expulsive period of its successor. In this way the great veins near the auricle contract and close first, and maintain their contraction during the expulsive period of the systole of the auricle. It would require an infinite force to open a fully-contracted vein, so that regurgitation from the auricle is amply prevented. A sphincter is as good as a valve to protect the veins. In birds the mitral valve itself is only a sphincter.

When the auricle contracts, it likewise appears to maintain its contraction, prolonging it into ventricular-systolic time, thus for a period supporting the auricular-ventricular valves. The ventricle also appears to maintain its contraction, as Roy and Adami's curves show, for an appreciable period after the outflow of blood into the aorta, thus for a time supporting the aortic valves.

In the case of mitral stenosis any overlapping of the contraction of the auricle on to that of the ventricle is obviously likely to be increased. It is difficult for the auricle, even if hypertrophied, fully to expel its contents through the stenosed mitral orifice before the advent of the ventricular contraction; and just as the contraction of a ventricle is normally longer than that of an auricle, because of the greater opposition its contraction experiences, so the resistance opposed to the auricle, when the mitral orifice is stenosed, is likely to prolong its contraction, and make it more ventricular in character.

Keyt of Cincinnati, as quoted by Professor Marey³ maintained that "one of the characteristics of aortic stenosis was the long duration of the ventricular systole." Dr. Hilton Fagge wrote: "If the mitral orifice be stenosed, the contraction of the auricle will be slower than normal, and the beat of the ventricle will thus be delayed." Dr. Galabin and Dr. Mahomed made very similar statements, after examining their graphic curves taken in cases of mitral stenosis. Dr. Sansom⁴ wrote: "It is obvious not only that the auricle (in mitral stenosis) contracts in a manner much more powerful and much more prolonged than under normal conditions, but also that it contributes in very marked degree to the general elevation (apex beat) which is completed by the systole of the ventricle." French writers, such as Dr. Constantin Paul, have advanced much the same opinions.

Observers such as these could not follow to a useful conclusion the evidence of their senses, because they believed that the power of the auricle did not count as compared with that of the ventricle, and that any overlapping of their contractions could have no physical utility.

As a matter of fact there is no obvious reason why, if the auricle has contracted to, say, half its diameter, in a case of mitral stenosis, before the contraction of the ventricle opposes it, the auricle should not continue to send on its residual contents into the full ventricle, the aortic valves opening, or the ventricle expanding to receive them. This is rendered the more possible by the fact that the walls of the ventricle, in well marked mitral stenosis, are thinner than normal, while those of the auricle are hypertrophied. I have seen an auricle with walls hypertrophied almost to the thickness of the ventricle. Dr. B. Foster and Dr. Sansom have reported auricles with walls measuring up to 6 mm. in thickness, exceeding, that is, the thickness of the right ventricle.

The ventricle can never exert its potential power of opposing the inflow of the residual blood from the auricle, because directly its contraction has raised the intra-ventricular blood pressure above that in the aorta its contents escape into the latter, and no further raising of blood pressure on its part is possible. The maximum resistance the auricle could, therefore, ever find opposed to it by the ventricle is determined by the pressure in the aorta, and an auricle towards the end of its contraction, especially if hypertrophied, could, theoretically, being small, exert a sufficient pressure on its residual contents to overcome this. Allen Burns described a case under his observation in which the ventricles became calcified, and the man lived for a long period with the auricles alone doing the whole work of the circulation.

It may be objected that in cases of mitral stenosis the auricle dilates as well as hypertrophies. I believe this to be one of the fictions of medicine. In a paper published in 1898⁵ I gave particulars of an analysis I made of all the *post-mortem* reports of Guy's Hospital during the ten years 1886-95. Out of a total of 4,791 necropsies during that period, there occurred 196 cases of stenosis of the mitral orifice. Of these cases, 23 came from the surgical wards,

and only one among them appeared to have died of asystole due to the stenosis, which was severe. If this case be excluded dilatation of the left auricle was only observed in 3 of the remaining 22 cases, where death occurred from accident or operation before the heart broke down. Dilatation, therefore, is not a feature of the disease during its course. I doubt if 3 in 22 be materially greater than the average for the heart generally at necropsies. The paper referred to established the fact, so far as statistics could establish it, that the characteristic change in the left auricle in mitral stenosis is hypertrophy, and that dilatation is a break-down phenomenon occurring late in the disease.

CONCLUSIONS.

1. There is considerable evidence to show that the contraction of the auricle normally overlaps that of the ventricle, lasting probably till the moment of opening of the aortic valves.
2. That in cases of mitral stenosis this overlapping tends to be still further prolonged, invading therefore the expulsive portion of the ventricular systole.
3. That the ventricle could not prevent the auricle sending its residual blood into it, if their contractions overlapped, because at that time the auricle, being small, would have few units of area of blood to contract on, and a thickened mass of muscle to exert the necessary pressure, whereas the ventricle would be in exactly the reverse position at the time.
4. In cases where the mitral was stenosed the auricle would be further helped by hypertrophy of its walls and thinning of those of the ventricle.
5. That the murmur of mitral stenosis ("presystolic") goes up to and into ventricular-systolic time because the blood flow does likewise.
6. That the murmur is "crescendo" in character because the auricle can exert an ever-increasing pressure on its contents as it contracts. Theoretically the pressure can increase inversely as the cube of the decrease in diameter.
7. That regurgitation through an incompetent mitral orifice is prevented, probably for years, by the contraction of the auricle behind that orifice during the expulsive portion of the ventricular systole.
8. That the presystolic murmur is replaced by a systolic murmur when the auricle cannot decrease its size in time to become a sufficiently small chamber to defeat the oncome of the intraventricular resistance, but on the contrary is defeated by it. This will allow regurgitation, the auricle will speedily dilate, fibrillate, and compensation will break down.
9. Temporary recovery by rest or bleeding will probably mean that the auricle becomes again, for a short time, master of the situation.

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BILHARZIA DISEASE IN EGYPT.

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THE outstanding facts in Drs. Lasbrey and Coleman's article on 1,000 cases of bilharzia treated by antimony tartrate, in the issue of the *BRITISH MEDICAL JOURNAL* of February 26th, are, as it seems to me—

1. The prevalence of the disease in and around Cairo.
2. The applicability of the treatment of bilharzia—both complicated and uncomplicated cases—by intravenous injections of antimony on a large scale in Egypt; and, most striking of all,
3. That the prestige of the British doctors with the fellahen of Egypt, at the present period of national unrest, is proof against the prejudice aroused by religious and political mischief makers.

The cases were all voluntary, and, since the completion of this series of 1,000 cases in August, 1920, another 1,000 have been done in five months. The C.M.S. Hospital, Old

Cairo, is by no means the only hospital in Cairo where large numbers of bilharzia cases are coming for treatment; the Kasr-el-Aini Hospital, if my information is correct, has treated about 1,600 cases of bilharzia by the intravenous method during twelve months, and other hospitals and practitioners in Cairo are similarly treating numbers of patients, though naturally on a smaller scale; also the Government hospitals in the provinces, some of which have a still larger number of cases to their credit even than the Kasr-el-Aini, and other hospitals, are carrying out the treatment. The great number treated is striking, but bilharziasis is so deeply rooted and prevalent in Egypt that, in my judgement, hospital treatment alone, even on this large scale, will take a long time to make an impression on it as a national disease; the sources of reinfection, too, are many. It should be remembered, however, that each case, when cured by antimony tartrate, ceases to convey infection, owing to the fact that the ova deposited in the bladder and rectum are also killed by the remedy—in other words, the patient ceases to be a "carrier."

The report of the first 1,000 cases treated at the C.M.S. Hospital, and the lucid description of the simple technique employed, is testimony that antimony tartrate is efficient for dealing with bilharziasis on a large scale, and capable of being applied in Egypt. Antimony tartrate is cheap, the cost of the amount sufficient for the course of treatment for one case is 1s. It is stable, it is easily procurable, it is soluble, and solutions containing it can be sterilized by boiling as often as necessary before use. These facts are all advantageous for working in a sub-tropical country and in out-stations. Antimony tartrate, when given by the veins, is, in all probability, not so toxic to the patient or injurious to the tissues as is generally supposed.

The method of administration is simple of application, but, as Drs. Lasbrey and Coleman's article shows, it needs practice, and, if carried out on a large scale, the arrangements need considerable organization. There are many details of method to attend to. Finally, it is not a remedy to be placed in the hands of the careless and the inexperienced.

Bilharziasis is so prevalent in Egypt, and the sources of reinfection after treatment are so numerous, that this direct method is alone not sufficient for dealing with the disease nationally, and in this connexion there is a trait in the character of the Egyptian which militates against the success of simple hospital treatment. The course of treatment at present lasts at shortest seventeen days, and usually three weeks; it may take a month. The Egyptian fellaheen reserves to himself the right to determine when the cure is completed. When he is free from pain, when his urine looks normal, when the act of micturition is normal, then, according to his standard, he is cured. His decision is made often too early, as the doctor knows from microscopic investigation. However, the patient thinks he is cured, and he goes away and cannot be traced. This happens possibly in one-third of the cases treated in Egypt, and it was found advisable by Drs. Lasbrey and Coleman to let the patients bring their mats and sleeping paraphernalia and to accommodate them in the hospital grounds during the course. The only drawback I know to out-patient treatment is this liability of patients to cease attending before the course is completed; it is a serious one, however, and as patients with bilharzia are very numerous in Egypt, and as it is impossible to treat a whole nation in the wards of a hospital, treatment modified according to circumstances is necessary and advisable. Treat the patients as out-patients, but take the treatment to the villages of the people, would seem to be the solution.

Many of the cases—they are the worst from the point of view of spreading infection—are too mild for the sufferer to bother to see a doctor; others are too bad, and, believing there is no cure, die in their villages. Practically the majority of sufferers will not seek hospital relief of their own accord. Therefore the organization of small mobile out-patient hospitals is needed with mobile laboratory attached, and a staff chiefly or in some instances entirely composed of Egyptians; it would take up a position in or near a village and would, from the Omdar or Sheikh, get a list of sufferers; such a mobile hospital would particularly work through the schools—the young are the chief sufferers.

I am not so optimistic as to believe that a clean sweep of the bilharzia cases in any village would be made in the

first instance, or for some years, but if care were taken to send only experienced and careful workers (Egyptian for preference) whose judgement as regards the dose and whose skill in the technique of the operation, and whose care in the preparation of the paraphernalia can be relied on, confidence would be secured and sufferers would come forward voluntarily, and, after a short time, there would be less trouble in applying the injections than there is in doing vaccinations for small-pox. In a short time a travelling hospital, instead of sitting down near a village and treating only a percentage of the sufferers, would be welcomed and would remain until all the bilharzia cases in the vicinity suitable for treatment were dealt with. It would then move on to fresh ground. Cases which were unsuitable for out-patient treatment would be sent to a hospital—no doubt in the car attached to the mobile unit.

But the organization of mobile hospitals, together with the present general hospital treatment, extensive though it is, is in itself not sufficient to deal with so prevalent a disease as bilharzia in Egypt on a national basis.

Leiper's discovery of the life-history of the bilharzia schistosome—its extra-corporeal stages of development in the mollusc (*Bullinus* and *Planorbis* in Egypt)—placed Egypt in possession of information the practical value of which lies in the fact that it can be applied on an economic basis for the purpose of extermination of the mollusc, and so stamping out bilharzia. Without these molluscs bilharzia disease could not exist in Egypt. It is probably impossible to eliminate the molluscs completely, but an advance can be made in two directions in dealing with them. In the first place an attempt may be made to exterminate them, and, in the second, measures may be taken to try and prevent those which cannot be exterminated from becoming infected with bilharzia.

But bilharzia will not be eliminated as a national disease from Egypt by the application of the antimony tartrate remedy, although supplemented by the hygienic measures suggested by Leiper¹ for dealing with the all-important mollusc—sound and thorough though they undoubtedly are. In order to achieve the object in view the co-operation of the natives must also be sought. That they will co-operate in spite of religious prejudices, ignorance and primitive notions, is evidenced by the fact that so many as 1,000 cases of bilharzia in one year at one voluntary hospital and 1,000 at another voluntary hospital in the same town sought the treatment.

The Egyptian mind is receptive; education by lessons at the primary school, by instruction at hospitals, by instruction of the general public by propaganda work, lectures, magic lanterns, advertisement posters, cinematographs—in fact education by publicity is what it needs.

It must not be thought that nothing is now being done by the medical authorities in Egypt. The Egyptian Sanitary Department is fully alive to the importance of this great question of bilharziasis. It has arranged for treatment to be carried out in the Government hospitals, and is moving in the direction of education of the fellaheen by means of lantern slides and diagrams and lectures. Native unrest possibly has prevented more being done so far.

CONCLUSION.

In order to eliminate the scourge from Egypt, it might be dealt with systematically on a much larger scale, and steps might now be taken to get rid of it by supplementing the present stationary hospital arrangements—

- (1) By working through the country with mobile hospitals with laboratory attached;
- (2) By adopting measures for the destruction of molluscs, and for preventing those which cannot be destroyed becoming infected;
- (3) By education of the fellaheen in the causes, prevention, and cure of the disease, and acquainting them with the life-history of the parasite by means of lantern slides, pictures, posters, lectures, cinematographs. The mobile hospitals would with advantage have a cinematograph attached, and the three great helminthic diseases of Egypt—*Hymenolepis nana*, ankylostomiasis, and bilharziasis—"featured." There is no reason why the cinematograph should not be used in this important medical educational work, with very great advantage to Egypt.

REFERENCE.

- ¹ *Journal of the Royal Army Medical Corps*, 1915, vol. II.