cautery, that the use of two needles—one thrust into the growth and a second applied to the surface—is apparently unattended with pain; certainly it is attended with less pain, than when an ordinary charcoal electrode is used instead of the second needle.

Before relating the tumour-cases, I may mention that, being anxious to witness the effect of the continued current upon an acute abscess, I made a trial of it, and the following may be taken as a fair illustration of the result. Ten cells were used in a case of acute suppuration in the left pectoralis major muscle. The patient was a powerful labouring man, and the abscess followed a severe and subsequently neglected sprain. A needle, connected with the negative pole, was passed into the abscess, and the positive pole was applied to the adjacent skin. The man complained of burning pain, but it was not severe. The next day the current was again applied. Its use had no effect upon the progress of the abscess, which pointed and broke during the following night. The report by Dr. Fagge and Mr. Durham of the utility of the current in cases of hydatid cysts inclines me to hope that some good may come from its use in the treatment of chronic abscess and of certain cysts.

I now pass on to describe to you three cases as illustrative of the experience we have of the continuous current in the treatment of tumours, other than polypi and such like growths for the cure of which it has been successfully employed.

A man aged 64 was admitted last October into Darker Ward with a recurrent fibroid tumour. The growth had been removed twice in King's College Hospital, and once here. It was of ten years' duration. The first operation was performed six months after his first discovery of the disease; the second, twenty months later. The growth now remained in abeyance for more than a year, but subsequently sprouted again; and the third operation was performed by Sir James Paget about two years ago. His family history was good.

On examining the tumour, which was superficially ulcerated, and from which the patient had at times lost considerable quantities of blood, it was found to be firmly adherent to the immediate surroundings of the knee-joint; and it was agreed, in consultation, that its removal was impossible without opening the articulation. The man's age and his general condition rendered amputation inadmissible; and, under these circumstances, it seemed to me a fair proposal to suggest a trial of electrolytic treatment. Accordingly, on November 14th, four needles—*serres fines*—were introduced, about half an inch apart, into the substance of the tumour, and were connected with the positive pole of the battery, twenty cells being used. The negative pole was applied to the surface of the growth. About the lowest of the needles some puckering or shrinking of the tumour, with dusky discoloration of its surface, was presently noticed. After the lapse of six minutes, the use of the current was discontinued. Slight bleeding followed the withdrawal of the needles, but was easily controlled by a compress of lint. On recovering from the effects of chloroform, the patient complained of pain in the limb, so severe as to prevent him from sleeping at night.

It is needless to describe the various applications of the current. Six needles were afterwards used; and, occasionally, thirty cells were connected with them. Sometimes they were attached to the negative pole; but Mr. Milner, from whose notes of the case I am now quoting, states—and I quite agree with him—that the action of the current was less marked under these circumstances than when the positive pole was joined to them. Twice weekly, through November and a part of December, this plan of treatment was continued; and the result may be summed up by stating that the tumour, as shown by casts which Mr. Milner made from time to time, was considerably reduced in bulk from softening and sloughing of its tissue, where the currents had passed through it, but there was no cessation of its growth; and when, in the end of December, the use of the current was discontinued, that we might see if any material change would result from previous treatment, the tumour began at once to grow and increase as it had done before the electric treatment was commenced.

I was struck with the thorough manner in which sloughing of the growth occurred in the immediate course of the electric current, and decided to try what good would come from this action in the case of a man who lay opposite to the patient already referred to, and who was suffering, like him, from recurrent fibroid disease. This was his story. In December, 1868, he discovered a tumour in the right loin; a year later it was removed by Sir James Paget, and proved to be recurrent fibroid. After nine months an enormous mass was again cut out. Six months later he came under my care, and the growth was again removed; and five months after this a fourth operation was required. On each occasion the growth had attained a great size; and on the last two the twelfth rib was exposed, and the tumour had to be dissected off from the capsular fat of the right kidney. Before the large wound from the last operation had closed, one or two isolated nodules, growing up in the granulating surface, made their appearance, and it was to these

that the electric current was applied. The patient was fifty-one years of age, and his general health was excellent. Two needles were used; one, from the positive pole, was inserted into the growth; the other, connected with the negative pole, was applied to its surface. The operation was painless. Some immediate sloughing was caused about the track of the first needle, twelve cells having been used for six minutes; but in the course of a few days, and after a repetition of the operation, the entire mass, about the size of a marble, seemed to melt away and disappear. The wound has since healed soundly over this portion of the granulating surface, whilst a fresh outbreak of the tumour at quite another part of the wound is being successfully treated on the same plan.

The third case was that of a lady, aged 47, who suffered from cancer of the right breast, a firm nodular mass occupying the upper part of the gland, without any secondary complications. Two needles were introduced; and six cells, subsequently increased to twelve, were employed. After the insertion of the needles (with the aid of ether-spray) the operation was painless. The current was used twice weekly, and at the end of the eighth application no change was observed in the tumour; if anything, it had slightly increased in size. It did not seem desirable to continue the use of electricity, and the breast was removed by operation.

What are we to conclude from these experiences? Other cases might be cited in which similar results have followed the use of the continuous current, but those I have described are typical of the rest. First, with regard to electrolysis. My belief thus far is, that in no instance has the progress of the tumours been visibly influenced by the use of the current in the sense of its causing wasting or shrinking of the growth independently of the cauterising action. It always seemed to me that, with the exception of some heat and tenderness, no change was produced when a current of from six to eight cells was employed, the electrodes being separated by some little interval of tissue. I shall, however, continue to give this plan of treatment a further trial, although I cannot feel sanguine as to the results.

With regard to the cauterising effects of the continuous current, there is, however, no question that we have a powerful and valuable remedy. With twelve cells, and using two needles, the one at the positive the other at the negative pole, small growths, such as those described in the second case, were rapidly destroyed without complaint of pain on the part of the patient, and what is more, were destroyed so effectually, that the skin healed over the parts of the granulating surface from which they were growing. For the cauterising of such recurrent masses, especially for that of the small nodules which spring up about the scar tissue after removal of a cancer-growth, and which, if allowed to increase, necessitate for their removal a considerable operation, the continuous current seems to offer a handy and efficient remedy.

ON THE NUTRITION OF MUSCULAR AND PULMONARY TISSUE IN HEALTH AND IN PHTHISIS.*

BY WILLIAM MARCET, M.D., F.R.S.,

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I NEED hardly remind the reader that Graham has concluded, from his admirable researches on liquid diffusion, that substances may belong either to a class of bodies which he has called *crystalloid*, or to another which he has called *colloid*. Chloride of sodium and sugar are instances of crystalloid substances, and gelatine is an illustration of colloid substances. The main characters of crystalloids are the ready diffusibility of their aqueous solutions, and their power of crystallising; while the characteristic properties of colloids are the slight degree of diffusibility of their solution in water, and their inability to assume the form of crystals. When concentrated to a certain degree, their solutions (I may say as a rule) either gelatinise on cooling, or assume a gummy adhesive consistence.

Taken as a whole, the animal body must be considered as a mass of colloids. Blood, when dialysed, or subjected to diffusion through a membranous diaphragm for twenty-four hours, only loses, I find, very nearly 7.3 per 1000 of its weight; and muscular tissue, if it be minced, mixed with water, and dialysed for the same lapse of time, only parts with 25 per 1000 of its constituents. On the other hand, the urinary secretion is a solution of diffusible substances, nearly all its consti-

* This communication may be considered as the abstract of two papers. One of them was read to the Royal Society last April; and the other, at the meeting of the British Association at Edinburgh in August of last year.

tients being crystalloids. The acid which I have described as a colloid acid of urine (*Proceed. Royal Society*, vol. xiv., p. 1), although uncrystallisable, diffuses through a dialyser tolerably readily.

It follows from these preliminary remarks that blood, or the material from which tissues are formed, is that part of the body which exhibits colloid properties in the highest degree. Tissues, although colloid, are less so than blood; and the urinary secretion may be considered as a solution of crystalloids. It may, therefore, be broadly stated that tissues appear to originate from a colloid material, and to undergo a crystalloid metamorphosis which allows their elimination by physical diffusion, first into the circulation, and finally from the blood out of the body through the kidneys.

The nutrition of animal tissues is the phenomenon which attends their waste and renewal during life. This process of waste is carried on throughout the bulk of the tissues; every particle of a muscle, for example, being subjected to waste during contraction, there must be distributed throughout its mass a material ready for assimilation and in molecular contact with the part undergoing change, or the crystalloid metamorphosis. It should be borne in mind that blood does not come into molecular contact with tissues; in the case of muscular tissue the capillaries run between the fibres, none of the blood-vessels ever entering the sarcolemma or proper sheath (Quain's *Elements of Anatomy*, 7th edit., vol. I, p. cxxiii); consequently there must be an intermediate stage between blood and muscular tissue, and there exists necessarily a nutritive material elaborated from the blood, and destined to become transformed into flesh. The object of this material being to form a colloid body, it must be essentially colloid—indeed, its chief constituent must be albumen, one of the most colloid substances known.

From the foregoing considerations it may be concluded that animal tissues consist of three classes of substances: 1. Those which constitute the tissue proper, or the ripe tissue; 2. Those forming the material in readiness for assimilation, and destined to repair the loss owing to the process of waste; and 3. Those which result from tissue-metamorphosis: they are in progress of elimination, and on their way out of the body.

These three classes of tissue-constituents are in mutual molecular contact. Class No. I may be considered as the framework of the tissue: it is the tissue in the mature and working condition; its next change is to become crystalloid and effete. It is insoluble in water, is soft and pliable, except in bones, and must be considered as formed of water and solid substances bound together by a force which I propose to call "a colloid attraction". Class No. II, or the material for assimilation, consists of the same substances as Class No. I; they are colloid, and in the same relative proportions, but in the soluble state. Class No. III is formed of the same substances as Class I and II, but in different relative proportions, and these are all in the crystalloid state.

For many years, during which my attention was often directed to the present subject, it appeared impossible to separate these three classes of substances, until, on considering the physical and chemical condition of muscular tissue, I came to the conclusion that this end might be obtained by two different means; and, it occurred to me that, should both of them yield the same result, this circumstance would go far to establish the correctness of my view.

First Method.—The composition of the fibrinous or insoluble portion of muscular tissue, forming class No. I of its constituents, had first to be estimated experimentally; then the composition of the material forming Class No. II was to be determined by calculation, according to the composition of Class No. I, the proportions being the same relatively in both classes; finally, by subtracting the proportions of the constituents of Class No. II respectively from those of the total quantities of the same substance present in the soluble state in flesh, the result of this calculation would yield the proportion of each constituent in Class No. III.

I shall very briefly relate how the composition of the fibrinous portion was estimated. Two hundred grammes of muscular tissue, free from fat as much as possible, and containing no blood, were carefully minced and extracted with 500 cubic cent. of distilled water; care was taken to make the mass into an homogeneous pulp before straining. The fibrinous residue left on the cloth or muslin was weighed and dried for the estimation of its water, and then incinerated with the greatest caution for the subsequent analysis of the ash. A small weighed portion of the dry mass was burnt separately with soda-lime for the determination of its nitrogen. The weight of the water in the fibrinous mass was considered as representing the bulk of the extract left in the mass, which, as I afterwards found, entailed practically no error.

The volume of the extract was next ascertained, and the albumen was carefully determined in a portion of the fluid. After coagulation and separation of the albumen, the mother-liquor was evaporated to dryness, with a small quantity of sulphate of lime, and the residue burnt

with soda-lime for the estimation of its nitrogen. A known portion of the extract, after evaporation to dryness, yielded a residue which was incinerated with the usual care with the view to the analysis of the ash.

By such means I was placed in possession of the necessary data to establish the composition of Class No. I of the constituents of muscular tissue. This was done by calculating the composition of the extract left in the fibrinous mass, according to that which had been found in the extracted solution, and then subtracting these numbers respectively from those found in the total constituents of the fibrinous mass. Class No. II was calculated as stated above, taking the proportion of coagulable albumen in 200 grammes of flesh as the basis for the calculation, Class No. III was obtained, as previously observed, entirely by calculation. The nitrogen found in the different classes was calculated into albumen.

Second Method.—This is a more direct means of arriving at the constitution of muscular tissue, but I question whether it is quite so satisfactory. However, both methods gave similar results. In the present case, a known portion of an extract of 200 grammes of flesh was dialysed for twenty-four hours (this experiment was repeated twice); and, in another experiment, a weighed quantity of flesh, being minced and mixed with water into a pulp, was subjected to dialysis for the same length of time. The colloid material left on the dialyser was then analysed, and found to have as near as possible the same composition as had been determined by the other method for Classes No. I and II of the constituents of muscles.

The result of the present inquiry does therefore really represent the constitution of muscular tissue. I have taken advantage of the first method to ascertain the constitution of muscular tissue in health and after death from phthisis, and of the tissue of the lungs also in health and after death from phthisis.*

The following is the mean composition of muscular tissue, together with the mean composition of pulmonary tissue, in health.

Mean Composition of Muscular Tissue in Health, from four Analyses of Ox-Flesh (on 200 grammes).

	CLASS I. Muscular Tissue proper.	CLASS II. Nutritive Material.	CLASS III. Effete Material.
Albumen	28.070	5.745	3.70 (Kreatine, etc.)
Phosphoric acid	0.251	0.050	0.563 Pyroph. of
Potash	0.086	0.017	0.764 potash.
Chlorine	—	—	0.167
Soda	—	—	0.239—total.

Water... On 200 grammes, 154 grammes.†
Fat... „ „ 5.0 „ (Marechal).

Mean Composition of Pulmonary Tissue in Health, from three Analyses of Ox-Lungs (on 200 grammes).

	CLASS I. Muscular Tissue proper.	CLASS II. Nutritive Material.	CLASS III. Effete Material.
Albumen	19.895	13.029‡	1.410 (Kreatine, etc.)
Phosphoric acid	0.481	0.314	0.058
Potash	0.051	0.033	0.451
Chlorine	—	—	0.541
Soda	(0.048)	(0.033)‡	0.521—total.

Water.. On 200 grms., 158 grms. (mean from the lungs of 3 sheep and 1 lamb).
Fat.... „ „ 4.28 „ (mean from the lungs of 2 sheep and 1 lamb).

A glance at these two analyses will show that the nutrition of muscular and pulmonary tissue is far from being carried on by the same chemical process; flesh wanting proportionally more albumen for its tissue proper (or fibrinous material), and lung more phosphoric acid. There is also a considerable accumulation of albumen in the nutritive material of the lungs (notwithstanding the fact that this result is rather too high), and a very small proportion of effete material.

The main difference, however, between the nutrition of these two organs may be observed in the proportions of phosphoric acid and

* I regret that it would take too much space to comment on these two methods, and to show that they must yield the same results if my theory be true.

† Muscular tissue contains a certain proportion of magnesia, which is not taken into account in the present analysis.

‡ This number is rather too high, as a very small quantity of blood was left in the tissue submitted to analysis; a source of slight error, which, in the case of healthy pulmonary tissue, could not be avoided.

§ The proportions of soda in Classes I and II are placed between brackets, because the whole of the soda is probably in the crystalloid state, and should belong to Class III.

potash of Class No. III or effete material; as, while in muscular tissue these two substances occur precisely in the right proportions to form pyrophosphate of potash (a very remarkable and interesting result), no such proportion is found to exist between the two corresponding substances in pulmonary tissue, which is clearly shown thus.

	Muscular Tissue.	Pulmonary Tissue.	Theory.
Phosphoric acid..	(0.563) 42.4*	(0.058) 11.4	43 } Pyroph. of
Potash	(0.764) 57.6	(0.451) 88.6	57 } potash.
	100.0	100.0	100

Hence in pulmonary tissue the phosphoric acid and potash effete are far from existing in a proportion which will allow their combining into a crystalloid. If my view be correct, it is necessary, however, that these two substances should become crystalloid, so as to allow their elimination by physical diffusion; and there is a very satisfactory way of accounting for the above result.

I formerly explained how the expiration of carbonic acid from the lungs was due to the diffusion of the gas from blood through the moist membrane of the pulmonary vesicles, and its final evolution together with moisture. On its way through the lung-tissue, carbonic acid must combine with that portion of the potash present, which would otherwise occur in the free state, converting it into a crystalloid, and therefore diffusible, compound. Hence it may be concluded that, in the process of nutrition of the pulmonary tissue, the potash is mostly eliminated as carbonate instead of pyrophosphate. The correctness of this view is much strengthened, if not proved, by the fact that pulmonary tissue in a state of tubercular consolidation and softening, and therefore unfit for respiration, was found to contain phosphoric acid and potash effete nearly in the proportions of a crystalloid pyrophosphate, as in the case of muscular tissue.

[To be continued.]

A PLAN FOR FACILITATING THE REDUCTION OF STRANGULATED HERNIA BY TAXIS.

By W. C. B. FIFIELD, M.D., M.R.C.S.L., Surgeon to City Hospital, Boston, U.S.A.

I NOTICE in the BRITISH MEDICAL JOURNAL for December 23rd, 1871, an article by Dr. P. C. Smyly, entitled, "A Plan for Facilitating the Reduction of Strangulated Hernia by Taxis." It is said that there is nothing new under the sun. Dr. Smyly's paper is another proof of the truth of this saying. I have for years been familiar with the process, which is often successful. In *Braithwaite's Retrospect* for 1857, there is the following quotation from Baron Seutin. The only difference is that Baron Seutin passed the finger in front of the intestine or omentum, and also used more force than Mr. Smyly describes. "*(New Mode of Reducing Strangulated Hernia.* By Baron Seutin). Baron Seutin declares that with this mode of reducing strangulated hernia (which he has now practised for twenty years), he hardly ever in his large practice finds it necessary to have recourse to an operation. The patient is laid upon his back with the pelvis raised much higher than the shoulders, in order that the intestinal mass may exert traction on the herniated position. The knees are flexed, and the body slightly turned to the opposite side to that on which the hernia exists. The surgeon ascertains that the hernia, habitually reducible, cannot be returned by moderate and continuous taxis. He next seeks with his index-finger for the aperture that has given issue to the hernia, pushing up the skin sufficiently from below, in order not to be arrested by its resistance. The extremity of the finger is passed slowly in between the viscera and the herniary orifice, depressing the intestine or omentum with the pulp of the finger. This stage of the procedure demands perseverance; for at first it seems impossible to proceed. The finger is next curved like a hook, and sufficient traction exerted on the ring to rupture some of the fibres, giving rise to a cracking, very sensible to the finger, and sometimes to the ear. When this characteristic crack is not produced, the fibres must be submitted to a continuous forced dilatation, which, by distending them beyond the agency of their natural elasticity, generally terminates the strangulation. This procedure is more (less?) applicable to Gimbernat's ligament, the hooking and tearing of which are more difficult than in the case of the inguinal ring. Considerable strength has sometimes to be exerted, and the index-finger becomes much fatigued. When, in consequence of the narrowness of the ring, the

finger does not at once penetrate, it is to be pressed against the fibrous edge, and inclined towards the hernia. After a time, the fibres yield and the finger passes. When the finger becomes fatigued, it is not to be withdrawn; but it is to be supported by the fingers of an intelligent assistant, who seconds the action it is desirable to produce. In inguinal hernia, the traction should not be exerted with the finger upon Poupart's ligament, but in a direction from within outwards, and from below upwards, by which the aponeurotic layer between the two ligamentous pillars constituting the inguinal aperture is easily torn through. The ring is then enlarged by this tearing, just as if it had been divided by a cutting instrument, or largely dilated, and reduction takes place easily by performing taxis in a suitable direction. The mobility of the skin, its laxity in parts where hernia prevails, and its extensibility greater in proportion to its thinness, and to the absence of a lining of fatty cellular tissue, by allowing the sliding and the thrusting of this membrane in front of the finger it cushions, affords protection to the intestine from all immediate contusion.

"When the strangulation is induced by the issue of a considerable mass of intestine, or an accumulation of fecal matters, it is desirable, first, to disengage one of the extremities of the noose, and to seek to expel the gas or fecal matters by moderate pressure, in order to facilitate the reduction of the tumour. In a few cases in which the finger cannot be introduced, a small incision may be practised in the skin, and the handle of a spatula or any blunt instrument may be passed in by separating the cellular tissue. Pressing this against the border of the ring, while avoiding the intestine, this orifice may be eroded or dilated without danger. The greater the resistance offered by the aponeurotic fibres, the greater will be their tension, and the more easily will their laceration be produced. As a general conclusion, it may be laid down that the facility and promptitude of this procedure, and the immunity that attends it, ought to diminish the gravity of the prognosis of strangulated hernia by rendering the circumstances under which recourse need be had to an operation quite exceptional. Such exceptional cases will be found (1) in old irreducible hernia; (2) when the strangulation in inguinal hernia occurs at the internal ring. Generally the external ring and the inguinal canal are large, and allow the easy penetration of the finger; and then this method is applicable, and the rupturing or dilatation of the internal ring should be attempted, and the manœuvre is rendered easier by the fact that in these cases the canal is much shortened, and the two rings approximated. If, however, the external ring be too narrow to admit the finger, an operation is required. (3.) When there are general symptoms of a gangrenous state of the intestine."

I have practised this method of Baron Seutin in one case very successfully.

ON A "RESIDUAL-AIR-PUMP" FOR EMPHYSEMA.

By HORACE DOBELL, M.D.,

Senior Physician to the Royal Hospital for Diseases of the Chest, etc.

MY friend Dr. Berkart recently described an instrument which he had invented for the purpose of better effecting the objects aimed at by the experiments of Drs. Hank, Hagel and Mader, of Vienna, in the treatment of emphysema of the lungs. The objects of these experiments and of Dr. Berkart's instrument were, "to reduce the intravascular pressure, and that resulting from it on the thoracic surface of the diaphragm," and to displace and replace the residual air stagnated in the emphysematous cells.

Dr. Berkart says, "With a somewhat bulky instrument, a modified Hutchinson's spirometer, which if safety is to be ensured, has to be worked by two assistants, Dr. Hank first used compressed air in croup and emphysema. Subsequently, he found that if emphysematous patients were allowed to expire into an atmosphere, the pressure of which was from four to eight inches of water less than that of the air, the relief they obtained was greater and more lasting than by the use of compressed air; and his brilliant results have been fully corroborated by Drs. Hagel and Mader. I therefore designed two instruments, and I have been using them for some time with the best results."

Being much interested in the treatment of emphysema, and fully appreciating the importance of the objects aimed at by Drs. Hank, Hagel, Mader, and Berkart, I at once induced Dr. Berkart to be kind enough to bring his instrument to the Royal Hospital for Diseases of the Chest, and to try it upon some of the numerous emphysematous patients who seek relief at that charity. By a set of inspiratory and expiratory valves communicating between an orinatal mask and an air-pump, the cylinder of which is suddenly exhausted at the instant when the patient completes an act of ordinary expiration, Dr. Berkart aims

* The proportions per cent. of phosphoric acid and potash effete in the four analyses of muscular tissue were as follows:

	I.	II.	III.	IV.
Phosphoric acid	43.8	43.7	43.7	40.4
Potash	56.2	56.3	56.3	59.6