quickly followed by the more ample records of Jolly and Ritchie, and of other writers. The rate of the auricular beating in flutter is from 230 to 350 per minute; the action of this chamber is remarkable, not only for its high rate, but for its regularity. It is to be recognized with the greatest certainty in electrocardiograms, of which examples are shown in Figs. IV and V. The condition is also remarkable because it continues uninterrupted for long periods of time. Sometimes it may occur in short paroxysms, more usually it comes to stay for months or years. Its nature until quite recently has remained altogether mysterious, though very numerous observations have indicated its close affinity to the condition called fibrillation. Thus flutter is often converted into fibrillation by the administration of digitalis. There have been few satisfactory records of a similar experimental condition. The term "flutter" was used by McWilliam as early as 1887; that was in the days when the two conditions flutter and fibrillation were not definitely

FIG. VII.—A natural outline of a dog's auricle, showing the paths of the excitation wave (broken lines) while the heart beat naturally (lower diagram) and during flutter (upper diagram). The numbers indicate the approximate order in which various parts of the musculature received the excitation wave.

distinguished. The first electrocardiograms of experimental flutter—and these curves are alone really distinctive—have been obtained during the past few years. We are now certain that a condition identical with that found clinically may be produced experimentally in the dog's auricle; this we have been taught by clinical and experimental electrocardiography.

In investigating disease there is one well known and most fruitful method of approach: it is to produce in animals a condition identical with that seen in the patient. When this has been accomplished it becomes possible to inquire into the precise nature of the disturbance. If and when that knowledge is obtained, we are in a position to consider rational plans of treatment. As I have related, in the case of flutter of the auricle, the first step has been taken. A continuous and rapid action of the dog's auricle can be produced in several ways, notably by rhythmically stimulating the organ with induction shocks at a rate of 300 to 600 per minute. The auricle is driven rhythmically and rapidly for a few seconds, and the stimuli are then abruptly withdrawn. In a certain proportion of such experiments a rapid action of the auricle continues after stimulation has ceased. The rate of action is not usually that of the rhythmic shocks which provoked

it; it is usually less. For the moment our chief concern is not the method of producing this rapid and continuous action, but its nature. Its nature is variable, but amongst the after-effects of stimulation a condition identical with clinical flutter is seen from time to time. It is not every auricle which is predisposed to flutter; it is not every stimulation which will invoke flutter in the predisposed organ. That, however, is immaterial, providing that we can produce it, and can be certain when it is produced that it is identical with the clinical condition. The electrical curves, clinical and experimental (Figs. IV and V) leave us with no doubt on this subject; these curves, so delicately analytical, place the conclusion beyond question.

Having produced experimental flutter, we proceed to investigate its nature. The method of investigation consists of mapping out the path taken by the excitation wave while flutter is in progress. A single illustration of method will perhaps suffice. The auricle of a dog has been forced into a state of flutter, as ascertained by electrocardiograms taken by methods comparable to those used clinically. The flutter continues uninterruptedly. Three points are now chosen in the line of the taenia terminalis, and to each of these a sensitive galvanometric recorder is connected. The curves of these recorders write simultaneously (Fig. VI). As the excitation waves flow through the muscle they pass beneath the several contact points, and at each the passage is signalled. The curves, considered together, show that each wave is passing regularly up the taenia from the region of the inferior to the region of the superior cava, and we are able to measure the rate at which it is travelling. This record is published to illustrate the orderly character of the events as the cycles are repeated, and to indicate with what certainty the direction taken by the excitation may be ascertained. Actually a slightly different plan of campaign to that described is usually adopted. It consists of maintaining one lead as a standard and moving a second to various points of the auricle, timing the arrival of the excitation wave at its several parts relative to the standard lead, and finally of its arrival at the several parts relative to each other. To exemplify in a simplified fashion a complete experiment I may use Fig. VII. This figure shows the natural outline of the auricle as it is seen from above. The two appendices project upwards in the diagram; the superior and inferior venae cavae are represented as transected. The figures 1, 2 and 4 in the lower diagram lie on the taenia terminalis. The order of excitation displayed by this animal while the heart beats normally is indicated in the lower diagram by the figures 1, 2, 3, 4, etc. The excitation wave, as is usual when the heart beats normally, starts in the region of 1, the point at which the sino-auricular node or "pace-maker" lies. A little later it is to be found simultaneously at the points marked 2. Follow the numerals and you perceive the course which it takes. It flows simultaneously along the muscular paths which radiate from the region of the node. Thus, it flows down the taenia to the inferior cava; it flows from the base to the tip of the right appendix; it flows through the intra-auricular band to the left auricle, and, still flying from its point of origin, traverses the left appendix from its base to its tip. The wave is not visible as a wave; it travels too fast for that; the whole process of spread occupies the twentieth part of a second.

In the top diagram of the figure is the essential part of the map for the same auricle in a state of rapid flutter. The order of excitation is quite different. The wave is first traced at the inferior vena cava (1) and it passes up the whole length of the taenia (2, 3, 4, and 5). Reaching the top of the taenia it moves around the superior cava and flows through the intra-auricular band (6 and 7) to reach the left auricle. It reaches the left appendix (9), and at the same instant a wave is timed to emerge from the inferior vena cava (9). The question which at once arises is whether this second wave, emerging from the inferior cava and repeating the course (10, 11, 12, 13, etc.) of the first wave, is a new wave or whether it is the continuation of the old one. Is there a succession of regular waves, each arising *de novo* in the inferior cava, or is there a single circulating wave? This question is answered by two considerations. If we propagate a wave artificially from the inferior cava, this spreads equal distances in equal times; it arrives at the two points 4 and 7 simultaneously. That is not the case in flutter; here it passes through

point 4 to reach point 7. But the decisive argument is found in the time relation of the wave; knowing the rate at which it travels along its path (1, 2, 3, 4, 5, 6, and 7) we can calculate how long it should take to move from 7 to 9, and can compare this calculated time interval with the actual interval observed; these are found to be the same within an inconspicuous margin of error. There can be no doubt, then, that we are dealing with a wave which circulates. It circulates in this experiment around a natural ring of muscle formed by the orifices of the two venae cavae. Looked at from above, the movement is in the opposite direction to the hands of a clock. In this instance it completed one circuit in 0.16 of a second; it completed therefore 380 circuits in one minute, and that was the rate at which the auricle beat.

The experiment which I have described is one of several, but it will suffice to illustrate the kind of evidence we possess of circus movement in the auricle. Flutter consists essentially of a continuously circulating wave. The path which this central or re-entrant wave usually takes is the one I have described, but that is not invariable. Sometimes in flutter the course is different; thus, the flow may be clockwise over the same route. In other cases only one cava is encircled; the path is shorter, and the circuits are more quickly completed consequently. In other cases, though these are not so clearly evidenced, the circus movement is around other natural orifices, such as the mitral orifice. These variations are chiefly of consequence because they render the experimental work more difficult; the important conclusion is that the wave can be shown to circulate when the auricle flutters. The proof of circus movement in the auricle is not confined to the class of experiment which I have cited; there is much more evidence that I can now give you; taken as a whole I believe it to be quite conclusive.

Now the wave as a whole is not, of course, confined to the central or re-entrant path; as it passes along this path offshoots are sent through the appendices to their tips, and into all other regions of the auricular muscle. Thus the movements of the whole auricular tissue is controlled by the circulating wave. There is the central or mother-wave, and there are its centrifugal offshoots into the remaining tissue.

Such is flutter as it occurs in the dog; such, therefore, is flutter as it occurs in man. In the dog we may see flutter last for hours; in man it may last, not for hours, but for years. I have known it to continue unceasingly for as long a period as seven years; for all we know it may continue even longer. A single wave continuously circulating for seven years: that, perhaps, may seem to be a remarkable conclusion; nevertheless, it is one we are now bound to accept.

THE FACTORS CONTROLLING FLUTTER.

We have seen that a condition comparable to clinical flutter may be produced in experiment; we have seen that when this experimental flutter is investigated it proves to consist essentially of a circulating wave. We may next consider the precise factors which maintain this circus movement. Refer back to the diagrams of the ring experiment and it will be clear that three factors are involved. They are:

1. The length of the central path.
2. The rate at which the wave travels.
3. The duration of the effective refractory period.

It must be evident that if the wave is to continue circulating a gap must exist between the crest of its advance and the wake of its retreat. As the crest travels it must always find the muscle which it enters in the responsive state. If for any reason the gap becomes closed, the wave will proceed no longer and the rapid action of the auricle will cease. The three factors named, and these alone, control the length of the gap. The duration of the refractory period at any given point must always be less than the time spent by the travelling wave in completing its circuit; this circulation time depends on the length of the path and the rate of travel. Now the rate of travel from point to point in the dog's auricle beating normally is approximately 1,000 mm. per second and the length of the refractory period at normal heart rates is approximately 0.15 to 0.2 of a second. In 0.15 to 0.2 of a second the wave will travel through 150 to 200 millimetres of muscle. On the basis of

these values a circus movement could not establish itself in a ring of muscle of less than 150 to 200 millimetres circumference. But it is known that much smaller circuits than these become established. What is the reason? The reason is that when the auricle flutters, the refractory period is reduced; also the rate of travel is usually reduced. These reductions both occur in response to an increased rate of beating such as prevails in flutter. Both changes facilitate the establishment of relatively short circus movements. The precise relations of the three controlling factors have now received close investigation. They are variable in different circumstances, but may be illustrated by a type experiment. A dog's auricle is fluttering at a rate of 500 per minute. Each circuit is completed in 0.12 of a second. The circuit has a length of 60 millimetres. The rate of travel is not 1,000 millimetres per second, but 500 millimetres per second. The rate of travel is but one-half the natural rate; that is so because the rate of beating is so high that the muscle is hard put to it to conduct the impulses. The length of the effective refractory period is not 0.20 but 0.10 of a second; it has become reduced with the rise of heart rate. The cycle is divided into two parts, a refractory phase of a tenth of a second, a responsive phase of a fiftieth of a second. The crest of the wave is constantly but a fiftieth of a second behind its own wake; it travels behind it at a distance of only 10 millimetres. We have direct and conclusive evidence that these figures may be taken as usually representative of the gap which exists; it is a minute gap, yet upon its existence the continued progress of the wave absolutely depends. To the question of this all-important gap I shall return at a later stage; it is a gap which will command the attention of many workers in the near future, for upon our power to influence its length, our success in treating flutter and, as we shall see, the closely allied condition fibrillation, will very largely depend. If by any means we could close that gap we could bring flutter to an abrupt termination.

CARCINOMA OF THE LARGE INTESTINE.*

BY

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THE treatment of cases of carcinoma of the large intestine is difficult. Most patients are fond of procrastination, especially in conditions where an operation enters into consideration. Time is lost with all sorts of examinations and investigations. X-ray photographs after bismuth meals, examinations and analyses of faeces, of vomit and of urine, and inspection with sigmoidoscopes often fail to reveal the early stages of carcinoma of the large intestine, which could be found if an exploratory examination were performed. I do not deprecate these examinations. They are all links in the chain, but they should neither be spread over too long a period nor have too much weight attached to them. Multitudinous drugs are swallowed; some of them give relief by their soporific action, thereby masking symptoms and assisting the disease to progress unrecognized. Strange diets are tried, and a varied assortment of patent foods is consumed. Spas are visited, baths, massage, and electrical treatment are indulged in; the abdomen is sometimes rubbed with bags of shot; enemata are resorted to; sometimes a course at Plombières. All is of no avail. The progress of the disease continues until the chances of cure by a radical operation are gone.

If abdominal pain with irregularity of the bowels, which is persistent for more than twelve months, were looked upon as sufficient to justify an exploratory operation many of these conditions would be disclosed before it is too late to eradicate them. It is very important to bear in mind that these carcinomata of the large intestine are not so likely to recur after operation as is carcinoma in other situations of the body. Provided that you can remove them during the first year or two the outlook is hopeful. I know a man working in this town now whose caecum I removed for carcinoma on February 7th, 1911, nearly ten years ago. He is well and strong and informs me that he

can carry 2 cwt. At the time of his operation he was only 28 years of age. Professor Leith, who examined a section of the growth, reported it to be "a cubical-celled carcinoma with a few columnar cells." I hope particular notice will be taken of this man's age, because I know that cases are overlooked because they are "too young to have carcinoma."

Then there is the question of haemorrhage. Many of these malignant cases do not show this symptom, yet it is present in many innocent conditions. There may be occult blood in the faeces, and so there may be in innocent conditions. Ballooning of the rectum is another condition which may be present in either malignant or innocent affections. These are links in the chain of evidence, but they are not strong enough to carry conviction.

The treatment I advocate for these cases is to operate early and freely. If there is a chance to perform a radical operation for the complete removal of the growth, by all means do so. It may not be wise to do it all at one sitting. This must depend upon the case. Take, for instance, Case IV, noted below. He was sodden with toxins, and would not have stood any lengthy operation. The obvious need was to relieve his obstruction, to free him of the poisonous matter he was absorbing. The next day I was able to perform a short-circuiting operation. Had the patient been in a good condition I should have excised the growth in the first instance.

The excision should be a free one. At least 4 in. of healthy bowel on each side of the growth, together with the mesentery and lymphatic glands, should be removed. There is some difference of opinion as to the best method to be adopted after excising the growth. Some surgeons close the ends and then perform a lateral anastomosis. I prefer an end-to-end junction. It is true that the calibres of the cut portions of bowel may be different, but that difficulty can easily be surmounted by careful suturing. The end-to-end junction is the nearest approach to Nature's arrangement, and this, I consider, should always be our aim. I prefer simple suture to any mechanical appliances, and I use linen thread, which is always reliable in my hands.

Between September 28th and October 16th last I operated upon five cases of carcinoma of the large intestine, two of them on one afternoon. When I say the large intestine I do not include the rectum. The disease is not common, and it is therefore remarkable that these five cases should have presented themselves to me within eighteen days. The following are brief histories of each of these patients:

CASE I.

W. O., a male, aged 54, had suffered from pain in the right side of his abdomen for twelve months. The pain was more acute at times, but the patient could not associate this with anything which might account for it. He had lost flesh, and was anaemic. An examination of the abdomen revealed a tense globular swelling, about three inches in diameter, in the right hypochondriac region. It was dull on percussion, and appeared to be attached to the liver. I could not separate it from the liver. There was a right inguinal hernia, which was easily reducible. It was thought that the swelling might be a distended gall bladder, and an exploratory operation was advised. On September 28th, 1920, under chloroform and ether, a vertical incision was made through the right rectus. The appendix was found to be thickened and inflamed, and was removed. A mass of hard carcinomatous growth was found in the hepatic flexure of the colon. It was delivered with difficulty and excised, with about four inches of the ascending colon and four of the transverse colon on either side. An end-to-end junction was made by simple suture with linen thread. Enlarged glands were removed with the mesentery of the colon. The patient made an uninterrupted recovery, and was discharged on October 23rd. His bowels act regularly, and he has no pain.

CASE II.

E. T., a female, aged 45, had suffered from pain in the right hypochondriac region for more than a year. The pain was worse at times, and went through to her back. She thought she had gall stones. On examination of the abdomen there was tenderness and rigidity in the right iliac region. The patient would not allow a full examination. It was thought she might have chronic appendicitis. On September 28th, 1920, under chloroform and ether, I could feel a hard, irregular mass in the right iliac region, which I thought was a carcinoma of the caecum. A vertical incision was made through the right rectus. The carcinoma of the caecum was delivered and excised, together with the enlarged glands in the mesentery, 4 in. of ileum, and 4 in. of ascending colon. End-to-end junction was made with linen thread. I show you the specimen removed. You will notice that the growth is confined to the caecum; the appendix was not affected. The patient made an uninterrupted recovery, and was discharged on November 1st. Her bowels act regularly, and she has no pain.

* Read before the Kidderminster Medical Society on December 3rd, 1920.