

An early stage of the severe disease just depicted may also be witnessed in older people, in whom there is much irregularity of the heart's action, with irregular and intermittent but not very weak pulse. A mitral murmur may very generally be detected, and perhaps an apex systolic thrill. These persons may suffer from constant dyspnoea; and from attacks of palpitation, during which the embarrassment of the breathing is much aggravated. There is no dropsy, nor lividity of the skin, and the urine is secreted in natural quantity. Here digitalis will give complete relief, quieting the palpitations, removing the dyspnoea, and regulating the pulse.

The existence of aortic valvular disease in any of the milder (as also in the severer) forms, is not to be considered an indication against the administration of digitalis.

An important question is, how long can digitalis afford relief and preserve life? As might be expected, its good results will depend on the more or less advanced stage of the disease. In its earliest stages the relief may be so complete as to permit the discontinuance of the medicine, and the patient may remain relieved for months or many years; but generally occasional returns of the symptoms recur, which may be again and again removed by a fresh recourse to digitalis. Thus life may be greatly prolonged and made useful, although the sufferer is unfit for very arduous work. Even when dropsy has appeared, and even become extensive, great and permanent relief may sometimes be obtained; but in most cases where the disease has much advanced, and has lasted for some time, the relief—although it may be very great, and all the dropsy and dyspnoea may be removed—is of short duration, and the disease, as it were, over-rides the medicine, and progresses in spite of it. It is of bad augury if a considerable dose is required to mitigate the symptoms, or when it is necessary to give the drug in increasing doses to maintain the ground at first gained.

If no dropsy is present the digitalis will not notably increase the quantity of urine, and will not therefore act as a

diuretic; for usually where there is no dropsy the urine is excreted in natural quantity.

The disease just described appears to run the following course:—At first, from valvular disease, or from some at present unexplained cause, the left ventricle dilates, and, as it dilates, becomes hypertrophied. When the dilatation and hypertrophy have progressed in some degree, the heart's impulse becomes strong and heaving, and is felt over an extensive area of the chest, while the patient is affected, at first on exertion only, with attacks of palpitation and dyspnoea.

Next, as the disease advances, either gradually or suddenly, the impulse becomes still stronger, more extensive, and more heaving, and the contractions are very frequent. The breathing simultaneously is permanently difficult, but becomes with each attack of palpitation paroxysmally worse—so bad, indeed, as to give rise to the idea that the patient cannot live through it. In this stage the pulse is frequent, small, and weak, and in strength is altogether out of proportion to the strongly contracting, heaving, tumultuously acting, left ventricle.* As the disease still further increases, to the above symptoms are added irregularity of the heart's action and irregularity of the pulse. With all the foregoing symptoms and physical signs, there is at first neither fulness nor pulsation of the jugular veins, nor any lividity of the face, nor dropsy; but with the further advance of the malady these symptoms arise, and are probably produced in the following way.

In consequence of the irregular action of the walls of the heart and its columnæ carneæ, the mitral valves become incompetent, and permit regurgitation. There may also be disease and incompetency of the mitral valves, with permanent regurgitation from the ventricle to the auricle, which regurgitation will be increased by the irregular action of the heart. This regurgitation causing considerable obstruction

* Digitalis controls this over-strong action of the left ventricle, and thus affords an instance of its usefulness in some cases of hypertrophied and too powerfully acting heart.

to the passage of the blood through the lungs, the right side of the heart becomes distended, and its valves in their turn become incompetent, leading to regurgitation into the veins, to general dropsy, and lividity of the skin.

When the disease has reached its worst stage, the heart's action is so embarrassed that, although its walls are hypertrophied, it strikes with each beat feebly against the chest, and its impulse may be scarcely perceptible.* The pulse is frequent, feeble, irregular, and intermittent.

In some cases, and especially with children, the disease may advance to a great extent without any irregularity of the heart's action; but with other cases irregularity occurs early.

The *post-mortem* examination shows that the left ventricle is very considerably dilated, and very greatly hypertrophied. The mitral, often, and not unfrequently the aortic valves, are more or less diseased, admitting of a variable amount of regurgitation. These statements are founded on *post-mortem* evidence.

For such a heart, digitalis will be found of great service.

The following explanation of its action is suggested:—By restoring order to the heart's movements, the regurgitation caused by the irregular action of the *columnæ carneæ* is obviated, and regurgitation from the left ventricle to the auricle, and thence through the lungs to the right side of the heart, is prevented. If this be the explanation of its action, then digitalis will remove the symptoms completely, only when the mitral regurgitation is dynamic, and will fail to remove those which depend on organic disease of the mitral valves; and where, as frequently happens, there is in addition to irregularity of the heart's action, organic disease of the mitral valves admitting of regurgitation, the digitalis, by quelling the irregularity, will remove so much of the dropsy and concomitant symptoms as are referable to this condition, but will leave

* In such a case digitalis quiets the heart, removes the embarrassment, and strengthens each beat very considerably, and illustrates the fact that it will strengthen the beats of an apparently weak heart.

unaffected the dropsy, and that share of the symptoms dependent on the structural valvular disease. This view explains the fact that digitalis is generally less useful in the cardiac dropsy of children than in that of adults, for in children we rarely meet with irregular action of the heart, and the symptoms are generally owing to serious disease of the mitral valves.

The truth of this statement may be verified by cases which unfortunately too often occur. A patient with dropsy, and with symptoms and physical signs like those just described, receives partial benefit from digitalis, which removes much of the dropsy and dyspnoea, but the medicine fails to give complete relief. There is found after death much disease of the mitral valve permitting regurgitation, and the left auricle is in consequence much distended. Such condition of the mitral valves the digitalis of course could not remove, but that share of the dropsy and other symptoms produced by the irregular action of the heart the digitalis could remove. The truth of these statements may be verified by *post-mortem* examination, combined with clinical observation. Such testing investigations will show that digitalis is useful generally in proportion to the degree in which the dropsy, etc., are due to irregular action of the heart, and are independent of organic disease of the mitral valves.

It must be admitted, however, that sometimes the foregoing explanation altogether fails: thus, we meet with cases of which the following is a type. A patient, generally a child, suffers from mitral regurgitant and obstructive disease, with ventricular dilatation, but chiefly on the right side. There is unintermitting inability to lie down, paroxysms of severe palpitation lasting hours or days with a pulse at these times very frequent, but always regular. Dropsy sets in; digitalis checks the palpitation, and removes completely the extensive dropsy by greatly augmenting the kidney secretion and gives great relief. In this condition sometimes better, and sometimes worse, the patient remains perhaps for years, then the pulse becomes irregular but without any increase in the

severity of the symptoms. These from time to time recur, but on each occasion give way promptly to digitalis, as soon as it has greatly lessened the frequency of the pulse. It also regulates the pulse, but as we shall presently see, the improvement is not due to this effect in these cases. After death the mitral orifice is found much contracted, the valves united, leaving only a small circular opening. Such is the diseased condition of the valves that it is impossible for the columnæ carneæ to affect them so that any irregularity in the action of the columnæ carneæ could not increase regurgitation, a condition this which explains why no aggravation of the symptoms took place on the occurrence of irregular action of the heart. The *post-mortem* shows that the chief disease is mitral obstruction. Now, in such a case digitalis could have no beneficial influence on irregular action, for it removes the symptoms before the occurrence of irregularity; and irregular action of the columnæ carneæ, as we have seen, could not increase the regurgitation; we are then constrained to assume that digitalis acts in the way suggested by Dr. Foster either by strengthening the auricle or by slowing the heart. There are, however, difficulties in accepting either of these views, for after a few days' administration of digitalis, and as soon as it has considerably reduced the pulse in frequency (a circumstance much in favour of Dr. Foster's view), the digitalis may then be discontinued and the patient will remain weeks or months ere the symptoms recur. Yet, still, the mechanical impediment to the passage of the blood from the auricle to the ventricle remains, and we should expect that the tonic or slowing influence of the digitalis must be kept up, unless it be that the auricle becomes, temporarily, much distended, and thus weakened, and the tonic or slowing action of the digitalis removes this embarrassing distension.

Many authors believe, and Dr. Fothergill has recently espoused this view, that the good effects of digitalis in the foregoing diseases are owing to its strengthening the contractions of the heart. Very likely digitalis does act as a tonic, and it appears to be serviceable, in certain instances where, from

exertion or other causes the heart becoming embarrassed, and perhaps, as Dr. Fothergill supposes, the left ventricle becoming distended, severe symptoms are suddenly produced.

I cannot help thinking, however, that the tonic theory, regarding digitalis, fails in most instances to explain its usefulness in heart disease. Admitting that digitalis strengthens the heart, it seems to me that the clinical evidence is very small as to its efficacy in this respect.

1. Thus: in aortic disease when the left ventricle is weak and unable to overcome the obstruction offered by the diseased aortic valves, the good effects of the drug are very slight, and indeed in my experience *nil*.

2. In fatty and other degenerations of the left ventricle, digitalis is not only useless but harmful.

3. In obstruction to the circulation in the lungs, from emphysema or from extensive retraction due to pleurisy, (especially if the other lung become emphysematous,) causing tricuspid regurgitation, digitalis appears to have little or no strengthening effect on the right ventricle in enabling it to overcome the lung obstruction.

4. In many of the cases most successfully treated by digitalis, the heart is not weak, but, on the contrary, is felt to beat with excessive force, and after death the left ventricle is found well nourished and much hypertrophied as well as dilated.

5. The efficacy of digitalis is most decided in cases where the heart acts irregularly, and not where it simply acts weakly.

It is said that irregularity is a sign of weakness, (of the muscular or nervous structure?) and that the tonic virtue of digitalis removes this condition. But firstly, over and over again, we meet with great cardiac weakness without irregularity; secondly, we may have much irregularity without weakness of the heart's impulse or the pulse; and thirdly, we find the heart well nourished and hypertrophied in cases in which digitalis proves of marked service; the irregularity being the only sign of weakness. It is indeed, a strong-acting, well-nourished heart, misapplying its force through imperfect co-

ordination; with no weakness of the contractile power, only disordered co-ordination.

Moreover, in estimating the effect of digitalis on the heart, we must be careful to discriminate its influence on that organ, from its influence on the pulse. Under the influence of digitalis, the pulse, no doubt, grows fuller and less compressible; but it must be borne in mind that digitalis slows the heart, and therefore, if the heart does only the same amount of work each beat must be stronger: for instance, if we reduce the pulse from 120 to 60, the heart, to do an equal amount of work must, with each beat, pump double the quantity of blood, and thus each beat will feel stronger. Again, digitalis contracts the arterioles, thus increasing arterial tension and rendering the pulse larger and less compressible.

In the heart disease of children with regular pulse, it is difficult to explain the good effects of digitalis by its influence in regulating an irregularly acting heart; but I think the difficulty is still greater in ascribing the good results to the tonic action of digitalis. Dr. Fothergill holds, that in these cases the left ventricle is weak and becomes distended, being too feeble to empty itself, and that digitalis strengthens the left ventricle, which then contracts fully, empties itself, and the dilatation diminishes. The pulse, it is true, is very feeble and frequent; but at the same time the heart beats forcibly and even violently enough to shake the patient. What prevents this powerfully acting ventricle from emptying itself, or at all events, propelling enough blood to produce a full instead of a very weak pulse? And can digitalis be required as a tonic for a heart beating already with such undue force, which after death is found hypertrophied and well nourished, there being no obstruction to the circulation from the left side? In these cases, with a very feeble pulse, we find a powerfully acting heart misapplying its force. This misappropriation of force may be due to want of co-ordinated action—a form of irregularity amenable to digitalis. Certainly digitalis prevents this waste of heart-power, for whilst this drug notably strengthens the pulse, the heart's action be-

comes much weaker, so that a far less powerful ventricular contraction propels more blood. It may be objected that the strong impulse is due, not to the left but to the right ventricle; that from mitral regurgitant or obstructive disease causing impediment to the circulation through the lungs, the right side becomes unduly distended and contracts with great force. This explanation, however, fails entirely in many cases where the physical signs and *post-mortem* examination prove that the impulse was mainly due to an hypertrophied, dilated left ventricle. No doubt the strong cardiac impulse is sometimes due to the right ventricle, and when the impediment to the free circulation depends on mitral obstructive disease, digitalis probably acts beneficially in the way explained by Dr. B. Foster.

Cases of the following kind not uncommonly occur, which may be greatly benefited by digitalis:—A patient (who has been, perhaps, troubled with slight palpitation of the heart for some years) on catching a cold is attacked with bronchitis, and finds in consequence, the palpitations much increased. These palpitations in their turn excite severe paroxysms of dyspnoea. The heart may appear healthy, or there may be only a slight mitral murmur. In such a patient the palpitations may be quelled and the breathing made calm, by digitalis.

This medicine, however, leaves the bronchitis untouched, except that by easing the breathing it indirectly assists expectoration, and by the same means enables the patient to obtain refreshing sleep. In this indirect way digitalis may benefit the bronchitis, but the medicine here acts on the heart; and if with bronchitis much palpitation or irregularity of the pulse occurs, this remedy is indicated.*

M. Jaccoud teaches, that diminished cardiac energy and arterial pressure indicate the administration of digitalis, and that when the energy of the heart and the arterial pressure

* If during a fit of palpitation the heart beats very violently, one or two drops of tincture of aconite, given every quarter of an hour, may succeed in quieting it better even than digitalis.

are augmented, it is contra-indicated. Digitalis and caffeine, he says, stimulate the heart and give tone to the blood vessels.

Da Costa strongly recommends digitalis in the condition termed by him "irritable heart." This disease occurs frequently among soldiers. It may come on suddenly or gradually, and begins with proneness to fatigue, palpitation and dizziness. It is characterized by pain, generally persistent, but also paroxysmally intensified, lacerating, or more rarely burning or tearing, increased by exertion and situated most frequently over the apex of the heart, sometimes radiating in all directions and shooting down the left arm, and accompanied by hyperæsthesia of the cardiac region, increased by each attack of palpitation. The patient complains also of palpitation varying in frequency and severity, occurring at all times of the day, accompanied by much distress and pain. The palpitation is generally brought on by exertion, although it may occur while in bed. These attacks are accompanied by dull headache, giddiness, and dimness of sight. The violent seizures may even produce insensibility. The sleep is much broken and troubled by disagreeable dreams. The patient usually cannot lie on the left side. The pulse is rapid, varying from 100 to 140 per minute, small, compressible, and sometimes jerking, often irregular in force and rhythm,—always remarkably affected by posture, being very frequent while standing, much slower while lying down, the difference amounting to from 30 to 40 beats per minute. Palpitation greatly increases the frequency, in one instance to the extent of 192 beats per minute. The respirations are but little hurried, varying from 24 to 34, and the patient complains of oppressed breathing rendered worse by an attack of palpitation. The impulse of the heart is extended, but is "quick, abrupt, or jerking," and the heart may beat irregularly. The first sound is deficient in volume, "feeble or short and valvular, like the second sound." Murmurs, as a rule, are absent. This condition is produced by overwork and fatigue, and is fostered by depressing influences. It commonly leads to hypertrophy,

when of course the physical signs are modified. When the heart is not hypertrophied, Da Costa found tincture of digitalis in ten minim doses thrice daily quieted the excited organ, reduced the frequency of, and often strengthened the pulse, and rectified irregular action of the heart. If much hypertrophy existed, then digitalis proved less serviceable and sometimes failed to give any relief; but here, aconite in three to six minim doses was very useful: but in purely nervous cases, this remedy was not only useless but often even increased the frequency of the pulse. In much irritability with slight hypertrophy a combination of digitalis and aconite did good. Belladonna was useful in cases accompanied by irregularity of the pulse, but proved of little service in other cases, modifying but little the frequency of the pulse. It was of no service in cases complicated with hypertrophy. He often continued the digitalis for months without producing any toxic effects. In addition to the foregoing treatment Da Costa employed rest in the recumbent posture.

In the cases of cardiac dropsy, previously described, so much benefited by digitalis, it appears to the author that in these a condition existed closely related to, if not identical with, that set forth by Da Costa under the term "irritable heart," but in a more advanced form; that this condition is more or less associated with a variable amount of valvular disease, mostly but not necessarily of the mitral valves, and that it is this peculiar "irritable" state, probably due to some affection of the nerves supplying the heart, that digitalis controls and benefits so effectually. Hence, if all or most of the symptoms are due simply to irritability of the heart, digitalis cures either all or most of the symptoms; but if the symptoms are mainly or entirely due to valvular disease then digitalis proves much less serviceable.

Digitalis is often very useful in pure hypertrophy of the heart. This condition may be due to valvular disease, especially of the aortic valves, or it may be due to Bright's disease or to excessive muscular exertion. In all these forms, digitalis will afford relief by quelling the attacks of palpi-

tion. In aortic disease the hypertrophy is compensatory and hence in most cases, especially of aortic obstruction, no treatment is needed for the hypertrophy itself.

B. Foster recommends it in aortic regurgitant disease when there is more compensatory hypertrophy than the impediment to the circulation requires, indicated by violent action of the heart, bounding vibratory arteries, visible all over the body, almost constant headache, flushed face, noises in the ears. These symptoms, however, it must be borne in mind occur only in severe cases, and that digitalis is useful where the symptoms are much less pronounced. Dr. Balthazar Foster points out that in these instances the action of the medicine must be watched, for too large a dose may induce alarming symptoms, the patient complaining of great prostration, and the palpitations instead of being lessened are increased. Foster attributes these effects to the slowing of the heart by digitalis and increasing the regurgitation at each diastole; but although this explanation may be partially, it is not, wholly true, for the same consequences follow too large a dose of digitalis in other forms of hypertrophy unassociated with valvular disease. In cases like these, two to five minims of the tincture is as much as can be tolerated. For the most part they are best treated by one to three drops of tincture of aconite given thrice daily.

Digitalis exerts little or no control over certain forms of heart disease which may produce dropsy.

General dropsy dependent on heart disease is in some instances produced by the lungs becoming degenerated, then emphysematous, and obstructing the free circulation of the blood from the right to the left side of the heart. To meet and overcome this condition the right ventricle grows hypertrophied, but only to an extent sufficient to meet the obstruction offered to the circulation; and, unlike the healthy heart, little reserve power is left in this organ; so that on the occurrence of any sudden access to the obstruction of the circulation through the lungs, the right ventricle becomes unequal to the task thrust upon it. This happens frequently in an attack

of bronchitis when the blood, unable to pass readily through the lungs, accumulates in the right cavities of the heart, overloads them to distention, till the tricuspid valves become incompetent, and permit of regurgitation from the ventricle to the auricle, and thence into the veins, when, if there is considerable obstruction in the lungs, dropsy will ensue; and the dropsy will vary with the amount of bronchitis; as this increases or declines, so does the dropsy augment or diminish. If the distension of the right cavities lasts a considerable time, then, on the subsidence of the bronchitis, the cavities fail to regain their natural size, the tricuspid incompetency and the dropsy become permanent.

Digitalis here appears to possess very slight, if any, power to strengthen the heart to overcome the obstruction in the lungs, unless indeed the heart acts irregularly. A considerable degree of cardiac irregularity, even without either hypertrophy or dilatation of the left heart, or disease of its valves, adds to the difficulty of the breathing, diminishes the quantity of urine, and produces dropsy, or increases it if already present. This irregularity, digitalis will remove, together with so much of the symptoms referable to this cause.

Cases like the following will exemplify the inefficiency of digitalis to strengthen the heart, and thus enable it to overcome any obstruction offered in the lungs. A patient of middle or advanced age, whose heart, acting irregularly, is much dilated on the left side, and who has consequently suffered from dropsy, dyspnoea, etc., symptoms which have been thoroughly removed by digitalis, on catching cold, and on the occurrence of bronchitis, the dyspnoea, lividity, dropsy, etc., return, and it would naturally be inferred that digitalis, having previously removed the same symptoms, would again give relief. But this is not necessarily the case, and a nice discrimination must be made of the circumstances producing the return of dropsy, etc.; for instance, if there is much emphysema of the lungs, the relapse is not uncommonly due solely to the obstruction in the lungs caused by the bronchitis

and emphysema, and is in no way dependent on any effect the bronchitis has produced on the dilated left ventricle. Digitalis can effect no good, but remedies are needed to control the bronchitis. If, however, as is not unfrequent, the bronchitis affects the dilated left ventricle, and brings back the conditions which existed when the digitalis did so much good, then a return to this medicine will again afford relief. In deciding the question whether digitalis should be given or not, attention must be directed to whether on the return of the dropsy, etc., fits of palpitation come on, with attacks of dyspnœa, and if the heart is excited to beat irregularly, in which case digitalis is required; but, on the other hand, if although there is hurried breathing and a very quick pulse, yet the symptoms just mentioned are absent, the patient will derive no benefit from digitalis.

Digitalis does no good in other serious diseases of the heart inducing dropsy; and indeed, unless care is taken, it may do much harm. For instance, a patient, often in the prime of life, and it may be without any history of rheumatic fever, has suffered for some time, perhaps for many years, from palpitation after exertion. Auscultation reveals an aortic obstructive or regurgitant murmur, or both combined. To overcome the obstruction to the circulation occasioned by the aortic valvular disease, the heart becomes hypertrophied, and this compensation saves the patient for a time from any troublesome symptoms except some palpitations; but after a variable time, serious symptoms arise, which generally increase rapidly in severity, and in the course of a few weeks or months the patient dies. This aggravation of the disease is denoted by paroxysms of palpitation, accompanied by urgent dyspnœa. The attacks may be occasioned by the slightest exertion, or may occur without any such provocation.

The dyspnœa soon becomes constant as well as paroxysmal, and about this time dropsy invades the legs, and rapidly extends till it involves the greater part of the body, and is often in excess in the pleural or peritoneal cavities. During its whole progress, and to the termination of the disease in

death, *both heart and pulse beat regularly and without any intermissions*, and the pulse often manifests the characters significant of aortic regurgitant disease. There is no lividity of the skin, but, on the contrary, it is strikingly pale and waxy looking; nor is there any fulness or regurgitation into the jugular veins. In addition to the aortic murmurs, one may exist having the character of mitral regurgitation, but after death the mitral valves are generally found healthy and competent.

The pathological history of such patients appears to be that disease of the aortic valves induces hypertrophy of the left ventricle, thus enabling it to overcome the obstacle to the circulation offered by the valvular affection. While the compensating hypertrophy keeps pace with the disease, the patient is troubled only by the increased action of the hypertrophied heart, and he may live many years in this condition but little incapacitated for work. Continuing in this state for a variable time, the disease of the heart may produce at last serious and fatal symptoms, in the following ways, the effect on the circulation in each case being the same.

In one instance the disease in the aortic valves advances with great rapidity, so quickly indeed as to make it impossible for the left ventricle to hypertrophy sufficiently to combat the obstruction to the circulation offered by the aortic disease, whence ensues much derangement of the circulation, on which depend the serious symptoms just detailed.

In the other instance the disease of the aortic valves remains either stationary or progresses very slowly, but the left ventricle undergoes degeneration, sometimes with great rapidity, and becomes consequently too enfeebled to meet the increased work thrust upon it by the diseased aortic valves, whence arises disturbance of the circulation, the setting in of dyspnœa, palpitations, etc., as described in the previous case.*

* It is commonly asserted that the dropsy associated with aortic disease is due to tricuspid regurgitation, that the aortic disease leads to hypertrophy of the left ventricle, and that the consequent increased strain on the mitral valves from the strong contraction of the left ventricle produces disease and incompetency of the mitral valves, with mitral regurgitation,