The Schorstein Lectures

AURICULAR FIBRILLATION.

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LECTURE I.

Introduction.

It not infrequently happens that discoveries of importance which have far-reaching consequences are not appreciated, even by many of those directly concerned with the subject, until long years after the discovery has been made.

I have little hesitation in applying this remark to the subject of these lectures, for auricular fibrillation of the human heart is the most important discovery yet made in the domain of the functional pathology of the heart, and few physicians are aware of its significance. The symptoms directly due to auricular fibrillation and the symptoms of heart failure induced by this condition are so clear and definite, that we have little difficulty in recognizing this condition as a distinct clinical entity. Its recognition is not of mere academical importance, but is of the greatest practical value, for when we recognize the various symptoms, they afford us grounds for a sure diagnosis, a safe prognosis, and for a rational line of therapy in a large proportion of cases of serious heart failure. The great frequency of its occurrence renders it imperative that all practitioners should become familiar with its symptomatology, for 60 or 70 per cent. of all cases of serious heart failure met with in practice owe the failure directly to this condition, or have the failure aggravated by its presence. Some of the symptoms have been overlooked in the past, while the significance of others has not been appreciated. Moreover, the response of hearts affected with auricular fibrillation to remedies differs so much from the response of all other forms of heart action, normal and abnormal, that the recognition of its characteristics materially alters the views universally held as to the action of drugs upon the heart.

Type of Case showing Auricular Fibrillation.

Before setting out in detail the features characteristic of auricular fibrillation, it might be convenient that you should appreciate the kind of case with which I am going to deal. The most common evidence of this condition is an irregular action of the heart of a very disorderly kind. It is that form of irregularity so frequently met with in the elderly, and in patients with hearts damaged by previous rheumatic infection. In the latter class the association of irregular hearts with mitral stenosis has long been recognized, and, on account of this association, the irregular pulse is sometimes described as the "mitral pulse," with which all clinicians are familiar.

While senile and rheumatic hearts are those most frequently affected by this condition, there are numerous cases in which auricular fibrillation occurs, where there is no history of rheumatism, and at an age when senile changes are not present in a marked degree. Auricular fibrillation is present in the great majority of cases with dropsy, or dyspnoea due to heart failure, where there is an irregular pulse. Thus, in Withering's report of cases to whom he administered digitalis successfully, where the symptoms of heart failure were associated with an irregular pulse, and in whom digitalis acted in a special manner, there can be but little doubt that these were cases of auricular fibrillation. Other cases are found recorded as "delirium cordis." In those predisposed to auricular fibrillation violent exertion may induce the condition, and many of the recorded instances of heart overstrain afford excellent examples of auricular fibrillation, and of the heart failure which accompanies it.

Methods by which Auricular Fibrillation has been Recognized.

It is an opinion widely held that the methods of investigation by means of graphic records and the electrocardiograph are of little practical value, however interesting they may be from a scientific standpoint. It is also a familiar assumption that physiological research is of little help to medicine, and the practical outcome of such a view is seen in the lack of collaboration among the different branches of medical science.

Now I wish, in dealing with this subject of auricular fibrillation, to point out not only how very important its recognition is to the clinician, but how it has been brought about by a long-continued search extending over many years, in which the features that led to its recognition were ascertained by the systematic use of graphic records, by the application of the results of experimental research, by the co-ordination of the clinical and physiological observations, and by the employment of the electrocardiograph in clinical and experimental investigations.

While these methods have been the means by which this obscure condition has been revealed, they are not now necessary for its clinical recognition in the great majority of cases. By the systematic co-relation of clinical symptoms, recognizable by the ordinary methods of physical examination, with the results of graphic and electrocardiographic records, the features of auricular fibrillation have become so clear that we can recognize, with little trouble, the salient features of the great majority of cases. While, therefore, I intend to lay before you the steps by which we have come to our knowledge of this condition, in order that the proof of the condition may be complete, I also wish to point out that its recognition becomes easy to the careful physician in the usual routine examination of the patient.

Historical.

It may bring the matter better to your mind if I cite my own experiences in the investigation of this condition. More than twenty-five years ago I began what seemed a hopeless undertaking—an attempt to ascertain the significance of heart irregularities and the mechanism by which they were produced. It soon became evident that the stereotyped phraseology which had been in use for centuries in the description of irregularities was inadequate and misleading. No advance could be made so long as the only means of describing the features was the impressions of observers. Graphic records enabled the salient features to be perceived and demonstrated. At first these records were taken by means of a Dudgeon sphygmograph, but I found that little advance could be made by records limited to the radial pulse, which gives information regarding only one chamber of the heart—namely, the left ventricle. After a good deal of trouble I devised a simple method of recording the movements of the jugular veins; this was done by fixing a tambour to the Dudgeon sphygmograph in such a way that at the same time that the radial pulse was being recorded I could get tracings also from the jugular pulse. By this method I could demonstrate, in a large proportion of cases, the action of three chambers of the heart, and occasionally the whole four chambers. Before I undertook this investigation others had recorded the jugular pulse and recognized its features, but little had been done to apply the information so obtained to the interpretation of the irregular action of the heart. By the systematic comparison of the tracings obtained from the jugular pulse with those from the arterial pulse or apex beat certain differences in the action of the chambers of the heart became evident, which permitted of a large number being separated into recognized groups. I published in 1893 a differentiation of some of the irregularities, based on the manner of their production. Some years later, and independent of my work, a number of observers were led to the examination of irregularities, and the research has been continually pursued, with the result that we are now able to appreciate the mechanism by which the great majority of irregularities are produced, so that what was until lately the most obscure part of clinical medicine is now one of the best known and the most completely proved.

In the course of separating the irregularities into groups I came across one group which showed such well-marked characteristics that I had little difficulty in recognizing it. At first my attention was attracted to it by the peculiar

nature of the jugular pulse. In tracings from the necks of normal persons the jugular pulse, when present, always shows a wave preceding the carotid pulse, a wave which we recognize as being due to the right auricle (Figs. 1 and 2). Now, in the group with which I am dealing there was a complete absence of this auricular wave, and the

Fig. 1.—Simultaneous tracings of the pulsation in the neck and of the radial. In the neck the pulsation is mainly due to the carotid (c) and the jugular pulsation is limited to a small wave (a) preceding the carotid and due to the right auricle.

Fig. 2.—Simultaneous tracings from the jugular and radial pulses from a patient with a normal heart. The jugular pulse is of the auricular form and shows a large wave (a) due to the auricle. The rhythm is regular. The space E represents the period of ventricular systole.

jugular pulsation, when present, fell mainly during the ventricular systole (Fig. 3). These two types of pulse had been recognized by observers before me, and described by the terms "negative," or normal venous pulse, and "positive," or pathological venous pulse, the pathological factor being supposed to be tricuspid regurgitation. For a variety of reasons, I showed that these terms were misleading, and demonstrated that the essential difference between them was that in the so-called negative, or normal

Fig. 3.—Simultaneous tracings of the jugular and radial pulses from a patient with auricular fibrillation. The jugular pulse is of the ventricular form, and there is an absence of the wave (a), due to the auricle, preceding the carotid wave (c) as in Figs. 1 and 2. The rhythm is irregular. The space E represents the period of ventricular systole.

venous pulse, there was always a wave caused by the auricle, whereas in the so-called positive, or pathological venous pulse, there was no such wave (compare Figs. 2 and 3). In order that this fact should be emphasized, I called the one form the auricular form of venous pulse, and the other the ventricular form of venous pulse. My intention in thus changing the nomenclature was to keep before me the fact that there was some change in the heart whereby the auricular activity was altered. By the systematic observation of patients for a long period of years, particularly those with mitral stenosis, I found that the jugular pulse of the auricular form changed suddenly into the ventricular form. One patient came under my care in 1880 with mitral and tricuspid stenosis. I had observed in her for many years a well-marked presystolic murmur, and had repeatedly obtained tracings from her jugular and liver pulses, which showed well-marked waves due to the auricular systole

(Fig. 4). The heart was always regular, except for the occasional occurrence of an extrasystole. This patient became seriously ill in 1897; her pulse became rapid and irregular, and she suffered from great dyspnoea. After a partial recovery the rate of the heart fell, but remained continuously irregular. There were other evidences of

Fig. 4.—Simultaneous tracings of the liver and radial pulses. The liver pulse is of the auricular form, and shows a wave (a) preceding the ventricular systole (space E). The rhythm is regular. Compare with Fig. 5.

a great change in the heart's action, as all evidences of auricular activity had disappeared; thus the presystolic murmur which had been present was gone, and there was a total absence of a wave in the jugular and liver pulses due to the auricle. In other words, these pulses had changed from the auricular to the ventricular form of venous pulse (Fig. 5). The patient died in 1898, and at the *post-mortem* examination mitral stenosis and tricuspid stenosis were found, and the auricles were enormously distended and thin-walled. From that time till a couple of years ago I have speculated as to what the auricle is doing in such cases. From the fact that in this case and in a few others the auricle was found distended and thin-walled at the *post-mortem* examination, I came to the conclusion that the disappearance of the signs of auricular systole was due to the auricle having become distended, atrophied, and paralysed. This view I put forward in a book on the pulse which I published in 1902. Shortly after this was published I had a series of cases, some of which I had watched for years, and at the *post-mortem* examinations the auricles were not thinned but were hypertrophied. With this fact before me I saw that my previous explanation could not be correct, for the fact that the auricles were hypertrophied indicated that they must have contracted during the years that I had

Fig. 5.—Simultaneous tracings of the liver and radial pulses from the same patient as in Fig. 4, a year later. The liver pulse is of the ventricular form, and there is now no auricular wave preceding the ventricular systole. The rhythm is irregular and auricular fibrillation is present.

watched them, and when there had been an absence of all signs of auricular activity. As it was clear that the auricles could not have contracted during the normal period—that is to say, immediately before ventricular systole—the only alternative I could see was that they contracted during ventricular systole. As in the meantime I had studied several hundreds of cases and had seen this condition start under a variety of circumstances, particularly in individuals with frequent extrasystoles, I put forward the view that ventricles and auricles contracted together, and assumed that the stimulus for contraction arose in some place that affected auricles and ventricles simultaneously. As at this time I could not conceive of any other possibility to explain the facts, I suggested that the stimulus for contraction arose in the auriculo-ventricular node, and I called the condition "nodal rhythm," under which name the clinical aspects of auricular fibrillation are described in my book on diseases of the heart, which I published in 1908.

With the advent of the electrocardiograph, we obtained a more accurate method of recognizing the contractions of the chambers of the heart. When electrocardiograms were taken of the cases that I had called nodal rhythm, my clinical observations were verified, inasmuch as no evidence of the normal auricular systole was found. In cases where the heart periodically became disorderly in its rhythm, and where I was able to demonstrate that the auricular form of venous pulse was present with the regular heart action, and the ventricular form during the period of irregular action, the electrocardiograms also showed evidence of auricular contraction during the normal period of the heart's action, and a disappearance of the normal auricular activity during the period of irregular action, fully confirming the observations I had made on nodal rhythm.

The attention of other observers had also been arrested by some of the clinical features of this condition. Thus Hering in 1903 separated from among other irregularities the irregularity peculiar to auricular fibrillation, and called it the *pulsus irregularis perpetuus*. He was mainly concerned with the physiological aspect of the subject, and did not recognize the full clinical picture, with the disappearance of all signs of auricular activity. Many other observers had noted the "positive" venous pulse, and in attributing it merely to tricuspid incompetence they had failed to appreciate its real meaning, and so missed the significance of its appearance.

Fig. 6.—A tracing from a patient with auricular fibrillation, showing the small fibrillary waves (*f*) in the jugular vein.

Although the disappearance of the auricular contraction was the feature that puzzled me in these cases, I realized that my explanation of it, as being due to synchronous contraction of auricles and ventricles, was far from being established, and I endeavored to interest others in the subject, who might investigate the matter by experimental methods, and find out, if possible, what the auricle was doing. Cushman was the first to suggest that auricular fibrillation might be a factor of clinical importance, and in 1906 he and Edmonds drew attention to the resemblance of the radial tracings in a case of paroxysmal irregularity in the human subject with the tracings from a dog, in whom they produced experimental fibrillation of the auricles. On reading this communication, I was struck with the idea, and found what I thought to be evidence of auricular fibrillation in numerous small waves in the jugular pulse (Fig. 6, waves marked *f*), and I published in 1907 tracings with this explanation, but I failed to appreciate the real significance of what auricular fibrillation was, and I thought it only a passing event. The matter was, however, brought to a final issue by Lewis in 1909. He had been pursuing an inquiry by experiment into the nature of cardiac irregularities, and had produced experimental fibrillation in the dog, and at the same time he took graphic records of the venous and arterial pulses. With the onset of fibrillation, the arterial pulse became irregular, and the venous pulse changed from the auricular to the ventricular form. When Lewis showed these records to me, I at once recognized them as being in every respect identical with the radial and jugular tracings I had obtained from my patients with nodal rhythm. Pursuing his investigations further, Lewis was able to detect in the electrocardiogram of experimentally produced fibrillation certain oscillations during ventricular diastole, which were induced by the fibrillating auricle. Examining more critically the electrocardiograms of typical cases of nodal rhythm which I sent to him, he found these oscillations also present, and demonstrated their correspondence with the small fibrillation waves I had noted in the jugular pulse. Since 1909 Lewis has

carried out a long series of observations on auricular fibrillation in the human subject and in animals, with the result that we now know that the vast majority of cases which I had described as nodal rhythm are due to auricular fibrillation. (For details, clinical and experimental, see Lewis's recently published book on *The Mechanism of the Heart Beat*.)

These results have been confirmed by several observers. Rothberger and Winterberg had independently in 1909 drawn attention to the fact that in *pulsus irregularis perpetuus* the electrocardiogram corresponded to that of auricular fibrillation experimentally produced. More recently James and Williams and Jolly and Ritchie have confirmed these results.

In the investigation which I have been carrying on for so many years I was not content merely to describe the mechanism by which the irregularities were produced, but I always kept before me the bearing these symptoms had on the patient's present and future state, and what indications they gave for treatment. To this end I made careful notes of all attendant circumstances, such as the patient's history, the size of the heart, the degree of heart failure, the response to treatment, and the future progress of the case. The result is, that though I failed to recognize the nature of the altered rhythm of the heart, yet from my notes of about a thousand individual patients, many of which I had watched for a number of years, I had been able to study many of the characteristics of this group and to recognize the clinical features. From these observations I am able to present a picture of this condition which, though far from complete, permits of the recognition of many features of the greatest practical importance.

What is Auricular Fibrillation?

The term "fibrillation" is applied to a curious condition of the muscle fibres of the heart, where the individual fibres, in place of contracting in an orderly and simultaneous manner during systole, contract rapidly and independently of one another. The auricle, when in a state of fibrillation, presents an entirely different aspect from what it does during its normal action.

"The walls of the auricle stand in the diastolic position: systole, either complete or partial, is never accomplished: the wall, as a whole, is stationary, but careful examination of the muscle reveals an extremely active condition, it appears to be alive with movement: rapid, minute, and constant twitchings or undulatory movements are observed in a multitude of small areas upon its surface" (Lewis).

When the ventricle passes into fibrillation, the circulation is at once brought to a standstill, and McWilliam has suggested that this is probably the cause of sudden death in the human subject. When the auricles pass into fibrillation, death does not ensue, for the fibrillation cannot pass along the bundle which connects auricle with ventricle.

Conditions Inducing Auricular Fibrillation.

In experiment auricular fibrillation can be produced by electrical stimulation of the auricular wall. In the human heart it is found to arise under a variety of conditions. It is probable that it is produced by altered nutrition of the muscle. Thus, I detected it in 1892 in a patient recovering from a mild attack of rheumatic fever, and there was no other evidence that the heart was affected. The attack passed off after some hours, and the youth has grown up into healthy manhood with no evident lesion of the heart. I have seen it appear in the heart in pneumonia, during the attack and during convalescence, with disastrous results in both cases. Digitalis can induce it in predisposed cases. I have known it occur intermittently in a fatal case of infective endocarditis, and Price has shown its occurrence in a fatal case of diphtheria. *Post-mortem* examinations in these last two cases showed that marked changes of an inflammatory nature had occurred in the walls of the auricle.

Effort, sometimes slight and sometimes violent, may provoke auricular fibrillation. This occurs most frequently in the middle-aged or elderly. Thus, a healthy and vigorous member of our profession at the age of 50 years ran rapidly for 200 yards, and was seized with an attack which lasted for two hours. This was eight years ago, and he is still well and actively engaged in his work. In many cases these attacks lasting for a short period are apt to recur with increasing frequency until they become

permanent. While they are occurring intermittently they are often easily provoked by effort, though they may not infrequently arise from no apparent cause. Thus, in one man under my care at the Mount Vernon Hospital, the heart would be detected beating irregularly several times a day, the irregular period lasting from half an hour to two hours. This irregularity was due to auricular fibrillation, as shown by records by the polygraph and electrocardiograph. He himself was not conscious of the altered rhythm, nor was there any recognizable cause for the onset. I have found it in a few people dying of exhausting diseases, as cancer.

We are not yet in a position to decide with sufficient accuracy the nature of the changes in the heart wall which favour the occurrence of auricular fibrillation. In the hearts which I have had examined, which showed auricular fibrillation during life, there has been found in the auricle and ventricle an increase of fibrous tissue and of nucleated cells in the muscular walls. In most cases there is probably some definite change which predisposes to this condition, and it only needs an adequate stimulus to provoke it. This stimulus may be of a varied kind, for while the onset can frequently be traced to violent bodily effort, it often occurs when there is no excessive effort. At present, we can only say that one predisposing condition is certain organic changes in the muscle wall of the auricle.

Duration of Auricular Fibrillation.

In the majority of cases when auricular fibrillation sets in it persists for the remainder of the individual's life. I have watched individual cases for over ten years in whom it was constantly present. In many cases it may appear for a few hours and may never recur, or it may recur at infrequent intervals for some weeks and months and then disappear. Many cases of paroxysmal tachycardia owe the paroxysms to auricular fibrillation, and in such cases it may last for a few seconds, a day or two, a few weeks, or even months. As a rule, however, when it is intermittent in its appearance, the tendency to its recurrence becomes greater, till finally it becomes permanently established.

Effect on the Ventricles.

Under normal circumstances the stimulus for contraction arises from a definite area in the auricle (Keith and Flack's node). From this point the stimulus passes through the auricle to the auriculo-ventricular node, and along the bundle to the ventricle. In fibrillation of the auricle the stimulus for contraction seems to arise in the fibrillating fibres of the auricle, and is transmitted to the auriculo-ventricular node in an irregular manner. It is probable that the manner in which the ventricle is affected depends on the power of the node and bundle to receive and transmit the auricular stimulations. It might be suggested that with the onset of auricular fibrillation the ventricle takes on a rhythm of its own, and indeed at one stage of my investigations I had suggested an idio-ventricular rhythm. But, in experiment, if after fibrillation has been set up, the bundle is cut, the ventricular rate at once alters, and the ventricle assumes its own peculiar slow rhythm.

Rate.—Changes in the rate and rhythm of the ventricle and in the size of the heart are very common with the onset of auricular fibrillation. In several cases I have detected these changes shortly after its inception. I have found the greatest difference in rate, ranging from 40 to 130 beats per minute. It is but seldom that we get the opportunity of seeing auricular fibrillation start, as the patient is frequently unconscious of the change in the heart's rhythm, though some recognize the curious sensation of fluttering. The patient may consult us because of the distress which may sooner or later appear, and then we usually find the rate remarkably increased, generally between 110 and 140 beats per minute and over. I have met with a number of cases in which the rate has become slower on the inception of auricular fibrillation. This always occurs when fibrillation has arisen as the result of the administration of digitalis. If we assume that digitalis slows the heart in fibrillation through its action on the vagus and the auriculo-ventricular bundle, we might

assume that the slowing occurs in consequence of some affection of the auriculo-ventricular bundle. In support of this view, I have observed a case for many years, in which there was persistent increase in the interval between the auricular and ventricular systoles, and in which at one time there was partial heart-block. When the patient's auricle started to fibrillate the ventricular rate fell from 60 to 40 beats per minute, and has continued at this rate for six years (Fig. 7 and 8). I have published a series of cases under the title "Nodal bradycardia," and included among them are cases with a rate of about 30 beats per minute, and also with a rate falling even lower at times, and finally inducing the phenomena characteristic of Adams-Stokes disease. In one of these cases the heart fell suddenly to 40 beats per minute and was quite regular; the slow rate persisted for a fortnight, when it suddenly

Fig. 7.—The jugular pulse is of the auricular form, and the a-c interval (space A) is increased. At the left of the tracing two apex beats are recorded, showing a wave (a) due to the left auricle.

Fig. 8.—From the same patient as Fig. 6. The jugular pulse is of the ventricular form. The rate is slower than in Fig. 6, and the rhythm is irregular. Fibrillation of the auricle is present.

increased in rate and the auricle resumed its normal action. In this case during its normal action there were no evidences of heart-block.

Rhythm.—When the auricle passes into fibrillation the ventricle usually becomes irregular in its action. The alteration is sudden, as shown not only by experiment but by clinical observations, in cases in which I have actually observed the change in the heart's action. The cessation of fibrillation can be recognized by the return to a regular rhythm, occasionally the return is accompanied by a few irregular beats, due to extrasystoles. Though many speak of this condition as the *pulsus irregularis perpetuus*, I have seen a number of cases where the rhythm of the ventricle was regular. In the majority of such cases the rate was under fifty beats per minute. In all likelihood heart-block was present, and the ventricle was contracting in response to a stimulus independent of the auricular fibrillation. In several instances the slow regular action has been induced by digitalis, as we know that in certain cases digitalis is apt to induce heart-block. In a case recently under observation the rate under digitalis fell from 110 to 70 beats per minute. Prior to the administration of digitalis the rhythm was very irregular, but when the rate fell to 70 beats per minute it was quite regular. The patient had no jugular pulse, but by the electrocardiograph Lewis demonstrated that auricular fibrillation was present.

The Size of the Heart.

In the great majority of cases a considerable enlargement of the heart follows the inception of auricular fibrillation. Though the auricles are often greatly distended, it is not possible to tell from clinical examination how much of this enlargement is due to the auricles and how much to the ventricles.

With the onset of fibrillation the increase in size does

not take place at once, though in a few cases of periodic fibrillation I have seen the heart increase greatly in size within a few hours of the onset, and the enlargement would quickly disappear within a few hours after the cessation of the fibrillation. As a rule little change in the size of the heart takes place at first, and if the heart is capable of maintaining an efficient circulation little increase in size may be detected for years. In the majority there is an inability to do the work efficiently, so that gradually the heart's strength becomes exhausted and an increase in its size follows. With appropriate treatment a considerable diminution may take place, but this is by no means constant. I have been surprised at its persistence in cases of old-standing auricular fibrillation, in whom a very striking improvement of the heart's condition has taken place as the result of treatment. In most of the cases we have carefully studied at the Mount Vernon Hospital and at the London Hospital we have failed to detect any decrease in the size of the heart in patients who had suffered from extreme failure and who had made a surprising recovery.

Effect on the Heart's Efficiency.

A great many patients in whom auricular fibrillation had occurred suffered from lesions of the heart, which impaired its efficiency. In all these the occurrence of fibrillation at once increased the impairment, and the symptoms of heart failure became intensified. In others, where there had only been a slight impairment of the cardiac efficiency, the onset of auricular fibrillation speedily provoked symptoms of extreme heart failure, while in others little difference could be detected. In a few cases the onset of auricular fibrillation has only slightly embarrassed the heart in its work.

To a great extent the symptoms of heart failure arise most markedly in those in whom the change in the auricular action has affected the ventricle, particularly in increasing its rate. In a few cases marked limitation of the heart's powers of response to effort has followed, with relatively slow acting hearts.

The symptoms of heart failure commonly produced are of the same kind as arise in heart failure from other causes, for example, shortness of breath on exertion and consciousness of the heart's action, particularly when some effort is made. With increase in the failure, oedema of the legs and lungs sets in. The face becomes livid, the patient cannot lie flat in bed, but has to be propped up. The liver becomes enlarged, while the veins in the neck may become engorged, and the pulsation in them becomes extremely marked. With these changes dilatation of the heart and great increase in the rate may be detected. As a rule, the onset of these symptoms is slow and partial, but occasionally they may set in with great rapidity; they quickly disappear if the heart reverts to its normal rhythm.

Cause of Heart Failure in Auricular Fibrillation.

However it may be brought about, the onset of fibrillation embarrasses the ventricle in its work. There can be little doubt that the orderly action of the auricle in regulating the supply of blood to the ventricle and in stimulating it in a normal manner results in a more efficacious action of the ventricle than the variable and irregular stimulation to contraction. When the ventricle is rapidly and irregularly stimulated to contraction there results a gradual exhaustion of the strength of the ventricle, and evidences of heart failure supervene. Other factors may aid in embarrassing the heart in its work, as the presence of a valve lesion; in many cases there is also concurrent damage to the ventricular muscle, the result of the same processes which had produced the fibrillation in the auricle. In cases that have drifted and died, where I have had a *post-mortem* examination there has been found extensive fibrous degeneration of the heart muscle. On the other hand, I have seen so many individuals with auricular fibrillation who have led strenuous lives, engaged in hard manual labour, that I infer that in them the muscle of the ventricle had not been seriously damaged.

Auricular Fibrillation and Digitalis.

Not the least in importance of the discoveries resulting from the recognition of auricular fibrillation as a clinical entity is the light that is thrown upon the action of drugs

of the digitalis group. I can only here refer briefly to a few points which I have been able to elucidate. I think every one who has carefully studied the description usually given of the effects of digitalis on the human heart cannot but be struck with the absence of agreement among the different writers as to the manner of its action, its dosage, and the best preparation. In some instances some peculiar reaction which the observer may have noted is looked upon as the characteristic effect of digitalis, but the mechanism of this peculiar reaction has not been understood. It is a good many years since I was struck with the varied reactions which I obtained from the use of digitalis. I collected a great number of cases; in some I got a definite reaction on the heart, while in others no reaction was obtained. When I separated these into groups I saw that the probable reasons for the varied reactions in the human heart were that digitalis gives a reaction according to the nature of the lesions from which the heart is suffering. You will observe that if this is found to be correct, we can at once understand how the physiologist and experimental pharmacologist have missed the most important effects of digitalis, for, so far as the heart in experimental work is concerned, they cannot reproduce the conditions under which the physician has to employ the drug.

It is not only in auricular fibrillation that digitalis acts beneficially, for there are many other conditions which benefit by it; but cases of fibrillation stand apart from all others in regard to their response to this drug. All cases of auricular fibrillation are not responsive, for there are factors which render certain hearts unsusceptible, as the presence of fever or extensive fibrous degeneration. It is in certain cases where there is a fair amount of healthy muscle that its almost specific action is seen. It is some ten years since I realized this peculiar response to digitalis. When I was appointed to the Mount Vernon Hospital, and later to this hospital, I seized the opportunity to start a series of observations under conditions which permitted a degree of accuracy unattainable in private practice. In these observations the same drug and the same dose were given to patients with and without auricular fibrillation. With only rare exceptions all the cases that showed a marked effect upon the heart were cases of auricular fibrillation, for, although the other cases might exhibit some benefit from the use of the drug, they never showed the same tendency to slowing of the heart's rate.

The slowing effects of digitalis are shown in a very striking manner in those cases of auricular fibrillation where heart failure set in with a great increase of rate of the heart. The chart (Fig. 9) is a good illustration of these types. The patient from whom the chart was obtained suffered from extreme heart failure, and the rate of the heart was 140 per minute and very irregular. She was given 1 drachm of digitalis per day, and after five days the pulse-rate fell in the manner shown in the chart. At the same time there was a remarkable improvement in the patient's general condition.

The difference in the reaction of hearts affected with auricular fibrillation and those with the normal rhythm is well brought out by the chart in Fig. 10, where the average heart-rate from six cases of mitral stenosis with auricular fibrillation is compared with six cases of mitral stenosis with the normal rhythm. The record begins with the rate on the day previous to administration of the drug, and it will be seen that the rate in the cases with

Fig. 9.—Chart showing a typical reaction of digitalis in a case of auricular fibrillation with severe heart failure and rapid pulse-rate. The administration of the digitalis began on January 27th in doses of 15 minims four times daily.

auricular fibrillation is greater than the rate of cases with the normal rhythm. This, I may remark in passing, is a point of some interest, for cases of heart failure with mitral stenosis with the normal rhythm rarely have as rapid a pulse as those with mitral stenosis with auricular fibrillation.

In each case the tincture of digitalis was given, 1 drachm

showed that the auricle was fibrillating. The drug was stopped, and four days later, when I was examining her, the heart suddenly increased in rate, and became quite regular, and the jugular pulse assumed the auricular form, showing, in fact, a sudden disappearance of the fibrillation and a return to the normal. In Fig. 11 the chart shows the remarkable slowing of the pulse-rate during the period

Fig. 11.—Chart showing the effects of similar doses of digitalis in a case of mitral stenosis. The patient took 1 drachm of digitalis per day from October 19th to October 25th, when vomiting was produced with little or no improvement in the pulse-rate. She again took the same quantity from November 10th to November 17th, when she again vomited, and the pulse-rate suddenly fell from 104 to 56 beats per minute. The fall in rate was due to the onset of auricular fibrillation, and the rhythm became irregular. This attack of auricular fibrillation persisted for four days till November 20th, when it suddenly passed off, the heart's rate increased, and the rhythm became regular.

per day, and was continued till nausea or vomiting ensued.

I have already referred to the fact that digitalis in some hearts induces auricular fibrillation. When this occurs the rate of the ventricle becomes greatly decreased. The following experience will serve as an illustration:

A female aged 21 suffered from mitral stenosis following rheumatic fever. She suffered from slight heart failure.

Fig. 10.—Chart showing the effects of similar doses of digitalis in 6 cases of mitral stenosis with the normal rhythm (A), and in 6 cases of mitral stenosis with auricular fibrillation (B). The figures at the side represent heart beats, those at the top, days. In each case the digitalis was given until nausea or vomiting occurred, when it was stopped. The average quantity was 7 drachms (1 drachm per diem). This had practically no effect on the rate in cases with the normal rhythm (A), while there was a rapid decrease in the rate in the cases with auricular fibrillation (B).

The rhythm was normal. Digitalis was given and pushed till nausea occurred. No change took place in the rate or rhythm. She was then put on digitalis a second time, and nausea again occurred, and at the same time there was a sudden fall in the pulse-rate, which became irregular (Fig. 11). Tracings taken of the radial and jugular pulses

of fibrillation from November 17th to November 20th. In this case, as I said, the change from auricular fibrillation to the normal took place when I was examining her. I was particularly struck with the great increase of the rate when the rhythm of the heart became regular.

The peculiar response of hearts affected by auricular fibrillation to digitalis is one of such importance that it is bound to modify the attitude of the profession in its use of drugs of the digitalis group. It gives us for the first time a clear conception of the reason that digitalis has acquired such a reputation as a cardiac drug. It helps us to realize why the drug has seemed so capricious in its action, slowing the rate in one patient, and having no effect on another. By the pursuit of observations on the lines suggested, we are gradually obtaining a clearer conception of its effects on the heart itself, and on its nerve supply. The inquiry into this subject is turning out to be one of great interest. The reaction to digitalis varies in different cases of auricular fibrillation, and the reasons for this variation are enabling us to obtain a better insight into the mechanism of the heart's action. This research is, however, only beginning, and it means a long and patient observation of individual cases on the lines we are pursuing in this hospital.

THE Catholic Nursing Institute, 60, Lambeth Road, S.E., desires it to be known that it is prepared to receive patients of any religious denomination. The ordinary payment is one guinea a week, a few private rooms at two guineas a week being also available. Patients admitted can be treated either by their own medical attendants or by those attached to the institution. The nursing is performed by Sisters who are trained nurses.

THE report submitted at the fourth annual meeting of the Army and Navy Male Nurses' Co-operation shows that this body is making steady headway, both the number of cases nursed by the association and the receipts for the services thus rendered having very materially increased. It is satisfactory that the society should be successful, for there is plenty of room for the employment of male nurses, and the army and navy are their natural training grounds. Indeed, we do not know where else male nurses could be thoroughly trained in general nursing. It is also of advantage to the nation that men discharged from the nursing section of the Royal Army Medical Corps should be enabled to continue to pursue their vocation, since sooner or later their services may again be required. In future No. 11A, Wobbeck Street, is to be used both as a residential home for the nurses and as the office of the association.