CROONIAN LECTURES

ON

MATTER AND FORCE.

Delivered at the Royal College of Physicians.

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LECTURE III.

On the Third Stage of our Ideas Regarding the Union of Matter and Force in the Biological Sciences.

MR. PRESIDENT,—I come now to the object for which I undertook this course of lectures. It is to show you that, even in this country in which John Hunter's great authority makes the *materia vite diffusa* a reality, and I might almost say a part of the *religio medici*, yet even here, the third stage of ideas regarding the union of matter and force is beginning to grow up amongst us, and gives the promise of fruit far beyond any we have hitherto gathered in physiology, pathology, and therapeutics.

The general ideas regarding the union of matter and force in the biological sciences have not as yet got beyond the second or Hunterian stage; and there are many who think that the first stage, which consists in the complete separability between matter and living force, still represents the whole truth. The third stage, or complete union between the ideas of matter and living force—that is, the utter inseparability of one particle of living force from the matter in which it has been placed, is as yet in its infancy, and cannot be yet subjected to the examination it will have to undergo.

We are only just entering upon the inquiry how far our ideas of conservation and correlation of energy can be extended to the biological sciences. We are only just beginning to ask how far a balance can be struck between the income and outgoing of all the energy which vegetables and animals possess in health and in disease. The quantity and quality of the energy that comes in, and the quantity and quality of the energy that goes out of the living thing, are questions in every respect as inseparable from the progress of biology, as the quantity and quality of the matter that enters into or is thrown out of any system. The slight progress that has hitherto been made is seen in the fact that there are many persons at present able to rest in the belief that the inseparability and conservation of matter and force are our main principles and our best guides in the abiological sciences; whilst most persons think that in the biological sciences the perfect or imperfect separability of matter and force, and the constant creation and annihilation of energy, are most likely to be the true foundations on which the sciences that include life must be built. But, if this be so, then the creation and annihilation of force must be established by positive proof, and must not rest only on assumptions which are directly opposed to the most certain knowledge we possess regarding matter and force in other branches of science.

We know now that in all living things no separate or peculiar matter is present. The stuff which takes part in the living actions, and the forces which are inherent in that stuff are there, and indestructible and inseparable. Inorganic matter and inorganic force always exist together in living things; so that, if a separable living force be also present, then we must admit that two totally different laws of force must be in action at the same time in the same matter. The unity of nature will at least be preserved by our hesitation to admit the assumption of a force capable of creation and annihilation, until some very conclusive evidence be obtained that there actually is in living things such a force or forces capable of being separated entirely from the matter of which they are made. Until this be proved, let us inquire how far the third stage of ideas regarding the union of matter and force and the principle of the conservation of energy opens new paths for investigation, and gives us new glimpses of truth. What are the actual and potential energies which enter into the body? To what motions do these energies give rise there? How do these motions leave the body? Matters in a state of tension, and ready for chemical motion, are constantly going into the body in the food and air. The quantity of active and latent energy which goes in, ought exactly to balance the quantity which comes out, deducting that which remains latent in the chemical substances, or becomes active in the actual warmth of the body itself. The chemical

changes in the matter within the body (that is, the decrease of potential energy or tension) give rise to different forms of motion. These motions appear as the functions or work of the body. Two chief kinds may be distinguished—first, motion in great mass, as mechanical work, etc.; secondly, little mass, or molecular motion, as heat, electricity, nutrition, etc. A little mass of carbon and of oxygen contains a certain amount of tendency to move, that is, of potential energy. These molecules, as soon as they can, move together, and the motion produced must continue in some form until a state of tension or potential energy again results. The latent force of the nourishment is most easily measured by determining the amount of latent heat which the food contains. In order to do this a known amount of substance is burnt, and the amount of heat produced is determined; and as the mechanical equivalent of heat is known, the equivalent amount of work which the substance can do may be calculated. By far the greater part of the potential energy or tension which goes in is ultimately changed into warmth. Other modes of motion, as electricity and mechanical work, take but a small part of the total income. The balance-sheet at present can give an idea of the form which the account will ultimately take; but it cannot tell the items with any approach to accuracy. The difficulties which surround the determination of these items at present may be seen by looking for a few moments where our knowledge now is regarding the origin of muscular motion.

According to the earliest ideas, muscular motion was produced by the soul. According to transition ideas, the motion was considered to be created by a definite something, a vital force or fluid, capable of being increased or diminished according as stimulants (nervous or other) acted on it or not; and finally, capable of quitting the matter of the muscle a short time after the body was dead. The Hallerian irritability was the best representative of this stage of ideas. According to the latest ideas, the origin of the motion must be some antecedent equivalent motion. This is looked for in the chemical changes in the nitrogenous or the non-nitrogenous matter of the contractile texture or surrounding blood. "No one," says Dr. Frankland, "possessing any knowledge of physical science, would now venture to hold that vital force is the source of muscular power. An animal, however high its organisation, can no more generate an amount of force capable of moving a grain of sand than a stone can fall upwards, or a locomotive drive a train without fuel." Professors Liebig and Playfair, and others say, that the chemical changes in the nitrogenous matter of the muscles are the cause of motion. Professors Frankland, Pick, and others, say that the mechanical work is much greater than can be accounted for by the amount of change in this matter, as measured by the urea produced. They determine the amount of mechanical work done in a given time, and they translate it into its equivalent of heat, weighing also the urea produced in that time. By burning a known weight of muscle out of the body, they determine how much heat it can produce; and from this they can calculate how much muscle must be burnt in the body to give an amount of heat equivalent to the mechanical work done in the given time. They then calculate what amount of urea this weight of muscle would produce. By comparing the actual amount of urea produced with the calculated amount, it appears that only one-fifth of the work can come from chemical change in the nitrogenous texture of the muscles. Four-fifths of the work must arise from the chemical action going on in the non-nitrogenous matters in the muscles or in the surrounding blood.

The experiments made by Dr. Parkes most completely confirm the view that the motion of the muscle during exercise does not bear any relationship to the amount of chemical disintegration in the albuminous substance of the muscle. Indeed, he suggests the opinion that the action of the muscle is not connected with disintegration, but with formation; that, when it is in exercise, it increases; and, when it is quiescent, it lessens in bulk; that is, that it more rapidly disintegrates during rest than during exercise. This view can only be proved by a vast amount of further experimental research.

When this question, which regards the value of this one item in the expenditure and income of matter and force, is solved by experiment, there will be left still more difficult problems—as, for example, how this conversion of heat into contraction of muscular fibre takes place; how the nerves are made to be able to increase or lessen the conversion of latent into active energy at will. This most extensive and important inquiry, which the doctrine of the conservation of energy has opened to our work, is good evidence that the third stage of ideas on the union of matter and force is beginning to be received in physiology.

What the worth of these ideas is may be seen in the comparatively simple problem of the source of animal heat, when the doctrine of the conservation of energy is admitted. Whether animal heat arises from nervous force or from chemical action has been a point as disputed as whether voltaic electricity arose from metallic contact or from chemical action. The dispute is ended in both instances by the admission of the

doctrine of the conservation of energy. If the animal heat comes from nervous force, or the electricity from metallic contact, then what is the equivalent of potential energy that gives these their actual energy? Unless the creation of force be assumed, the equivalent in actual or potential energy must be forthcoming. In the case of animal heat, it may be said that the nervous force comes from an equivalent energy of nutrition; but then the further question must be answered, Whence does this energy of nutrition come? And this brings us ultimately to the chemical force which gives the potential energy to the matter that enters the body. This is the prime origin of the motion which we call animal heat.

The different kinds of apparatus or organs which the animal possesses for the conversion of energy determine in what form of motion the expenditure of energy can take place. The brain, the nerves, the muscles, the electric organs, the textures in general, all these are machines set in action chiefly by the potential energy or tension in the food, textures, and air; the supply of oxygen, hydrogen, and carbon being the first necessary condition.

The mechanical, chemical, nutritive, muscular, and nervous motions are so related, that it is most difficult to separate the action of any one motion, even the simplest which can occur in the human body. When these motions are so increased or diminished as to constitute disease, then the difficulty of isolating any one motion becomes by no means lessened. Still, even in disease, the doctrine of the conservation of energy can enable us to make at least as great an advance as was made in our ideas and language when the doctrine of phlogiston, or the hypothetical inflammable principle which was thought to possess a power of levity, was given up.

Vital force in disease must cease to be regarded as an imponderable material capable of varying in quantity and quality. It cannot be made more active by stimulants, or be kept up by whips, whether ponderable as alcohol, æther, ammonia; or imponderable as heat, light, electricity, friction; nor is it capable of being made less active, or let down or unacted by excessive use or by withdrawal of the stimulants.

When any excess of motion takes place, we must have an answer where the equivalent of that motion comes from, and whither it will go. Our ponderable and imponderable whips and stimulants are bound up with the matter, and produce more active motion according to the latent energy which the matter itself possesses. When any want of motion occurs, we must ask whence the deficiency of motion comes. Is there a want of matter possessing latent energy? or is there increased resistance to the conversion of latent energy into active motion?

It may be said that this is only a verbal alteration; but it is, in truth, an alteration in the foundation on which all our knowledge is based. It is an alteration which represents the direction in which science is advancing; and it is an alteration which not only marks the advance, but renders further progress more certain and more easy.

I will take the first and greatest question in pathology to illustrate the importance of the change in our views regarding the union and conservation of matter and force.

Inflammation, according to our unchanged ideas, is an increase of heat, redness, swelling, and pain, caused by an excess amounting to tumult in the nutritive changes in the inflamed part. The dilatation of the smallest arteries and veins; the retardation of the current of the blood; the disappearance of the layer of serum which lines the vessels; the piling up of the colourless globules in the veins; the stoppage in the capillaries,—all these are produced by a direct or reflex paralysis of the contractile textures of the small arteries and veins. (Cohnheim, *Virchow's Archiv*, Sept. 1867.) In other words, excess of nutrition in the inflamed part is considered to arise from a loss of energy.

This is directly opposed to the principle of the conservation of energy. Let us apply this principle to inflammation in parts free from blood-vessels and nerves, as the cartilage and cornea, where, at least, no question of a direct or reflex paralysis of the blood-vessels can arise.

In the non-vascular textures, the increased action is limited to increased heat and nutrition. These two forces are directly related, so that a certain quantity of heat can produce a certain quantity of nutrition, and *vice versa*; but neither can arise from nothing. Either requires some other mechanical, chemical, electrical, or thermal motion to be given to the matter in the inflamed part, to increase the healthy motions which are always there. This increased motion may come from without by injuries and accidents, or from within by diffusion of active substances into the cornea and cartilage. According to the amount of increase of motion, will be the amount of inflammation. In the vascular textures, the increased motions of oxidation and nutrition outside the vessels act directly on the contents of the nearest vessels, and, from the increased action between the vessels and textures, the dilatation of the vessels, the disappearance of the serous layer, and the heaping up of the red and white corpuscles arise.

The principle of the conservation of energy requires that increased oxidation and nutrition in the inflamed part cannot arise except from an equivalent quantity of some form of motion, or some form of potential energy reaching the part. The same principle also requires that the inflammation must continue until the increased motion passes off in heat, or in pus, or in some other form of motion. Thereby the increased motions subside to the amount which is called health.

The doctrine of the conservation of energy and the inseparability of matter and force will lead to an entire change not only in physiology and pathology, but also in that most practical part of medicine, therapeutics. At present, our knowledge is very confused and uncertain as to how and where medicines act. We almost believe that our medicines have the power not only of creating, but of annihilating force; and we almost think that they are able to select the part on which they will act, whilst they leave other parts of the body entirely free from their presence. From our want of knowledge how and where the effects are produced, the greatest possible difference of opinion exists as to the action and work of all the different classes of medicines—stimulants, sedatives, tonics, alteratives, specifics, evacuants. We are almost led to say that stimulants create force, because they increase contractility and sensibility; that sedatives destroy force, because they diminish contractility and sensibility; that tonics create force, and specifics destroy force, and alteratives change force. But the law of the conservation of energy requires us to believe that no food and no medicine can cause the creation or the destruction of the slightest particle of energy. The amount of conversion of potential into actual energy may be made more or less. The conversion of one kind of motion into another kind may be diminished or increased, but no annihilation nor creation of force is possible.

We must cease to regard the so-called imponderable heat, or its opposite cold, friction, or its opposite rest, electricity, light, etc., as entities that can be increased or diminished as remedies; and we must begin to look at them as modes of motion of the particles of matter in the different parts where they act. These modes of motion, by their correlations with the motions of oxidation and nutrition which are going on in the affected part, determine whether more motion or less motion should result.

The medicines which are taken into the body have the same incapability as food to create or annihilate force; they possess chemical energies by which, wherever they go, they take part in the motions of oxidation and nutrition which are going on there; and, according to their chemical properties, they add to the motions, or increase the resistance to the motions, that constitute disease.

The questions, then, which must be answered before we can obtain clear ideas of the actions of medicines in the body are: 1. What are the different motions which occur in the body? and how are these different motions related to one another? and 2. How do different agents or medicines increase or diminish these different motions which occur in the different organs and textures?

Assuming that any energy which shows itself in any of the motions of the body must arise from some other form of energy, and that this must ultimately be traced up to the chemical energy which enters with the food and air, then the action of medicines in increasing or diminishing or altering the action of oxygen in the different textures must be at least one of the most important questions in therapeutics.

Let me for a moment take the most directly chemical of all medicines, alkalies and acids, and let me try to show you that they are capable of taking a part in oxidation; and, from this experiment regarding the actions of acids and alkalies out of the body, perhaps you will be inclined to agree with me that they are capable of playing opposite parts in the oxidation which is going on every where in the body.

I have here an organic matter, grape-sugar, and oxygen in the oxide of copper, precipitated from the sulphate by alkali, which I can bring into contact with each particle of organic matter. In each of these glasses, the same amount of sugar and oxygen and alkali is present. I will leave one glass as a standard of comparison regarding the rate of oxidation of the grape-sugar. To the other glasses I will add different amounts of alkali and acid; and even in a few minutes, without raising the fluids to the temperature of the body, you will see that the most alkaline is most rapidly oxidised, and that the least alkaline or acid fluid will have the oxidation retarded or altogether stopped.

That alkalies and acids have the same action in the body, and that they can promote or retard oxidation, must be determined by direct experiments; but meanwhile these views will lead us to think more of the alkaliescence of the blood, and of the extent of the evil that acidity may occasion, even if we do not use sugar and acids more freely in inflammations and fevers, and urge our alkalies with greater perseverance where fatty and gouty thickenings and deposits exist. If time permitted, I might here mention the wonderful experiments on the produc-

tion of acute fatty disease of the liver, spleen, heart, etc., by phosphorus-poison. The formation of phosphoric acid in the textures probably is the direct cause of the accumulation of fat by arrest of chemical action.

Inseparable from the action of oxygen in the system are the other correlated actions—heat, electricity, nutrition, contractility, and sensibility. These must increase or diminish as the action of oxygen increases or diminishes; and the questions which arise, as to the mode and extent of the convertibility of any one of these motions into other modes of motion, have to be determined by further investigation.

Stimulants, tonics, and evacuants, may, perhaps, not only take part directly in the motions of any part, but they may also promote or retard the conversion of one motion into other motions. Specifics and alteratives may, directly as well as indirectly, change the motions in the system; and sedatives and narcotics may have the same double action in retarding or stopping the motions that take place.

This view will almost lead us to consider all medicines as alteratives, and, if so, we may perhaps place stimulant and sedative medicines at the two extremes of the alternative actions; the stimulants giving rise to the greatest increase of motion, and the sedatives allowing the least motion or the nearest approach to rest. Hence rest and motion may be taken as the two great aims of therapeutical actions. The two substances which perhaps I might name as best shewing these opposite actions, are laughing gas, NO_2 , which, in small quantity, rapidly increases involuntary and voluntary motion; and prussic acid, HCN , which almost immediately stops all conversion of energy in the heart, diaphragm, and other respiratory muscles, by paralysing the excito-motory ganglia in the heart itself, and by the same action on the eighth pair.*

These are some of the questions which are opened to therapeutical inquiry by the doctrine of the conservation of energy and the inseparability of matter and force. When these questions can be answered, most of the differences of opinion on the action of medicines will disappear. Perhaps we shall ultimately be able to estimate the increase or diminution of any one motion which, by affecting all other motions in a part or in the whole body, constitutes disease. When the disease arises from increased action, we shall restore that normal quantity and quality of motion in the body on which the health depends, by decreasing the motion or adding to the resistance to conversion; and, when the disease arises from diminished action, we shall attain the same result by increasing the motion or lessening the resistance to conversion.

With regard to the question where medicines act, the idea of the inseparability of matter and force will probably lead to far broader views than we now hold. For want of more definite knowledge, we are almost tempted to assume that medicines have an elective affinity which determines the place where they will act. If, however, it can be shewn that most medicines pass into every texture of the body and carry with the matter whatever force they possess, then it follows that our present ideas of the local action of medicines are far too restricted.

The experiments which I have published in the *Proceedings of the Royal Society*, June 15th, 1865, on the rate of passage of lithium into and out of the vascular and non-vascular textures shew the rate at which chloride of lithium passes into the textures through the stomach of the guinea-pig.

$\frac{1}{4}$ grain in	3 days	plenty found everywhere.
3 "	15 minutes	everywhere except in the lens.
"	30 "	"
"	30 "	" traces in the lens.
"	30 "	" outer part of the lens.
"	60 "	"
"	60 "	" except in the lens.
"	in 2½ hours	" and throughout the lens.
"	4 "	"
"	8 "	"
"	24 "	"
"	26 "	"
$\frac{1}{4}$ "	5½ "	" except in the lens.

Hence, in four minutes, in a guinea-pig, three grains of chloride of lithium may be found everywhere by the spectrum-analysis; and this quantity was found to give traces in the lens of the eye after thirty-three days; and it appeared in the urine for thirty more days, the guinea-pig probably re-dosing itself from its own skin.

The following table shows the rate of passage of carbonate of lithia into and out of cataracts in men.

20 grains of carbonate of lithia were taken

25 minutes before the operation—No trace of lithium was found in the cataract.

2½ hours " —Lithium in the watery extract of the cataract.

3½ " " —Lithium in each particle.

4 " " " "

4½ " " " "

5 " (old man) " " "

5 " " " "

7 " " " "

4 days { spontaneous soft cataract, 25 to 30 } " —Traces in alcoholic extract of ash.

7 " " —In alcoholic extract not the slightest trace of lithium.

7 " 5 hours " —Slightest trace in the alcoholic extract.

In man, five grains gave evidence in the urine in from ten to twenty minutes, and continued to pass out for eight days. After a twenty-grain dose of carbonate of lithia, the crystalline lens shewed lithia in two and a half hours. After seven days none was found.

Sulphate of thallium was also shewn, by spectrum-analysis, to pass into all the vascular and non-vascular textures, and even sulphate of silver was traced into almost every texture.

In the *Proceedings of the Royal Society*, April 12, 1866, Dr. Dupré and I further shewed that four grains of sulphate of quinine passed in fifteen minutes into every texture of a guinea-pig, and was detectable for forty-eight hours.

If we had sufficiently delicate modes of detecting other substances, it can hardly be doubted that they would follow the same law, and be found to pass into every texture. With the matter, whatever energy that matter possesses must pass also; and wherever the matter finds motions going on in which it can take part, there the medicine will act. It may be present in equal quantity elsewhere, and yet give no sign of its presence, because no increase or diminution of the motions in those parts may occur. Let me illustrate this for an instant by supposing a shower or sheet of any substance fell in this room—for example, alcohol. In many places, it would apparently not be present, no action would occur. Where there was varnish, it would act chemically on the resin; where the fire was burning, it would burn; and in our eyes it would act chemically, increasing the actions there.

From these glimpses into the physiology, pathology, and therapeutics of the future, each of which might well have been the subject of many lectures, it is evident that a great change will take place in our ideas in the biological sciences when we follow the progress of knowledge in the abiological sciences. As the abiological sciences have passed, or are passing, through three different stages of perfect and imperfect separation and perfect union of ideas regarding matter and force; so it is reasonable to expect that ultimately we shall pass through the same three stages of ideas regarding the union of matter and force in the biological sciences; and, if so, we shall arrive at an idea of life which will be based on the perfect union of matter and force.

If biology be disposed to profit by the progress of the other sciences, we must endeavour to search for vital force, as the most peculiar of all the motions of which matter is capable. It must be able to arise from other motions and be able to give rise to other motions; and it must be altogether as incapable of destruction and creation as the abiological forces themselves. It may well be said, what can be the nature of this motion? how can it be understood? The answer must be the same as that which we must give even now regarding the nature of the motion of the simple or compound atoms of matter which we call electricity or magnetism, or even light or heat. How many among us at present have a clear idea of the motion of the simple molecules of matter which we call heat, or even gravitation and crystallisation? Whilst we are unable to grasp the marvellously complex double polar motion of compound molecules which constitutes electricity, can we expect to be able to form an idea of the most complex of all the motions of matter from which the mind turns away to the image of some aerial or aetherial spirit, with large wings and larger powers; or rests satisfied with an imponderable gaseous or liquid matter diffused through living liquids, or temporarily attached to more solid granular matter?

Notwithstanding our ignorance, let us attempt to gain knowledge by following in the footsteps of the abiological sciences. Whatever form of motion or tension proceeds from the body, let us regard it not as created or destroyed, but as the representative and equivalent of that

* Some late experiments of Dr. Preyer, of Bonn, shew that when an animal is made for some time to breathe oxygen, and then is given a small poisonous dose of prussic acid, the poison takes no effect whatever. (*Die Blausäure*, W. Preyer, M.D., Bonn, p. 67.) "Prussic acid, he says, acts as if it suddenly robbed the blood of oxygen. If we were able to take away from an animal all the oxygen of its blood in a few seconds, then, without the least doubt, we should have a perfect representation of poisoning by prussic acid." P. 69.

energy which went into the body. Let us consider that the balance of in-going and out-coming energy of the body is exactly comparable with the balance of the in-going and out-coming matter; and let us remember that these balances are inseparably dependent the one on the other.

The views which I have endeavoured to bring before you will be at once condemned as materialism by those who think that they know more of matter than as the fixed abode of force, and more of force than as that which gives energy to matter. Those who are so ready to use the word materialism as a reproach, should remember that they can give no definition of matter which does not involve the definition of force, and that they know nothing whatever of matter except as that which can exert or resist force; and they should not forget that there is no proof whatever that force is something without weight which the Creator has made separably to adhere to matter. Those also who are tempted to oppose spiritualism to materialism must remember that, in the progress of science, this something without weight, this fluid, air or æther, has ceased to be the actual force itself, but is considered only to be an imponderable matter to which the force is inseparably united. From this point of view, the question between materialism and spiritualism is, in fact, only a question between ponderable and imponderable materialism. Hence the scientific spiritualist of the present day differs from the materialist of the present day only as far as imponderable differs from ponderable matter. The spiritualist who still holds the primitive idea of the perfect separation of matter and force may find full occupation for his reason in weighing the evidence on which his belief or internal conviction rests; but he must leave the investigation of the foundations of natural knowledge to those who can see no reason for faith in witches, ghosts, transmutations, and transmigrations.

There are some who think little of scientific truth, but, comparatively speaking, care much to recognise the Almighty Will as the primary cause of all things. Such persons will find that this power and will are shewn in the inseparable union of matter and force quite as much as if he had willed to make them completely separable: while we, who search for truth above all things are compelled by our belief in the inseparability of matter and force in the abiological sciences to work out the inquiry how far this inseparability holds true in the biological sciences also.

Our ideas of the grandeur, the unity, and the power of the first cause will surely not be lessened if it can be shewn that one law of the union of force and matter and of the conservation of energy obtains throughout the organic as well as through the inorganic creation.

THERAPEUTICAL MEMORANDA.

RELIEF OF LARYNGISMUS STRIDULUS.

By JOHN R. WARDELL, M.D., F.R.C.P., Tunbridge Wells.

UNDER the head of "Therapeutical Memoranda," in this JOURNAL of April 18, Dr. Rooke of Cheltenham records the fact of having accidentally relieved the dangerous paroxysm of laryngismus stridulus by the introduction of the finger into the throat of a child for the removal of some fancied cause of obstruction; and this gentleman very properly recommends the same method of procedure momentarily to be had recourse to when the medical attendant is summoned to one of those perilous attacks. Twenty years ago, in a series of papers on this disease published in the *Provincial Medical and Surgical Journal*, I pointed out the beneficial effect of constantly "rotating the finger in the throat," when there is an immediate attempt to vomit, the laryngeal muscles become relaxed, and air is admitted into the trachea. It is the first thing to be done. I have seen it succeed when death seemed most imminent. Not long ago I was hastily sent for to a gentleman's child who, during dentition, had one of these fits of threatening suffocation. I gave explicit instructions that in the event of another paroxysm occurring, some one should instantly rotate the finger in the child's throat. On two subsequent occasions this plan of treatment was most successful; the child was thus made to breathe, and the paroxysms were at once cut short.

BITARTRATE OF POTASH IN ACUTE RHEUMATISM.

By FREDERICK H. HARTSHORNE, L.R.C.P.E.

I VENTURE to invite attention to Bitartrate of Potash as a remedy in Acute Rheumatism. During the last six months, I have in many cases prescribed it; the result has been uniformly a marked and decided improvement in the state of the patient, and rapid recovery from the disorder. Usually I have administered fifteen or twenty grain doses every four hours, flavoured with liquor aurantii, and combined with thirty or forty minims of tincture of henbane; or the same dose of bitartrate of potash I have given in simple mint-water.

REMARKS ON THE DIAGNOSIS OF MITRAL OBSTRUCTION.*

By HENRY SIMPSON, M.D.LOND.,
Physician to the Manchester Royal Infirmary.

THE observations I venture to address to you this evening, ought, perhaps, to be prefaced by an apology for occupying the time of the Society with so well-worn a subject as that of valvular disease of the heart. But the last few years have proved that the old ground may even yet be explored with success, and that after the harvest some scattered grain may be left for the gleaner. No better illustration of this can be found than in recent writings on the diagnosis of mitral obstruction. Until Dr. Gairdner drew attention to the frequency with which the physical signs of this affection are to be found—if looked for—physicians were too much in the habit of considering it useless to attempt its discrimination during life; and, although every one knew that in the *post mortem* room it was often to be met with, few ventured to predict it.

This opinion, and the want of precision as to diagnosis consequent upon it, may I think, be traced, in part at least, to *a priori* reasoning as to the lack of muscular power in the auricle as a propelling organ. How could walls so thin and weak, and unsupported by valves, be expected to contract with force sufficient to cause a murmur? Perhaps the best answer to this question may be, that the fact has been proved beyond the possibility of doubt.

Although to Dr. Gairdner belongs the credit of having drawn the attention of the profession in this country to the subject in such a way as to arouse inquiry, it must not be supposed that earlier writers have been uniformly silent on the matter. Dr. Hayden of Dublin, to whose courtesy I am indebted for a copy of two valuable clinical lectures on mitral obstruction delivered in 1866, attributes to Dr. Markham "the merit of having been the first writer in these countries to draw attention to the subject." But, without wishing to detract from Dr. Markham's well-earned distinction as an original observer, it would scarcely be loyal in a pupil of Dr. Walshe's to pass over without notice the explicit mention of the physical signs of mitral obstruction in the first edition of his work on Diseases of the Chest, published in 1851, where he gives the peculiar rhythm of the murmur as "post-diastolic or præ-systolic rather than precisely coincident with the diastole." But Dr. Markham in 1860 and Dr. Walshe in 1862 still speak of this murmur as rare, while "on the other hand," as Dr. Peacock observes in his article in the October number of the *Medico-Chirurgical Review*, "Drs. Gairdner and Hayden speak of this sign as of almost constant occurrence."

As with regard to the frequency, so, even now, there is a want of unanimity as to the value, or even the meaning, of this sign. So lately as August, 1864, Dr. Ormerod, in the address on medicine delivered before the British Medical Association at Cambridge spoke as follows:—"A murmur at or near the apex only, accompanying the first sound, and ending suddenly with a snap at closure, admits of more than one interpretation. Its seat is unquestioned—the mitral or tricuspid orifice. But is it due to obstruction of the flow of blood from the auricle to the ventricle, during the auricular systole, or to imperfection of the auriculo-ventricular valve, allowing regurgitation during contraction of the ventricle?" He then goes on to say, "a direct mitral murmur, such as is generally admitted to be of this nature, is quite unlike the murmur under consideration. It is soft, and closely resembles the murmur of sigmoid regurgitation." Here there is complete opposition of statement, as to a matter of observation, between Dr. Ormerod and the three principal writers on obstructive mitral disease; for I think it is evident that reference is made to the murmur respecting which Dr. Peacock writes as follows, "The former also (that is the obstructive murmur), as pointed out by Dr. Gairdner and Dr. Hayden, is harsh and short, and terminates abruptly." So far as my experience goes, it confirms in every respect the statement just quoted. It seems possible that Dr. Ormerod may not have altogether avoided a foregone conclusion as to the character a direct murmur *ought* to have; for he says further, "it may be questioned, too, whether the contraction of the auricle, slight and momentary as experimentalists report it to be, is capable of producing so loud a sound."

Then, with regard to the second interpretation, he remarks: "It assumes that the coaptation of all the portions of the valves is not simultaneous; but that when, at a certain point of contraction, the valve

* Read before the Manchester Medical Society.