Since these remarks were written, another case showing the benefit of short-circuiting for carcinoma of transverse colon has reappeared at hospital. I "short-circuited" more than two years ago, and on recovery proposed excision of the cancerous colon. But the poor fellow, aged 31, was obliged to decline, as his business matters were in confusion and required his personal attention then. He only returned three weeks ago looking very well and with regular bowels, but the growth was too far gone to justify removal (*vide Clin. Soc. Trans.*, March, 1905, for details).

REMOVAL OF GALL BLADDER IN A WOMAN AGED 75.

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THE following case may be worth recording on account of the age of the patient, the severity of the symptoms, and the completeness of the recovery.

Mrs. M., aged 74, a widow, had suffered from frequent attacks of pain in the right hypogastric region, accompanied by jaundice. There had been progressive exhaustion and emaciation for eighteen months. I saw her first in consultation with Dr. Muzio Williams in March, 1902. The history was that eighteen months previously she had been suddenly seized with violent pain in the right hypogastric region; vomiting was severe, and the following day all the usual symptoms of jaundice manifested themselves. The stools were pale, the urine was porter-coloured; the skin yellow, and the itching intolerable. This condition lasted for some days, the jaundice never completely disappearing; when in about a month another attack came on. These attacks recurred with increasing frequency, until, at the time I saw her, she was completely bedridden, rarely out of pain, deeply jaundiced, had lost more than 2 st. in weight, and had all the appearance of a woman suffering from malignant disease of the liver. There was a large solid mass reaching from below the right costal margin to the level of the anterior superior iliac spine; percussion over the right chest gave a clear note down to the last rib. There was complete enteroptosis. The lower border of the liver was easily felt below the umbilicus, and in the right iliac fossa a small movable mass was made out.

Dr. Turney had previously seen the patient and advised, in the event of the continuance of the symptoms, that an operation should be attempted. Dr. Muzio Williams agreed with me that, as the patient was markedly losing ground, there was no other course open.

I made an incision as for appendicitis, as that corresponded with the lower edge of the liver and was over the mass which I took to be the gall bladder. That organ was found considerably enlarged, and an incision into it showed it to be greatly thickened; the walls were more than $\frac{1}{2}$ in. thick, and it was filled with a large mass of inspissated bile which readily broke down; there were in addition several large gall stones. After removing the mass and the stones, 6 oz. of normal saline solution were injected into the cystic duct; these were followed by another 3 oz. As none returned, it evidently passed through the *via duodenales* into the duodenum.

I removed the gall bladder and succeeded in getting the neck of the cystic duct into the lower angle of the peritoneal wound. The peritoneum was then closed and the fascia muscles sewn round the orifice of the duct, but the skin was not attached to the stump. The dressing was changed daily for a week, and 3 or 4 oz. of normal saline solution injected into the duct daily for seven days. After that the injections were discontinued. There was a gradually diminishing quantity of bile discharged, and in a month the wound was healed.

From the day following the operation decided improvement in all the symptoms set in; the urine became normal in colour; bile passed freely into the intestine, as evidenced by the colour of the stools; gradually the jaundice disappeared, the pain entirely ceased.

I have just seen the patient, two years after operation; she has put on more than two stone in weight. She takes daily walking exercise of four miles. She has had no pain or return of any of the symptoms, and is quite well, and stronger than she has been for years past. The eminently satisfactory result of operation on this case of severe cholangitis is encouraging.

I am indebted to Mr. Mayo Robson for the suggestion which I found in his book—as to the injection of saline solution—and I cannot help thinking that it was the washing out of the clogged ducts that cured this patient.

NEW METHODS OF STUDYING AFFECTIONS OF THE HEART.

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IV.—ACTION OF DIGITALIS ON THE HUMAN HEART IN CASES WHERE THE INCEPTION OF THE RHYTHM OF THE HEART IS DUE TO THE VENTRICLE.

I HAVE already endeavoured in two papers in this JOURNAL¹ to demonstrate the fact that the rhythm of the heart may originate with the ventricle. Continued observation has afforded me still stronger proof in favour of this observation. The study of the effect of digitalis on my patients has brought out very striking differences between these cases and those where the rhythm starts at the auricle. No rational idea of the manner in which digitalis acts can ever be obtained unless this change in the heart's action is appreciated. The means whereby one can recognize and demonstrate whether the rhythm of the heart is auricular or ventricular in origin is by the jugular pulse. When a pulse is present in the jugular if the auricle is active it will undoubtedly always produce a wave with its systole, but if the rhythm is ventricular in origin then no wave will appear at the time usually occupied by the auricular systole, but the jugular pulse will be found to be synchronous with the ventricular systole. This change of the jugular pulse from one of the auricular type to one of the ventricular has been illustrated by examples in my previous papers in this JOURNAL and in my book,² and very convincing illustrations will be found in the second case recorded in this paper, and in a paper which Deutsch read at the last German Medical Congress at Leipzig.³

Apart from the scientific interest which this view should evoke, the matter is one of the highest practical importance, as a large number of the cases of heart failure which we are called upon to treat present not only this feature, but the inception of the rhythm by the ventricle is the direct and immediate cause of the heart failure. I have been engaged for some time on a minute inquiry into this subject, and the results obtained so far justify me in stating that they will not only profoundly modify our conception of many forms of heart failure, but will give us a more direct and definite aim in our attempts at treatment.

In my first paper on the ventricular rhythm, I showed that this condition might arise in different ways, one of which was that which occurred in advanced disease of the mitral valves. In this complaint, towards the end of life, the pulse frequently becomes irregular—the well-known "mitral pulse." This is almost invariably the sign that the ventricle has taken on the inception of the rhythm of the heart. If there has previously been present an auricular systolic murmur of the crescendo type it disappears, though a low-toned diastolic murmur may continue; and if there has been a jugular pulse present, it will now be found to be of the ventricular type. If the heart's action is rapid, it may be quite regular with the ventricular rhythm (see Figs. 5 and 8).

There seems to be reasonable ground for assuming that an anatomical basis will be found to account for some varieties of ventricular rhythm. In those cases where the ventricular rhythm arises subsequent to long-standing disease of the mitral valves and great dilatation, I had assumed that the auricle, like an over-distended bladder, became paralysed, temporarily or permanently. Certain signs, however, now lead me to doubt the correctness of this view in all cases, as it would seem that the auricle might contract during the ventricular systole. I mention this, that the term "auricular paralysis" may be understood to apply to those cases of long-standing mitral disease where the rhythm is ventricular in origin, and where no evidence of an auricular contraction occurs. Dr. A. Keith,⁴ in his recent Hunterian lectures, dwelt upon the nature and functions of certain bands of muscle fibres in the heart. In these lectures he analyses the anatomical condition of a number of hearts I sent him, and he brings out in a striking manner the relationship between certain anatomical conditions and the symptoms during life. Thus, in describing the heart from the first case I cite below, he found extreme atrophy of the musculature of the auricle with great elongation and atrophy of the auricular canal, there being also marked stenosis of the mitral and tricuspid orifices (see his Fig. 9). In another heart with mitral and tricuspid stenosis which I

had under observation for three years, and whose pulse never showed any irregularity, and in whom the auricle was active until her death, Keith found great hypertrophy of the musculature of the auricle, and neither stretching nor atrophy of the auricular canal.

To illustrate the effect of digitalis in cases of ventricular rhythm I shall deal first with those cases that result from advanced mitral disease, as a peculiar and distinctive reaction is produced that I have not found in other forms of ventricular rhythm nor in cases when the auricle is active. The reaction about to be described does not occur in all cases, but many show it in a remarkable degree, and it is astonishing how readily susceptible those hearts are to the influence of digitalis.

CASE I.

Female, aged 51, seen first on March 23rd, 1902. There is a history of weakness and shortness of breath, extending back for many years. She lies propped up in bed, her legs and abdomen being greatly swollen. The urine is scanty, the respirations are short and shallow. There is marked pulsation in the veins of the neck of the ventricular type (Fig. 1).

Fig. 1.—From an old-standing case of mitral and tricuspid stenosis. The jugular pulse is of the ventricular type, and the irregularity is due to the inception of the rhythm of the heart by the ventricle. (March 23rd, 1902.) (The space Σ in this and all other tracings represents that portion of the ventricular systole during which the semilunar valves are open.)

The pulse is small and very irregular. There is a great enlargement of the heart, the apex beat being felt in the sixth interspace, 2 in. beyond the nipple line, and the heart's dullness extends 2 in. to the right of the middle line. There is a systolic murmur heard at the apex, and also heard all over the back of the chest. A systolic murmur of a somewhat different character is heard over the front of the heart and at mid-sternum. A diastolic murmur occupying sometimes the whole of the diastolic period is heard in a small area at the apex. It is of a low, quietly blowing character, fading away towards the end—not ending in the characteristic crescendo murmur of the auricular systolic murmur. She was prescribed the pill containing digitalis, squill, and calomel three times a day. The pulse began to get slower in ten days' time, and on April 12th it had taken on the rhythm shown in Fig. 2.

Fig. 2.—From the same patient as gave Fig. 1, three weeks later, showing how digitalis has exhausted the contractility, a weak, short beat following a large beat, then a long pause due to further exhaustion of the contractility. The shading underneath shows the position of the murmurs. (April 12th, 1902.)

Fig. 3.—Taken at the same visit and from the same patient as Fig. 2, showing how the size and duration of the beat depends on the length of the preceding pause.

Sometimes this rhythm would vary as shown in Fig. 3. With the occurrence of this slow pulse the patient's condition improved, the urine increased in quantity and the dropsy to a great extent dis-

appeared. Relief, however, lasted only a few months and she died on October 21st, 1902. At the *post-mortem* examination the mitral orifice was narrowed to a mere slit and the tricuspid barely permitted the passage of a finger.

There are some features to which I wish to call attention in this case. The rhythm of Fig. 1 is a very disorderly one and is a characteristic example of the kind of irregularity that occurs when the ventricle takes on the inception of the rhythm. It will be noticed that in the jugular pulse there is absolutely no sign of an auricular wave before the ventricular systole (space Σ). In most of the tracings I have given hitherto a distinct wave in the jugular followed by a fall always preceded the radial pulse; here, on the other hand, even where there is a long diastolic pause, no sign of an auricular beat occurs. The large wave v in the jugular is due to the right ventricle sending back directly through the over-distended auricle a large wave, and its perfect synchronism with the left ventricle is shown in its relationship to the radial pulse (lower tracing). The marked effect of digitalis is shown in Fig. 2, where a certain kind of regularity is to be observed. There are two beats linked together and they give a superficial resemblance to the form of pulse known as the *pulsus bigeminus*. But in true bigeminy and in the regular occurrence of extra systoles the auricles are active, and the peculiar arrhythmia is dependent on the activity of the auricle, so that it is manifest that we have to deal here with a totally different kind of arrhythmia. I am of opinion that the cause of the slow action of the heart is due to the digitalis depressing the function of contractility after the manner shown in my last paper. It was there pointed out that when digitalis depressed the contractility, if time were not given for the function to be restored, the contraction was less in force and shorter in duration, and experimental evidence was given to show that the fibres might refuse to contract and so a beat might drop out, to be followed by a stronger and longer systole. It will be noted that after a long pause (Fig. 2) a very large and long beat occurs. The stimulus arises shortly after this beat and the ventricle responds, but so exhausted is the contractility that only a small beat occurs and of very short duration. Its force is so small that it can barely open the aortic valves to produce a slight pulse wave in the radial artery; in fact, so weak is the second beat of the left ventricle that in many cases it fails to affect the radial pulse (see Fig. 9). The resistance offered to the wave sent back through the auricle to the jugular by the right ventricle is so slight that we always get a good record of its contraction in the jugular pulse, and here it is at once seen how much shorter is the ventricular contraction of the second beat compared with the first. After the second beat contractility is so greatly depressed that no response takes place for a time, when after a long rest it responds again with a long and full systole. This variation in the contractile force of the heart is still better seen in Fig. 3, where the size and duration of the beat depends entirely upon the time given to the muscle to recover. It is possible that other functions may be affected here besides that of contractility, but the depression of this function is so patent and so readily demonstrable that it is manifestly the principal, if not the entire, cause of the striking effect produced by the digitalis.

In the following case I would particularly draw attention to (1) the change of the jugular pulse from one of the auricular type to one of the ventricular type, and back again to one of the auricular type, indicating a temporary inception of the rhythm of the heart by the ventricle (temporary auricular paralysis?); (2) the extreme susceptibility of the heart to digitalis when the inception of the rhythm is due to the ventricle, compared to that when the rhythm is normal; (3) the difference in the reaction when the rhythm is normal and when it is ventricular.

CASE II.

Female, aged 16. Seen first on March 21st, 1903. Has had rheumatic fever, and for some years has suffered from breathlessness and palpitation on exertion. This has increased lately, and there is slight oedema of the legs. There is marked pulsation of the veins of the neck of the auricular type (Fig. 4). The pulse is small, regular, 86 per minute. There is great heaving of the left chest with the movements of the greatly enlarged heart. The apex beat is large and diffuse, and felt in the sixth interspace and in the anterior axillary line. There is a loud, rough, systolic murmur heard over the whole heart and round to the back, but loudest at the apex. With rest and digitalis she rapidly improved. She broke down again, and a note on January 9th, 1904, states that the abdomen is greatly swollen, the liver enlarged, the legs oedematous, and the urine scant. The radial pulse is small, soft, and rapid, 126 per minute, while the jugular pulse is of the ventricular type. Under digitalin granules she again improved, but in February the granules were stopped, and she speedily broke down again. On

Fig. 4.—This and the following eight tracings are from the same patient. Here the pulse is regular, and the jugular pulse is of the auricular type. (March, 1903.)

March 10th, 1904, the condition was similar to that described on January 9th, the radial and jugular pulse tracings being shown in Fig. 5.

Fig. 5.—The jugular pulse is now of the ventricular type. (March 10th, 1904.)

She was prescribed digitalin granules, one per day. They speedily took effect, and on March 18th the pulse had become slow and irregular (Fig. 6). The urine had greatly increased in quantity, the abdomen

Fig. 6.—The jugular pulse is still of the ventricular type, but under the action of digitalis the radial has become slow and irregular. (March 18th, 1904.)

and liver had diminished in size, and all signs of dropsy had gone. The digitalis was continued till March 28th, one granule being taken every second day, and she continued in fair health, the pulse still slow and irregular, as shown by Fig. 7, which was taken on March 26th.

Fig. 7.—Shows the characteristic effect of digitalin being maintained. (March 26th, 1904.) The jugular tracing shows the nature of the arrhythmia, and resembles that in Fig. 2.

The digitalin was stopped on March 28th. Four days after stopping it the pulse had increased to 85 per minute, though she felt still fairly well. On April 5th—that is, eight days after stopping the digitalin—the rate of the heart had increased to 120 beats per minute, the pulse had become small and weak and the jugular distension had increased.

Fig. 8.—Eight days after stopping the digitalin failure of compensation again set in, the pulse here being 120 per minute, and the jugular pulse being still of the ventricular type. (April 5th, 1904.)

(Fig. 8.) The other signs of heart failure were beginning to show themselves. She was again put on digitalin, one granule per day. On April

9th the pulse was still 120 per minute. On April 11th it was 130, on April 14th it had again become slow and irregular. (Fig. 9.)

Fig. 9.—Nine days after beginning the digitalin the characteristic effect is reproduced. (April 14th, 1904.)

The digitalin was again stopped, but as the pulse began to increase in rate on March 17th, one granule per day was prescribed. The patient continued in fair health, but as the pulse did not slow down satisfactorily, on May 1st I doubled the dose. I did not take any further tracings till May 14th, contenting myself with watching for the slowing of the pulse. Finding it did not yield as before to the increased doses of digitalin, I took tracings on this day, and found a perfectly regular radial pulse, while the jugular pulse had completely changed its character, being now of the auricular type—that is, the auricle has again resumed its activity, and the heart chambers contract in their normal sequence. Occasionally, for a short period, it would show a slight alternating rhythm, as in Fig. 10.

Fig. 10.—With continued use of digitalin the auricles resume the inception of the rhythm of the heart, as shown by the fact that here the jugular pulse is of the auricular type. (May 15th, 1904.)

The digitalin was stopped, and the patient continued in fair health for some months. Up till now (February, 1905) the jugular pulse has continued of the auricular type, and the pulse has been quite regular except during a short period shortly to be described. On December 18th, 1904, she was again beginning to get oedema of the legs, and the abdomen began to swell, and she was very breathless. The pulse was small, soft, and rapid, 110 per minute, and the jugular pulse was still of the auricular type. She was prescribed one granule of the digitalis per day. No improvement had taken place by December 27th, when she was ordered to take two granules per day. By January 2nd, 1905, the rate had fallen to 80, as a rule quite regular, but occasionally an extrasystole of ventricular origin would occur (Fig. 11). Sometimes for a

Fig. 11.—Shows a jugular pulse of the auricular type with the occasional occurrence of a ventricular extra-systole. The auricular waves (a and a') occur at regular intervals, while the small waves (z) in the radial occur prematurely. The larger size of a' is due to the fact that when the auricle contracts the ventricle is already in systole, and therefore cannot receive the auricular contents, which are thus sent back into the veins, producing this larger wave. (January 2nd, 1905.)

short period these ventricular extra-systoles would appear after every second beat (Fig. 12). The digitalis was stopped, and the arrhythmia

Fig. 12.—Shows an allorhythm due to the regular occurrence of ventricular extra-systoles. (January 2nd, 1905.)

disappeared. She still continues in fair health, with a perfectly regular pulse.

I need not dwell on the convincing character of this series of tracings from this patient. The demonstration of the normal rhythm in Fig. 4 and of the ventricular rhythm in Figs. 5 to 9 and the return to the normal rhythm in Fig. 10 is surely sufficient to give pause to the most sceptical critic. That some profound change had taken place in the rhythm of the heart is placed beyond cavil, and if my interpretation is wrong there are sufficient striking facts recorded in the tracings to afford material for a close investigation into this matter. The space *x* in all these tracings represents that portion of the ventricular systole when the semilunar valves are open, and in the jugular tracings it will be seen that when the auricle is active a wave, *a*, precedes the space *x*, and a fall occurs during that period. When the rhythm is ventricular no auricular wave precedes *x*, and the space itself is always filled by a large wave.

The effect of digitalis when the rhythm is ventricular is manifestly of the same nature as that in Figs. 2 and 3; that is, it is mainly, if not entirely, an effect on the contractility. This case shows a remarkable sensitiveness to digitalis when the rhythm is ventricular, and I have often been able to slow and quicken the pulse rate in this manner in similar cases. Even when the auricle was restored to activity—as in Fig. 10—we seem to get an echo of the effect on contractility, for the slight arrhythmia shows also an alternating large and small beat. This is not a pure pulsus alternans, for we saw in the previous paper the rate was perfectly regular, whereas here—in Fig. 10—the pulse periods vary in length, a short period and a long period alternating. It will be seen that this is due to variation in the auricular rhythm, whereas in the case of the true pulsus alternans the variation was entirely due to difference in the size of the ventricular beats.

When the digitalis was pushed in December no speedy reaction followed like that in previous attacks of heart failure. When a definite reaction did occur (Figs. 11 and 12) it was of a totally different nature—namely, the occasional occurrence of ventricular systoles independent of the stimulation from the auricle—that is to say, ventricular extrasystoles. In my experience this is an unusual effect of digitalis, and in the next paper I will suggest a probable explanation when discussing the relationship of digitalis to the fibres joining auricle and ventricle.

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OBLITERATIVE ARTERITIS,

LEADING TO GANGRENE OF EXTREMITIES IN OTHERWISE APPARENTLY HEALTHY MEN IN THE PRIME OF LIFE.

BY

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In a paper read at the annual meeting of the British Medical Association, in July, 1903,¹ we described two cases of obliterative arteritis in young men, leading to gangrene of the extremities. Of these cases the second was a complicated one, but the first was a typical one, affecting three limbs, in an otherwise apparently healthy man aged 37 years, there being absolutely no evidence of syphilis, alcoholism, renal disease, saturnism, ergotism, or premature senility. Our present case is remarkably similar in its main features, though only the two lower limbs have been affected.

CASE.

The patient, A. H., a cigarette maker, aged 39 years, a Jew from Roumania, was admitted into the German Hospital on August 3rd, 1904.

He enjoyed good health, but at twenty-three years of age commenced to suffer from pain in the right lower extremity. The pain was in the foot and the muscles of the calf of the leg. It used to come on when he had walked for six or seven minutes, and was accompanied by muscular weakness, so that when the pain came on he had to stand still, but after two or three minutes it used to get better, and he was able to go on for another six or seven minutes and then stop again, and so on. Evidently this was a kind of "intermittent claudication" of the extremity.² He says the foot was quite red at that time, as it not rarely is in cases in which the blood supply is obstructed, owing to changes in the arteries of

the affected limb.³ At Riga, in 1889, after more than a year of these sufferings, the right lower extremity was amputated below the knee joint. The wound healed rather slowly—that is to say, in about five months, and he then remained well till 1903. About June of that year he began to suffer from severe pains in the toes and the calf of the left lower extremity, and he had a kind of "intermittent claudication" in that extremity, similar to that which he previously had had in the other. It was this trouble which brought him as a patient to the German Hospital. There is not much more to be said in regard to the past history of the case. The patient has been moderate in alcohol, and there is not any history of venereal disease. He says, however, that he has been accustomed to smoke at least ten cigarettes a day, and has also taken a good deal of strong tea. His father died at over seventy years of age, and his mother is still living, aged about sixty-six years.

Fig. 1.—Transverse section of part of the popliteal artery ($\times 57$), showing its channel obliterated by connective tissue (A). In this are many newly-formed blood vessels (B), and in some parts groups of brown pigment granules, some of which are represented diagrammatically in black (C). D=the middle coat. There are some small areas of calcification (E) just outside the elastic lamina, which is not very distinctly seen in the section illustrated.

Condition after Admission (August, 1904).—The patient was a medium-sized, active man, without signs of disease in the heart, lungs, or abdominal organs. The urine showed nothing abnormal. There were no signs of any disease of the nervous system. The arteries and nutrition of the upper extremities seemed to be natural. Arterial pulsation could be felt in both inguinal regions, but pulsation was hardly, if at all, perceptible in the left popliteal artery (the right leg had been amputated in 1889, as already stated). Examination of the blood (October 6th, 1904) showed the haemoglobin value to be about 100 per cent. of the normal standard; the number of red cells in the cubic millimetre was 5,120,000, and nothing remarkable was noticed in regard to the white corpuscles. Ophthalmoscopic examination (October, 1904) showed nothing abnormal.

On account of gangrene, Dr. Michels first of all removed the left big toe on August 5th, 1904. The wound did not heal properly, and intolerable pain in the foot continued, so that on October 7th, 1904, Dr. Michels, at the patient's repeated request, other treatment having been found useless, amputated the left lower extremity below the knee. At the operation there was hardly any bleeding from the cut vessels, and on examination it was found that the lumen of the popliteal artery was completely obliterated at the site of amputation.

The progress of the case was quite uneventful. The patient was free from pain after the operation and the wound healed well. In December the stump appeared a good one, although at one part he said it was tender to pressure. His general