even into the brain, as has recently been done by a very careful and skilled worker, who learnt by means of a *post-mortem* examination how easy it is to go wrong, and how absolutely impossible to know the extent of the sinuses, the thickness of their walls, or, indeed, if they exist at all, without an external operation which is practically devoid of danger and has everything in its favour.

In these days, when enthusiasm runs high and the nasal cavities share with other regions its successful as well as unsuccessful results, I am sure I do right in adding a word of warning with regard to careless probing in the higher nasal regions, and I refer especially to the opening of the frontal sinus from the nose, in order to drain, irrigate, or insufflate. From investigations I have recently made, I am correct in saying that it is a proceeding which bristles with danger both to neighbouring healthy structures and to life. Even supposing it was devoid of danger, surely it must more often than not be absolutely useless—for example, in the case recorded, I would ask, What benefit can possibly result from syringing, or insufflating, or draining such large cavities lined by unhealthy degenerated mucous membrane of eighteen years' standing?

One must bear in mind that in dealing with the frontal sinuses we are dealing with a bony cavity, and that diseases of all bony cavities are very intractable to any treatment which is not thorough, that its relations are as various and intricate as its size, that its walls are often thin, and that no treatment which does not actually allow one to see and feel one's way with certainty and safety can be considered scientific or accompanied with reasonable prospects of success.

REFERENCE.

¹ For further information as to size of sinuses and their variations, see An Analysis of the Frontal Sinuses in 120 Skulls from a Surgical Aspect, with Cases illustrating Methods of Treatment, *Lancet*, September 18th, 1896.

THE INFLUENCE ON THE ACTION OF THE AURICLE OF VARIATIONS IN ITS CAPACITY.

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"NOTHING appears to us more inadmissible than the existence of a current going from the auricle to the ventricle during the systole of the latter. In presence of a physical impossibility....." In these words Professor Marey has expressed the view which has hitherto been held without question in France and England, but which the following experiments seem to throw some doubt upon.

I chose two rubber balloons such as are commonly sold to children, the one, *v*, being large and thick walled, the other, *A*, being small and thin. The larger, *v*, when filled with air, but not distended, was about the size of the closed fist, and its walls were about equal in thickness to a sixpenny piece. The smaller, *A*, when similarly full of air, but undistended, was rather smaller than a hen's egg, and its walls were about equal in thickness to a piece of goldbeater's skin. A short tube was inserted into the mouth of the balloon, and tied there. The free end of each of these tubes was connected by a short rubber tube with a T tube, as shown in the figure.

EXPERIMENT I.—Air was blown in by the free tube of the T-piece, and was at liberty to pass into either or both of the balloons. It was found that, although the walls of the smaller balloon, *A*, were many times thinner than those of the larger balloon, *v*, yet the former supported better the pressure and the latter alone was distended.

EXPERIMENT II.—Both the balloons, *v* and *A*, were separately inflated to twice or three times their original diameters. They were then put in communication by opening the clamps placed on the tubes between them. Instead of the large thick-walled balloon, *v*, sending air into the small thin-walled balloon, *A*, the air took the reverse course, and *A* emptied itself into *v* and still further dilated it.

EXPERIMENT III.—Air was allowed to escape from *v*, so that the balloon *v* was diminished in size; *A* was distended as in the last experiment. *v* and *A* were then put in communication. In this case the air was expelled from *v* into *A*, and the connecting tube had to be closed to prevent *A* being burst.

EXPERIMENT IV.—The balloon *A* was inflated and then put in communication with *v*, which was empty and collapsed. In this case the air escaped from *A* into *v* at such a rate that a rubber band which was stretched across the end of the tube inserted into *A* was made to vibrate

sufficiently to produce a loud musical note. This note had not been heard in Experiment II, when the air passed from *A* into *v* more slowly.

It follows from Experiment I that a weak, thin-walled, but small balloon can sustain a greater pressure than a strong, thick-walled, but large balloon; and it follows from Experiments II and III that, if both these balloons be inflated and then put in communication, the direction of the current of air will depend quite as much on their relative sizes at the time as on their initial strengths. The same conclusions may be arrived at mathematically; the internal pressure which a hollow sphere can support, or, if contracting, exert on its contents, being easily proved to vary inversely with the diameter of the sphere.

Now, exactly the same mechanical principle applies to the heart and to the two chambers, the auricle and ventricle. These on contracting assume a form sufficiently spherical for the purpose of the analogy—and the error would be comparatively small if they did not—and as they contract they exert a pressure on their contents which increases in proportion as their diameters diminish. Supposing that the auricle and ventricle should at any time be contracting simultaneously, is it, as Professor Marey states, "une impossibilité physique" that the auricle should succeed in sending its contents into the ventricle?

If the auricular cavity happen at the time to be small, the auricle having nearly finished expelling its contents, and the ventricular cavity happen at the time to be large, the ventricle having just commenced its contraction, then Experiment II suggests the possibility of the auricle being master of the situation, and sending the remnant of its contents into the ventricle, in spite of the latter being already in contraction.

Professor Potain² has shown in France, and Professors Roy and Adams³ in England, that the auricular systole lasts till the opening of the aortic valves. If so, the auricular systole must overlap any portion of the ventricular systole which precedes such opening. During this, the first phase of the ventricular contraction, the ventricle is large and full of blood; the auricle, on the other hand, is small and nearly empty of blood, it having already sent most of its contents into the ventricle. The auricle, in fact, is just in the position in which it has every advantage from relative size, and the mechanical advantage thus gained probably more than compensates it for its relative muscular deficiency, and leaves it at this stage of its contraction more than a match for the ventricle resisting it.

It has been pointed out that the auricle is not more than one-tenth the thickness of the ventricle, and therefore could not exert more than one-tenth as great a pressure on its contents. Since, however, the auricular walls thicken as they draw together during contraction, it is not necessary to suppose that the diameter of the auricular cavity must be re-

duced to one-tenth that of the ventricular before the auricle can exert an equal pressure on its contained blood. When its diameter has become one-fifth or perhaps one-fourth the auricle will probably have thickened sufficiently for its increased muscularity, and the mechanical advantage under which it works, to enable it to contend successfully with the ventricle, and to expel the last portion of its contents into the contracting ventricle.

The left ventricle, on contracting, can never exert a pressure appreciably greater than that in the aorta, because the aortic orifice acts as a safety valve, and blood escapes into the aorta directly the ventricular blood pressure is sufficiently raised. Practically, therefore, the greatest pressure against which the auricle can ever have to contend from the ventricle is measured by that in the aorta. If, therefore, at, or towards, the end of its contraction the auricle can exert a greater pressure on its blood than that in the aorta, it can send it into the ventricle, whatever be the state of the ventricle at the time.

It is not my intention here to prove that the auricle does send blood into the ventricle while their contractions overlap, but merely to point out that it is mechanically able to do so, if its cavity be sufficiently small at the time. I desire also to protest against the generally received assumption that it is physically impossible for the auricle to send blood into the contracting ventricle.

Personally, I strongly believe that the auricle does contend successfully with the ventricle when their contractions overlap, and that it sends blood into the ventricle at that time. This belief I base on the following considerations:

1. That, as I have shown, the overlapping of the systoles occurred at a time when the auricle is favoured by every mechanical advantage.

2. That this action best explains why the auriculo-ventricular valves shut late—that is, at about the time, or but little before, the aortic valves open. The auriculo-ventricular valves are prevented from closing by the support they receive from the contraction of the auricle behind them, and perhaps the necessity of still allowing a small stream of blood to enter the ventricle.

3. That it similarly explains why the contraction of the papillary muscles begins late, as shown by Professors Roy and Adami¹ (and whose conclusions to my mind are quite out of the reach of the attempts which have been made to disprove them), these muscles not being required to contract till the auricle ceases to support the valves.

4. Professor Potain in his article in the *Clinique Médicale de la Charité*, p. 543, wrote: "It is remarkable that the snap (of mitral closure) is as a rule less clear when the præcordial elevation preceding it is more considerable. One willingly attributes the fact to the ventricular hypertrophy which appears capable of stifling in some way or other the vibrations produced." Now Professor Potain attributes the præcordial elevation to the contraction of the auricle. A vigorous præcordial elevation therefore suggests a vigorous auricle. In this case the mitral valves are well supported by the auricle and the residue of its contained blood, and with a strong pressure on each side of them, the resultant pressure to close the valves is but small, and they consequently close quietly. A simpler explanation than Professor Potain's.

5. In mitral stenosis, with incompetent valve and hypertrophied auricle, this theory explains at once the frequent absence of a systolic murmur, and therefore presumably of regurgitation. Regurgitation in fact need not occur, though the stenosed valve be very incompetent. The auricular contraction is admittedly prolonged by the difficulty the auricle experiences in emptying itself forwards. The auricular systole which normally overlaps the first phase of the ventricular contraction now overlaps the second or expulsive phase as well. Regurgitation from the ventricle towards the auricle is therefore prevented by the auricle itself, which remains contracted behind the incompetent mitral orifice, and I have shown that the auricle is mechanically capable of resisting the ventricle under these conditions. It is only when the auricle dilates that regurgitation need occur.

6. In mitral stenosis a "presystolic" murmur is commonly continued into the time of præcordial elevation. From this Dickinson² and others have concluded, in opposition to the generally-received opinion, that the murmur is ventricular-

systolic in origin, and depends on mitral regurgitation. If, however, as I have indicated in this paper, the auricle is also contracting during the earlier portion of the ventricular systole, the blood current from the hypertrophied and nearly emptied (therefore small-chambered) auricle will still pass onwards towards the ventricle, in spite of the latter entering into contraction, and the murmur will continue to be auricular-systolic in origin. There seems no reason why the presystolic murmur should not continue up to, during, and even after the first sound, if the contraction of the hypertrophied auricle be sufficiently prolonged, and its blood be not all previously expelled into the ventricle.

7. There are many other facts in the physics of the circulation the difficulty of explaining which disappears as soon as it is recognised that the auricle can exert a pressure on its contents increasingly great in proportion as the size of its cavity is reduced during its contraction. It would make this paper too long to discuss these here, as well as certain baseless objections, such as the auricle not being valved towards the great veins, which might be raised.

REFERENCES.

¹ Marey, *Circulation du Sang*, p. 692. ² Potain, *Clinique Médicale de la Charité*, p. 543. ³ Roy and Adami, *Heart Beat and Pulse Wave*, *The Practitioner*, vol. xliv. ⁴ Roy and Adami, *Loc. cit.* ⁵ Dr. Dickinson, *Lancet*, 1887.

ON THE PREVALENCE OF ANKYLOSTOMIASIS
IN ST. LUCIA AND ITS TREATMENT.

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ANÆMIA, tropical anæmia or progressive pernicious anæmia, is a disease of such severity, and is so prevalent in this island, especially among the coolies, that the discovery of any means of curing it may be regarded as a decided advance in therapeutics. The number of admissions into Victoria Hospital for anæmia in 1892 was 209; in 1893, 277; and in 1894, 272.

Most of these cases were coolies, but the natives are also very prone to contract the disease. The miserable, dejected, and despondent appearance of the sufferer is characteristic of anæmia. The pale, waxy complexion, the difficulty of breathing, and the slow, laboured walk show that the patient is utterly unfit for work. He has probably remained on the estate, endeavouring to perform even a very moderate task, until dyspnoea on the slightest exertion compels him to seek hospital relief.

Up to the middle of last year we were in the habit of treating these cases with alteratives and tonics, and a generous diet. Among the tonics, iron, in an infinite variety of preparations, was the favourite remedy. Arsenic and its compounds, phosphorus in various forms, chlorate of potash, quinine, strychnine, hypophosphites of lime and soda, cod-liver oil, and other valuable medicines, were given with varying results. Bismuth, dilute hydrochloric acid, and pepsine were administered alternately to assist the failing digestive and assimilative powers. Of the three, pepsine wine undoubtedly occasioned great relief in many cases.

Tabloids of thyroid extract (prepared from the thyroid gland of the sheep) were imported expressly for these cases of profound anæmia, but I cannot say that they afforded any permanent relief. They seemed to allay the urgent symptoms of dyspnoea, and the patient's condition apparently improved for a time, but the change was only temporary. The severe cases generally went from bad to worse, and almost ably ended fatally.

After carefully perusing the researches of Dr. Sandwith on the *Prevalence of Ankylostoma Duodenale in Egypt*, and the valuable article on the same subject in Davidson's *Hygiene and Diseases of Warm Climates*, I determined to make a *post-mortem* examination on the first fatal case of pernicious anæmia that occurred in hospital, and find the parasite if possible. I had not very long to wait. On March 27th, 1895, Kanjania, a female coolie, died in the Victoria Hospital of pernicious anæmia.

Post-mortem Examination.—The usual pathological signs of anæmia were noted. I removed the small intestine and opened it carefully, the contents being preserved in a basin.