wish to avoid confusion of thought and speech, surely, if we wish to repress that needless ever-changing nomenclature, that substitution of words for ideas, that reproduction of old thoughts disguised under freshly furnished raiment, which in knowledge so often begets movement without progress, we shall make sure that the name given shall be based on some physical characteristic of the thing named; so that, whilst theories of its nature may change, the name bestowed upon it, and by which it becomes everywhere and by everyone understood, remains unchanged.

Now, my contention is, that our answers to all these questions should be in the affirmative. I contend that there is a general assemblage of pathological conditions upon which we may bestow the generic term phthisis; that included in this term are subsidiary groups of states, which, differing each from the other in some essential points of their pathological and clinical history, demand separate recognition; and that, in naming them, we should have exclusive regard, not to the ephemeral theories of their nature, but to the abiding facts of their physical constitution.

Guided by these considerations, I regard the ultimate condition of the lung invaded, altered, consolidated, and excavated by fibroid material, as a phthisis; and, seeing that the most obvious and unvarying fact in its physical constitution is the presence and action of this very fibroid substance, I am bold enough to call it fibroid phthisis. This boldness will doubtless call down upon me a storm of reprobation and denial. Be it so. Confident that there is at least some just foundation for the position which I have taken, I must be content to endure and wait.

In reply to this contention, it will be said that the subject is no longer open to discussion; that experimental, pathological, and clinical inquiries concur to prove that there is but one phthisis, the sole originator of which is the tubercular bacillus; that there is neither room nor need for subsidiary classifications; and that their advocacy can be accounted for only by the ignorance or incompetence of the advocates.

But these arguments, couched in such courtesies of modern controversy, are not so conclusive as they sound and seem. Many answers may be made to them; but on the present occasion I shall confine myself to two, which, as I venture to think, are neither light nor irrelevant.

In the first place, assuming the absolute unity of phthisis under the exclusive causation of the tubercular bacillus, this unity does not do away with the fact that there are included in it subsidiary groups, which, for reasons already given, and not refuted by the bacillary presence, require separate and permanent recognition. At present, the bacillary hypothesis, although supreme in the domain of pathology, continues to be of but small account, or even barren, in the field of practical medicine. We cannot prevent the entrance of the bacillus into the organism; we cannot follow it into the secret places where it dwells and works; we cannot reach it by drugs, nor put an end to its multiplication by taking refuge among the mountain-tops. But, although we cannot eradicate the bacillus, nor arrest its action upon the organism, we may, perhaps, succeed in helping the tissues to resist, more or less successfully, the attacks which it makes upon them, and the destruction which follows in their wake.

And, although, in addressing ourselves to the furtherance of this object, we must have regard, in the first place, to the general well-being of the organism, we must not be unmindful of the different structural effects which arise from the unitary action of the bacillus. We must remember that sometimes these structural effects appear under the form of tubercles, sometimes under the form of caseous masses, sometimes under the form of fibroid consolidations, and sometimes as combinations of these forms; in which, however, one form is always predominant. Now, it can scarcely be denied that there is some difference of meaning in these differences of structural effects; that they pursue different courses; and that they react in different ways to the influences of climate, food, alcohol, and drugs. And, if this be so, I can discover no valid reason why those different groups should not be recognised by distinctive names; nor can I understand how we are to preserve a complete loyalty to the uses of knowledge, if we continue to refuse them recognition. It can be no invasion of the rights and privileges of the bacillary suzerainty to grant subordinate autonomies to the several groups of states which, arising under its influence, and continuing through its presence, pursue independent courses and create widely different histories. Why, under the generic name bacillary phthisis, should we not recognise the subordinate independence of tubercular bacillary phthisis, caseous bacillary phthisis, and fibroid bacillary phthisis? Surely every just differentiation is a substantial gain, and every confounding of things fructively distinct a material loss.

In the second place, I hold that the assertion that all ulcerations of non-malignant deposits in the lungs are bacillary, remains unproven, and is opposed to the results of inquiries made by several competent observers. I contend, on the contrary, that there exist cases of ulcerative bronchiectasis, and of fibroid lung with excavations, in which, after repeated search by processes successful in veritable tuberculosis, no tubercular bacilli could be found. It is to such cases that I give the name of non-bacillary fibroid phthisis.

It may be now justly asked, would anything be gained by establishing this distinction? I think much, in many ways. It is, however, of the clinical gain alone that I shall at present speak. By adopting and carefully studying the proposed distinction, we should learn that the history of non-bacillary fibroid phthisis is quite different from that of bacillary tubercular phthisis, and that the treatment which would prove useful in the one might prove both useless and injurious in the other; for example, alcohol, which is usually helpful in caseous, is usually hurtful in fibroid, phthisis. If any one will critically compare the broad facts making up the history of tubercular, with the broad facts making up the history of fibroid phthisis, I think he will become disposed to admit that the distinction now contended for is both real and considerable.

Let me bring to your remembrance a very few of the contrasting facts which are found in the two forms of phthisis now under consideration.⁵ Tubercular phthisis is primarily of constitutional origin, and appears for the most part in the young; it is bilateral; its course is accompanied by elevation of temperature and rapidity of circulation, by progressive loss of flesh, strength, and colour, sometimes by laryngeal ulceration, and sometimes by sensations of painful exhaustion and *malaise*; it is usually rapid in its progress; the majority die within three years; and the few who, in consequence of fibroid complications, live for several years, enlarge the average duration of the disease to four or five.

On the other hand, fibroid phthisis is usually of local origin, and appears for the most part in the middle-aged; it is in the main unilateral; it is unaccompanied by elevation of temperature or hurry of circulation; flesh, colour, and strength may remain but slightly affected for years; it is not incompatible with great bodily and mental energy; the urine almost always contains a little albumen; the progress of the malady is slow; oedema is never absent throughout; and death, which seldom occurs within five years, is often delayed for thirty.

Here, I must bring these lectures to an end. Acutely sensible of their shortcomings, I regret that they have not been worthier of the occasion, of the place, and of you. Nevertheless, I take courage of heart in the thought that those who have worked the most, and have thought the deepest, and can judge the best, will not be ready to forget, or to despise when remembered, the small but sometimes perfect uses of imperfect work.

REGARDING THE EFFECT OF THE SALINE INGREDIENTS OF THE BLOOD ON THE CONTRACTION OF THE HEART.

By SYDNEY RINGER, M.D.,

Professor of Medicine in University College, London.

BEFORE we can hope to attain to a scientific treatment of disease, it is obvious we must possess an exact knowledge of the action of drugs on each tissue; moreover, we must ascertain whether the effect of a drug is due to its direct action on the tissue, or through the agency of the nervous system, or by affecting the activity of the circulation. This exact knowledge we can best acquire by testing the effect of a drug on the tissue actually separate from the rest of the body, or, as far as possible, isolated from the other tissues.

Now, the heart offers exceptional opportunities for this mode of investigation. If blood, or an artificial circulating fluid, be made to circulate through the cavities of a frog's heart, detached entirely from the body, this organ will continue to beat spontaneously, or will respond to stimulation for many hours. This statement holds good, too, with portions of the heart, as the lower third of the ventricle, a part supposed to be free from nervous ganglia. Here, then, we have the means of testing, with facility, the immediate action of a drug on the whole heart, on the ventricle, or on a portion of the ventricle.

In this communication, I propose to describe the behaviour, in physiological doses, of the natural salts of the circulation—the salts proper to the blood itself—on the frog's ventricle.

⁵ That is, there exist in the organism certain peculiarities of soil which enable the bacilli to grow and multiply.

The experiments recorded in this paper were made on the heart of the common English frog. The ventricle excised from the rest of the heart is tied, in the auriculo-ventricular groove, on a "perfusion-cannula," that is, a double cannula; through one tube, the blood, or artificial circulating fluid, is made to flow into the ventricle, and out of the ventricle through the other tube. The ventricle is then immersed into a glass vessel, filled with oil, with a membranous diaphragm at the bottom (Roy's tenometer). This membrane, sucked up with each contraction of the ventricle, falls again with each dilatation, and works a lever which accurately records the movements of the ventricle on a revolving cylinder. The testing drug is added to the fluid circulating through the cavity of the ventricle.

It is a curious fact that, when water only is made to flow through the ventricle, it speedily contracts, so remains, and, in a short time, dies; the water producing in the ventricular, as in the skeletal muscles, "water-rigor."

Now, if common salt be added to distilled water, in the same proportion as it exists in the blood, the ventricular contractions grow weaker and weaker; at last, contractility ceases, and the ventricle stops in diastole, and a contraction cannot be excited by any strong stimulation, even with a strong galvanic induction-shock. The addition of any other of the saline constituents of the blood, save one, will not restore the suspended contractility. The only constituent which will restore the suspended contractility is lime. On the addition of a physiological quantity of a lime-salt, as, for instance, one part of calcium-chloride to 10,000 parts of saline solution (0.75 per cent. of common salt), spontaneous contractions return, and the ventricle very soon begins to beat as strongly as ever.

The following trace shows the effect of simple saline, and the effect of a subsequent addition of lime-water on the ventricular contraction. Fig. 1A shows the strength of the contractions when the ventricle was fed with diluted bullock's blood. On substituting for the blood 100 cubic centimetres of saline solution, the contractions quickly grew weaker and weaker; and when they became very feeble, I added to the saline solution 0.5 cubic centimetres of pure lime-water, at the point indicated by an arrow in Trace B. The contractions speedily improved, and soon became as good as those produced with dilute blood.

Other soluble lime-salts act in the same way; for instance, calcium bicarbonate or calcium chloride. Lime-salts, therefore, will sustain the contractility of the ventricular muscular tissue, and indeed are essential to the maintenance of the contractility. In fact, without a lime-salt, no single salt, nor all the saline constituents of the blood combined, can sustain contractility.

Soluble lime-salts in physiological quantities, added simply to the ordinary saline solution, soon modify the character of the contraction, by prolonging it (so that the top of the trace becomes broader) and delaying dilatation. This is seen in Fig. II.

Even with physiological doses of lime, the increased duration of each contraction becomes so great that, if the ventricle beat with normal frequency, a contraction begins before the completion of the dilatation of the preceding beat, and thus fusion occurs, sometimes partial, sometimes almost complete, as is well shown in these tracings.

A shows the contractions with dilute blood, and B the contractions

with saline solution, containing calcium chloride, after circulating through the ventricle six or seven minutes.

Lime-salts, therefore, though able to sustain the heart's contractility, are inadequate to maintain the circulation; for the diminution of the dilatation, owing to the fusion of the beats, by a half or two-thirds, lessens correspondingly the amount of blood the ventricle can receive, and, therefore, propel into the arterial system.

Any potassium-salt added to simple saline solution accelerates the weakening of the ventricular contractions, and soon suspends all contractility; but on adding any potassium-salt in physiological dose (as one part of potassium chloride to 15,000 parts) to saline, containing a physiological quantity of lime, the effect is most singular and interesting. The potassium-salt quite obviates the delay in dilatation caused by the calcium-salt, and insures a perfectly natural contraction. The effect of lime and potassium salts is well shown in the following trace. At A is shown the trace, while the ventricle was supplied with diluted blood. B shows the effect of replacing this by 100 centimetres of saline solution containing one centimetre of 1 per cent. solution of calcium chloride; the beat becomes broader, the top of the trace rounder, with much delayed dilatation. At the point indicated by an arrow, 0.5 centimetre of 1 per cent. solution of potassium chloride was added, which greatly accelerated dilatation, but failed to completely restore the beat to the character it possessed when the ventricle was supplied with diluted blood. I then added another 0.25 per cent. of solution of potassium chloride, and the ventricle recorded Trace C, in all respects like that occurring with diluted blood.

Here, then, potassium chloride partially antagonises the effects of the lime-salt, and by accelerating dilatation, produces a natural contraction; and thus we have produced, by the combination of calcium chloride, potassium chloride, and sodium chloride, a neutral solution capable of sustaining the ventricular contraction, and of producing perfectly normal contractions.

The foregoing solution is quite neutral in reaction, hence contractions can go on without the circulating fluid being alkaline; but, after an hour or an hour and a half, the contractions grow weaker, and the trace becomes reduced in height to the extent of a third or a half. Now, on the addition of a physiological dose of sodium bicarbonate (1 cubic centimetre of one per cent. solution to 100 cubic centimetres of fluid), the contractions become again quite normal. The strengthening effect of the sodium bicarbonate is due, I suggest, to its neutralisation of the acid developed in the contracting ventricle itself. Experiments show that the addition of a very small quantity of acid to a circulating fluid, enough to give even a faint acid reaction, at once arrests contractility.

All [muscle during contracting forms an acid, and so the ventricle would destroy itself by its own efforts, but that the alkaline sodium bicarbonate of the blood, by neutralising the acid as it is developed, protects the muscular tissue from self-destruction.

Although sodium bicarbonate, under the circumstances detailed, will increase the strength of the contraction, it cannot sustain contractility without the presence of lime in the circulating fluid. For, if sodium bicarbonate be added to saline solution, in physiological quantities, it delays somewhat the suspension of contractility, but does not prevent it; and if sodium carbonate and potassium chloride be added to the circulating fluid, contractility ceases sooner than it does with saline solution and sodium bicarbonate alone. But if a physiological quantity of calcium salt, as calcium chloride, be added to saline solution containing sodium bicarbonate and potassium chloride, we get a solution capable of sustaining contractility unimpaired for many hours.

The addition of a physiological quantity of sodium bicarbonate to saline solution containing a physiological quantity of calcium chloride augments the duration of the beat, thus broadening the trace, rounding its top, and increasing the fusion of the beats, lessening, therefore, the amount of blood received, and, consequently, propelled by the ventricle; but a physiological quantity of potassium chloride not only antagonises calcium chloride, but likewise sodium bicarbonate; and, as I have said, we thus obtain a fluid well able to sustain the heart's contractility. This is well exemplified in Fig. V. A is the trace taken whilst the ventricle was supplied with blood.

saline solution with sodium bicarbonate, nor saline solution containing sodium bicarbonate and potassium chloride, will sustain the contractility of the ventricle. If to any of these solutions lime be added, contractility is maintained; in other words, a lime-salt is essential for the continuance of contractility. Whilst this statement holds good, yet the addition of lime to saline solution, or to saline solution containing bicarbonate of soda, cannot long sustain contractility; indeed, to maintain contractility for several hours, the solution must likewise contain a potash salt.

When the ventricle is supplied with 100 cubic centimetres of saline solution containing 1 cubic centimetre of 1 per cent. solution of sodium bicarbonate, and 1 cubic centimetre of 1 per cent. solution of calcium chloride, good temporary contractions ensue; but, as I have said, they soon become prolonged, so that the trace gets rounder at the top, and next the dilatation becomes prolonged. If the ventricle beat with normal frequency, the beats fuse more or less completely. Whether this occur or not, the ventricular contractions grow weaker, slight persistent spasm (contraction) sets in, and the contractions grow weaker and weaker till the heart stops. In the cold months, these changes occur slowly, and the ventricle goes on contracting for an hour to an hour and a half; but, in summer, especially when the weather is very hot, these changes described take place much more rapidly.

The presence of a potassium salt like potassium chloride in physiological doses prevents the occurrence of any of the changes just described, and maintains natural contractions. Even when the ventricle has grown very weak, or has stopped beating, the addition of potassium chloride to the circulating fluid will restore contractility, the beats being at first weak, but gradually growing stronger, till the trace becomes equal to the trace produced by blood or circulating fluid.

Here is a trace showing the effect of a solution containing lime without potash, and showing also the effect of the subsequent addition of potash. As the changes occur much more rapidly in hot weather, I record a trace taken in July, when the temperature of the room reached nearly 80° Fahr. A is the trace of the ventricle supplied with circulating fluid. I then replaced the circulating fluid by 100

B shows the trace taken ninety minutes after the diluted blood was replaced by 100 cubic centimetres saline solution, containing 1 cubic centimetre of 1 per cent. solution of calcium chloride, 1 cubic centimetre of 1 per cent. solution of sodium bicarbonate, and 1 cubic centimetre of 1 per cent. solution of potassium chloride.

It has, then, been clearly shown that neither saline solution, nor

cubic centimetres of saline solution containing 2 cubic centimetres of 1 per cent. solution of calcium chloride. In about twelve minutes the contractions became much weaker. At this point I added 1 cubic centimetre of 1 per cent. solution of sodium bicarbonate, which temporarily strengthened the contractions, though they soon again became weak. Then, I added 1 cubic centimetre of 1 per cent. solution of

potassium chloride, which soon strengthened the contraction; these changes are all well seen at *a*.

At the point indicated by the arrow *a*, I added the sodium bicarbonate to the saline solution containing calcium chloride; but, some seconds elapsing before the bicarbonate could reach the ventricle, the trace at first grew smaller and smaller; but when the sodium bicarbonate reached the ventricle, a temporary strengthening of the contraction ensued, but it soon grew weak again. At the point indicated by the arrow *b*, I added to the circulating solution the potassium chloride solution, with the effect of speedily and considerably increasing the strength of the beat. The ventricle continued beating spontaneously; and, at the end of rather more than three hours, when I was obliged to discontinue the experiment, the heart gave the following trace.

The contractions after this long interval were as good as at the beginning of the experiment.

In this experiment, on the addition of potassium chloride, the strength of the contractions rapidly improved; but, in other cases, the recovery is much slower, and twelve to twenty minutes may elapse before the complete restoration of the ventricular contractions. I introduce this chart because it shows summarily the same changes which occur much more slowly in cold weather. This chart likewise shows that, although without lime no contraction of the muscular tissue is possible, yet, even with lime and sodium bicarbonate, in proper proportions, added to saline solution, the contractions ultimately grow weak, soon in hot weather, far more slowly in cold. But on the addition of potassium chloride (although the addition of this salt merely to the saline solution, or to saline solutions containing sodium bicarbonate, is quite unable to sustain contractility), the contractions at once grow stronger, and soon become normal, and the ventricle continues to beat naturally for hours.

Potassium chloride, or some potash salt, is essential, therefore, to the prolonged continuance of contractility. It would appear that, unless the dilatation of the ventricle be speedily and effectively performed, "exhaustion" sets in, and the ventricle contracts feebly, but, on facilitating the dilatation, the ventricle quite recovers.

The normal contraction of the ventricle, then, is the result of a mutual antagonism between calcium and sodium bicarbonate salts on the one hand, and potassium chloride on the other. We can modify, in various ways, the character of the contraction, indicated in the form of the trace, by altering the normal relative quantities of these salts. If we increase the quantity of lime chloride, or of sodium bicarbonate, we broaden the trace of each contraction round its top, and produce some degree of fusion; but we can obviate these effects by increasing the quantity of potassium chloride. If, on the other hand, we increase the quantity of potassium chloride, the trace of a contraction at first becomes sharper at its summit, and then it does not mount so high, indicating that the ventricle contracts only imperfectly; and these effects of potassium we can entirely remove by increasing the quantity of calcium chloride. There is, indeed, as I have maintained, a physiological antagonism between these salts, and on this physiological antagonism the proper contraction of the heart depends.

Season, or rather temperature, and the condition of the frog, so affect the muscular tissue of the heart, that at certain months, and with weak exhausted frogs, a circulating fluid is required of somewhat different composition.

Cold favours the effects of lime, whilst heat favours those of potassium. Cold, like lime chloride, makes the contraction slower, and the summit of the trace broader. Heat, like potassium chloride, shortens the duration of each beat, and makes the summit of the trace sharper. To obtain a complete and normal contraction in cold weather, more potash must be used; and, instead of 0.75 cubic centimetre of 1 per cent. solution to 100 cubic centimetres of circulating fluid, 1 cubic centimetre should be added. In summer, the potash solution may be reduced below 0.75 cubic centimetre per 100 cubic centimetres; but it is better to increase the lime chloride solution to 1.5 or 2 cubic centimetres of 1 per cent. solution to 100 cubic centimetres of circu-

lating fluid. There is no need to increase or diminish the amount of solution of sodium bicarbonate. With weak frogs, or those kept in confinement for some time, the solution must be modified. Exhaustion assists the effects of potash, for both lessen the amount of contraction, so that, in the case of exhausted frogs, the quantity of lime solution must be somewhat increased, in order to form, under these conditions, a fitting circulating fluid.

In conclusion, let me urge a practical suggestion, which seems to spring naturally from these experiments. In cases of profuse hæmorrhage, as in flooding, or in the excessive alvine discharges of cholera, it is of cogent importance that we should employ a fluid suitable to the life-or-death case. I think the foregoing inquiry points out that an effective injection should contain not only sodium bicarbonate, but likewise physiological quantities of salts of calcium and potassium.

DOMESTIC REMEDIES OF THE ARABIAN DESERT: WITH ETHNOLOGICAL NOTES, ETC.

By E. GORDON HULL, M.D., B.A., Dublin.

DURING the autumn and winter of 1883-4, while acting as honorary medical officer and assistant-geologist to an expedition sent out by the Palestine Exploration Fund, to Arabia Petrea and the Arabah Valley, I had an opportunity of making some notes on the common ailments and remedies of the Bedawin, and also some observations on their physical condition, which I will state as shortly as possible.

Physically, they are a small race, but their limbs and bodies are well formed and proportioned, and they are capable of enduring great fatigue on a diet consisting principally of boiled rice and butter, with unleavened bread, coffee, dates, and water. We came across two principal tribes, those of the Sinaitic Peninsular, and those who live east of the Arabah valley. The Towara, who live between the gulfs of Suez and Arabah, are more civilised than their eastern brethren, and indulge in a little agriculture, but they live chiefly by tending sheep and goats.

I measured twenty-six adult males, picked men of the tribe; taking three measurements, that is, height, chest round nipple, and length of right arm from acromion to top of middle finger. The average height was 5 feet 4½ inches; average chest-measurement, 31 inches; average length of right arm, 27.6 inches. The maximum chest-measurement in a man of 5 feet 11 inches was only 34½ inches, and the minimum in one of 5 feet was 30 inches. Yet, with such insignificant chests, they were splendid pedestrians and mountaineers, and did their day's march without a murmur. Certainly, they were all in very good condition, for I do not suppose there was an ounce of fat among the whole tribe. The next tribe with whom we came into contact were even of smaller make, averaging only 5 feet 2 inches in height. Their muscles, especially of the upper extremities, were very poorly developed, while they nearly all, except the sheik, exhibited marks of inferior intelligence; about five or six out of our twenty men were decidedly half-witted, and all of them had the habit, common among such people, of repeating over and over again everything that is said to them, or that they say to one another. They appeared half-starved, and used to chew continuously the dried beans provided for the camels. Like most wild animals, they have splendid teeth, very firmly fixed in the jaw, and their sight is remarkably keen. They nearly all turn in their toes when walking.

Owing, no doubt, to their habits, the Arabs seem to be most subject to the diseases due to exposure; but, as far as I could judge, these diseases have a tendency to the chronic or subacute form, rather than the acute. Two I particularly noticed as almost universal, that is, chronic bronchitis, of a dry kind, and without emphysema; and chronic articular rheumatism.

The first cannot fail to force itself on every traveller's attention, as it gives rise to a peculiarly irritating paroxysmal cough, rather canine in character, which, as the Arabs sat round our tents at night, often disturbed our slumbers. The second, that is, rheumatism, I noticed when taking the measurements of a series of the men; nearly all their shoulder-joints creaked and groaned as they raised them; and this will account for the curious inability of the Arabs to move about or do any work in the morning before they are "thawed," and rendered supple either by fire or by sun. It seems, at such a time, as if all their joints were temporarily ankylosed, so stiff and unpliant are they. Ophthalmia is common; it appears to begin usually as a purulent conjunctivitis, but is very liable to attack the cornea; and, in a great many cases, it proved to be really associated with granular lids. A great number of the Bedawin of the Peninsula had corneal opacities, but, amongst the wilder tribes of the east of the Arabah, I noticed