The clavicle, from its position as the only bony communication between the upper limb and the body, is most frequently broken by violence indirectly applied during the transmission, through it, of the shock which is caused by a fall on the hand or shoulder. Under such circumstances, it generally gives way near the great convexity, and the fracture is usually oblique, and almost always simple, while the subjacent structures escape without injury; but when, as in the present case, the bone is broken by direct violence, the fracture may be transverse, or comminuted, or both, and any amount of damage may be done to the parts beneath. The most common form of injury which it may give rise to is compression or laceration of the subclavian vein—the latter being exceedingly rare, though a case of the kind occurred in this hospital some years ago, and, as is well known, the late Sir Robert Peel died of this accident. The artery appears always to escape. I know of no case in which it has suffered (if gunshot injuries be excluded); but the brachial plexus has been interfered with, the first rib has been fractured, and laceration of the pleura has taken place.

Here the fracture was undoubtedly caused by direct violence. It was put up in the usual way, but on the next day the arm began to swell beneath the bandages; and before forty-eight hours had elapsed from the time of injury, it was much swollen and very cedematous, and threatening gangrene. For this condition of things two explanations are possible. 1. The subclavian vein had been contused or lacerated; 2. The axillary pad and bandage had been too tightly applied. And, after careful examination, it appeared that the mischief was most probably the result of some injury of the vein, while at the same time there was no sufficient ground for thinking that it could be due to any fault of the apparatus applied, and that for the following reasons.

1. There was no evidence that the bandage was too tight.
2. It was quite certain that the elbow was flexed before the arm was bandaged.
3. The axillary pad was unusually soft; and I must add that, though harder ones are commonly used, I have never seen any mischief result from their employment.

One of the most remarkable features of the case is, that although on admission there was a condition approaching to gangrene, yet there was no very great amount of swelling until the arm had been entirely liberated for some hours, when it became so excessive that the bandage, loosely applied over some cotton-wool, had to be released. This state of the limb might have been brought about in either of the following ways.

1. If the subclavian vein had been compressed, irritated and plugged, it is clear that no great amount of swelling could occur from the obstruction of the return of blood to the limb until the enclosing bandage was removed.
2. A sort of inflammatory oedema may have extended through the limb, something like that which occurs in traumatic gangrene; and I am disposed to think that such was the case here—a kind of cellulitis setting in, with great effusion of sero-plastic fluid, and tension of the skin; for, in the first place, the swelling was very extensive above the elbow, where there was no retardation to the blood-flow; and, secondly, on making the incisions, the cellular tissue was found to be much infiltrated with serous fluid, without any very remarkable distension of the veins; but, with the view of avoiding the latter as much as possible, the incisions were confined almost entirely to the outer aspect of the limb.

This case serves to illustrate a particular danger that may follow fracture of the clavicle; and the question presents itself, What ought to have been done if the condition of things had been diagnosed? In cases of fracture from direct violence, I should not employ the axillary pad, or even apply a bandage at all, but simply put the patient to bed and support the shoulder. I should leave the parts quite alone, and let the fragments unite as they best can, moulding them afterwards as opportunity offered. The plan of bandaging the fingers separately, and then the arm as far as the lower border of the axillary pad may be followed by bad results, for if there be congestion it may escape notice, and such congestion may go so far as to strangle the limb under the bandage. If, then, the fingers, hand, and forearm be bandaged at all, it should be done lightly and openly, so that you may not be prevented from seeing what is taking place in the limb.

ROYAL COLLEGE OF SURGEONS IN IRELAND.—At a meeting held on Monday, June 2nd, 1873, the following officers were elected:—*President*: John Denham. *Vice-President*: Robert W. Smith. *Secretary to the College*: William Colles. *Council*: R. Adams, W. Colles, F. Kirkpatrick, Richard G. H. Butcher, Alfred H. McClintock, Alexander Carte, G. H. Porter, J. H. Wharton, B. McDowell, A. J. Walsh, E. Hamilton, E. Ledwich, R. Macnamara, R. McDonnell, J. Morgan, G. H. Kidd, E. D. Mapother, A. H. Jacob, H. G. Croly.

THE ACTION OF DRUGS AND OTHER MEDICINAL AGENTS UPON THE TISSUES OF THE LOWER ORGANISMS.

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I.

A SHORT time has only elapsed since the publication of three valuable series of lectures illustrating the action of drugs on the animal economy. Two of these courses have been, or, I may perhaps say, still are being, published at intervals in this JOURNAL—I allude to those by Drs. Brunton and Fraser (see JOURNAL for 1871 and 1872); the third has appeared in the pages of a contemporary from the pen of Dr. Rutherford. It is with some diffidence that I commence a series of papers on what may, at first sight, appear to be exhaustively treated by one or other of the above-named gentlemen; but I hope, however, to show that I shall not seriously encroach on the subject matter investigated by them, inasmuch as my experiments will be strictly confined to the invertebrate animals, and specially to the operation of medicinal agents on those lowly organised beings in whom the energy inherent in their plasma is untrammelled by nervous or vascular influence. Since the valuable treatise of Kühne (*Untersuchungen über das Protoplasma*, Leipzig, 1864) has been published, Binz, Stricker, Recklinghausen, Cohnheim, and others, have investigated the action of certain drugs on different forms of amoeboid life; and lately Rossbach (*Die Rhythmische Bewegungserscheinungen der einfachsten Organismen. Verhand. der Physik-med. Gesellsch.* Würzburg, 1872) has carefully recorded his observations of heat and various chemico-physical agents on the movements of the contractile vesicles and cilia of certain infusoria and vorticellae. In the following researches, my constant aim has been to elucidate by experiments the molecular changes which may occur after the exhibition of medicinal agents in the tissues of animals, irrespective of any influence induced by the operation of nervous or vascular systems. With such views before me, I shall attempt in each case to show the action of the peculiar agent employed; first, upon the vitalised, and to some extent independent, components of the animal under observation; secondly, its action upon the animal itself. By this method I hope to eliminate those operations which depend on the mutual relations of the various components of an organised mass from those which are unconnected with any such dependence; at the same time that we ascertain the connection (if any) which exists between the molecular changes of the components and the functional or other phenomena of the aggregates.

In order fully to illustrate this inductive method of observation, I have selected for the first series of experiments the lowly organised actiniae; and this has been done partly from the readiness with which such animals can be examined during the course of the investigations upon them, and partly from the great persistence of life exhibited by their component molecules (*Journal of Anatomy*, vi, p. 382) when removed from the body, as this property permits the exhibition of various chemical agents to them without destruction to their life.

The first experiments noticed will show the effect of increments of temperature on the above-named organisms, both as respecting their molecular constituents and in the aggregate. They were made on the pulsatile corpuscles, elsewhere described by me (*Ibid.*), and were performed with the assistance of a modification of Stricker's hot stage (kindly lent to me by my friend Dr. Lauder Brunton), a spirit-lamp, and a microscope. The results are tabulated.

TABLE I.—Application of Heat to the Pulsatile Corpuscles of Actiniae.

Degrees. Cent.	a. Pulsations in 10"	b Pulsations in 10"
5		18
10	7	20
15	18 (strength increased)	23
18	24	26
20	28? (feeble)	26*
23	Very feeble	30? (feeble).
24	None	
25		32?
28		35?
30		A tremor; motion almost ceased.

The results in the third column of the table were obtained from the pulsations of a corpuscle extracted from a more vigorous actinia than

* The rapidity of the pulsations above 26 in 10" is so great that it may be doubted whether the subsequent numbers are correct. Practice has, however, enabled me to place the contractions with tolerable, if not perfect, certainty, as recorded.

in the case of "a"; and this may possibly account for the difference in the rapidity of the motion of the two bodies at the same degrees of temperature. In each case, the drop of sea-water enclosing the pulsating bodies (which were carefully selected for the regularity of their contractions) was held between two thin glasses, a smaller one undermost and a larger one above: the latter, when placed in position over the well of the hot stage, acted as a cover to this part of the apparatus, and prevented evaporation to any appreciable extent. The effect of heat on these bodies appears to be similar to that on the contractile vesicles of amœbæ, infusoria, etc., as noticed by Rossbach (*Opus cit.*, pp. 203-4, and p. 234); and between certain ranges of temperature, to those on the hearts of frogs (Cyon, *Ludwig's Arbeiten*, 1866, noticed by Brunton, *St. Bartholomew's Hospital Reports*, vii, p. 216; and Panum, *Bibliothek for Lager*, Bd. x, p. 46; noticed in Schmidt's *Jahrb.*, Bd. c, pp. 149-156) and mammals (Brunton and Panum, *op. supra citat.*) Although in the last cases the influence of the nervous system must be considered, we still have the fact that, so far as experience carries us, within certain limits of temperature, increments to their specific heat increase the rapidity of the contractions of living pulsatile elements.

The Influence of Heat on the Bodies of Actiniae.—In the following cases the animals themselves were exposed to a gradually increasing temperature. The experiments (eight in number) were conducted in three different methods; in two, the covered well of Stricker's hot stage was filled with sea-water, which was heated in the usual way after receiving two baby-anemones; in four other cases, the animals were placed in a beaker-glass half filled with sea-water of a known specific gravity, and heat was applied by means of a sand-bath. In the last two cases a similar apparatus was used, with this difference, that the heat was applied by placing the beaker-glass in a larger one containing hot water at a high temperature. The increments of temperature were in all cases gradual, varying from about 1 deg. *centigrade* to 2 deg. *centigrade* in a minute of time; at 5 deg. *centigrade*, of the eight animals, five were more or less expanded, three fully so; at 20 deg. *centigrade*, only three were expanded, and two of those were gradually shrinking; at 30 deg. *centigrade*, two only were partly open, and these were shrunken; at 41 deg. *centigrade*, the only animal subjected to the heat was shrunken, perfectly inactive to stimuli, and without any hold on the tank. The temperature in this case was subsequently raised to 46 deg. *centigrade*, but with no apparent effect: the animal was probably dead at the lower temperature. Six of the anemones recovered, none of which had been subjected to a higher temperature than 35 deg. *centigrade*.* I have tabulated the results in the last two cases.

TABLE II.—Time occupied by Experiments 16'.

Degrees. Cent.	Actinia "a" (half-inch diam.)	Actinia "b" (a baby anemone).
10	Fully expanded	
15	Ditto	Fully expanded.
20	Contracting somewhat	Contracting.
22	Smaller; shrinking	
27	Still shrinking	Smaller.
30	Tentacles much shrunken; stomachal orifice protruded	A few tentacles expanding and in motion.
32	Stomach everted; tentacles shrunken	Tentacles curling and shrinking; has lost its hold of the tank.
38	Smaller generally	} Removed from the tank.
41	Much shrunken generally; no reaction to stimuli; the animal has lost its hold on the tank	
46	Dead	

The shrinking of the anemone tissue must not be confounded with the contraction of the healthy animal, as the two processes, although they are frequently observed to take place simultaneously, are quite distinct in their nature. Contraction almost invariably takes place first in the tentacles and tentacular ring. The shrinking caused by a high temperature, on the other hand, may take place without the withdrawal of this portion of the animal, or at all events with only a feeble contraction of it: shrinking is also accompanied with a general corrugation of the integument, which is not usually observed in contraction. The specific gravity of the water before and after the experiments was not appreciably altered; therefore the results recorded were not due in any way to osmosis. I believe we must consider the shrinking in such cases as due (curious as it may at first appear) to increased molecular activity of the component parts. The eversion of the stomach in "a" (Table II), and the motion of the tentacles in "b" at a high temperature, point to this; and although these phenomena were not observed to take place in the other cases, we must not overlook them on that account.

* Kühne (*o. c.* p. 43) states that sea-water amœbæ died at about this temperature in his early experiments; latterly he found death took place in amœbæ generally between 40 deg. and 45 deg. *centigrade* (p. 46 *idem*) "without doubt".

The shrinking, accompanied as it necessarily is with the expulsion of most of the contained water in the animal, denotes a rapid and general concentration* (if I may so call it) of the molecules, which differs from voluntary contraction in displaying a want of muscular co-ordination. The next experiments show the effect of carbonic acid gas and chloroform vapour upon the same animals. I class these experiments together, as the effects of the two agents appeared to be very similar in kind, although not in degree.

The Action of Carbonic Acid on the Pulsatile Corpuscles.—When the freshly pulsating corpuscles of an actinia mesembryanthemum are placed in an atmosphere of carbonic acid gas, their movements are rendered slow and rapidly cease. If, however, after this arrest of all motion has continued for several minutes fresh air be admitted to them, the pulsations soon commence again without perceptible loss of power. At the moment when the pulsations cease, the corpuscles are uncontracted.

The Action of Carbonic Acid on Actinia.—An actinia mesembryanthemum, when removed from a tank in an expanded condition, was placed in an atmosphere of carbonic acid gas. The first effect was a partial contraction of the tentacular ring; the second, about ten minutes later, a general cedema of the same, with flaccidity of the tentacles. After an exposure of about forty minutes, there was no reaction to stimuli, such as that produced by irritating the integument with a steel style; the general appearance of the animal was the same as previously noticed. For three days after this experiment the animal, although placed for that period in a tank of sea-water, was throughout in a very sluggish and closely contracted state.

The Action of Chloroform-Vapour on the Pulsating Corpuscles.—The vapour of chloroform induced a rapid cessation of motion in pulsatile corpuscles when they were exposed to its influence. This phenomenon was usually preceded by a marked slowness of the movements, with an irregular jerking of the corpuscles at intervals of every few beats. When all motion had ceased for some time, the contractions were readily renewed upon exposing the corpuscles to the atmosphere.

The Action of Chloroform-Vapour on Actinia.—The vapour of chloroform has a very powerful action on actiniae. A fully expanded anemone (*A. mesembryanthemum*) was removed from the tank on one occasion at 12.55 P.M., and at once placed under the influence of the vapour.† The immediate effect was an imperfect attempt at contraction. After remaining under its influence for half a minute, the creature, in a half contracted state, was perfectly insensible to the action of stimuli; its colour had also changed from a dark red to a bluish hue. When replaced in the sea-water, sensibility began to return in a quarter of an hour; and in an hour and a half the creature was natural in colour and fully expanded, although the tentacles were somewhat slow to react when irritated. In some cases I have found an cedema of the integument to occur during the action of the anæsthetic; in others, some corrugation. The acidity of the muciform fluid which exudes from the integument appeared to be increased in some few cases; and the quantity of this fluid was always augmented when the vapour was unmixed with air. In almost pure chloroform-vapour an actinia will remain for five minutes, and afterwards recover when removed from its influence.

From the results of the preceding experiments with carbonic acid gas and chloroform, I am inclined to consider that these agents act on actiniae and their corpuscles in a similar manner. In both cases we have slowness of the contractions of the pulsating corpuscles, with subsequent cessation of all motion. Again, movement, if the stoppage be not too prolonged, can be renewed by simply placing the corpuscles in favourable conditions for the absorption of air. In both experiments, actiniae, after a partial attempt at contraction, lose their power of motion and their sensibility, and yet may subsequently be revived by similar means to those adopted in the case of the pulsatile corpuscles. I believe that the cessation of motion in such cases depends probably upon the absence of oxygen; and this observation coincides with that of Rossbach (*Opus supra cit.*, p. 233) on infusoria and vorticellæ—namely, that all movements in such animals depend on the presence of oxygen. No coagulation of the contents of the pulsatile corpuscles was observable, as was noticed by Kühne (*Opus supra cit.*, p. 53) in amœbæ, when they were similarly deprived of oxygen; nor is it probable, from the possibility of their subsequent revival, that any such change occurred in the actiniae or in their corpuscles in the above experiments.

The Effect of Oxygen Gas upon the Pulsatile Corpuscles.—The next experiments showed the action of oxygen upon the pulsatile corpuscles.

* I do not think the shrinking is due to coagulation of the plasmic fluids of actiniae, as similar phenomena occur under conditions which preclude such an opinion. See for instance the experiments with chloroform. It is, possibly, the "heat-tetanus" of German physiologists.

† The vapour in this case was greatly diluted by air; unfortunately, I was unable to ascertain the precise proportions of the two fluids.

I may here state that I used the modified Stricker's stage (above noticed) whilst investigating the action of gases on these bodies. When a rhythmically pulsating corpuscle is placed in a current of pure oxygen gas, its contractions are rapidly rendered slow, and after ten minutes' exposure, cease altogether. The pulsations cannot subsequently be renewed by the admission of air; in other words, death has taken place coincidently with the cessation of motion.

The Action of Pure Oxygen on Actinia.—An actinia mesembryanthemum in a contracted state was submitted to the action of a stream of pure oxygen gas for about ten minutes.* This experiment was performed by placing the animal in a glass tube, two inches in calibre, and closed at each extremity by corks, with the exception of a small perforation large enough to admit a quill, one at each end. Into these openings glass tubes were tightly fitted, one of which was connected with an apparatus for generating the gas. Upon using the apparatus, a continuous current of oxygen gas was readily made to pass over the surface of the animal. At the termination of the experiment, the anemone was observed to have changed colour from a brownish-green to a dead yellow, but its shape was unaltered. Upon touching the creature with a style, shreds of tenacious muciform fluid were easily detached; these had no distinct reaction with litmus, and under the microscope were seen to be mostly composed of bacillar corpuscles, with a few spheroidal ones intermixed. Upon replacing the creature in sea-water, and after carefully removing the adherent mucosity, I noticed that the subtegumentary tissue was bared in many places, and that the outer layers were disintegrated at those spots. The animal remained in a contracted state for many days afterwards. In a subsequent experiment, the anemone was partially expanded when the investigation began; it however speedily contracted itself under the influence of the oxygen, and the integument became somewhat corrugated after seven minutes' exposure. In both cases the tentacular ring was extremely contracted. The evolution of mucous shreds was much less in the second animal than in the first; this I ascribe partly to the greater vitality of the earlier specimen, the second one being evidently very feeble when operated upon. Contrary to what we might expect from the preceding experiments with carbonic acid gas and chloroform, the action of oxygen upon actinia appears in some respects to resemble these agents. It induces slowing of the corpuscular pulsations; but the contraction with the tegumentary corrugations of the entire animal is far more marked in the oxygen gas than in the two preceding cases; and in this respect the last agent resembles in its effects rather those due to a high temperature than such as result from an exposure to either of the above-named fluids.

The Operation of Ammonia on the Pulsating Corpuscles.—Gaseous ammonia acts with great violence on the pulsating corpuscles of actinia. When these bodies are exposed to the influence of this gas, their pulsations immediately cease. When an atmosphere containing only one-eighth part of the gas was brought into contact with them, their pulsations were greatly increased in rapidity, and in some cases they became irregular. To obtain a mixed atmosphere containing a known volume of any special gas, I used a graduated glass syringe, which was filled with air to a graduation. The known space left was next filled with the gas required in the mixture by inserting the nozzle of the syringe into the gas-generator: the mixed gases were then forced in a gentle stream through the Stricker's stage, as in other cases.

The Operation of Ammonia on Actinia.—Upon exposing two specimens of actinoloba dianthus to an atmosphere of gaseous ammonia after removal from the tank, they immediately contracted, partially; subsequently (in the course of a few minutes), slight oedema of the tentacular rings occurred, with the evolution of a large quantity of alkaline mucosity. After repeated washings with sea-water, the mucosity still retained a strong alkalinity. On the following day, the smaller of the two animals (pedicle about a quarter of an inch in diameter) was dead and partially disintegrated; the other (pedicle half an inch in diameter at base) was covered with a tenacious alkaline mucosity, the pedicle much contracted and corrugated, tentacles somewhat expanded. The sensibility, which immediately after the experiment was much impaired, if not entirely lost, in this animal, had somewhat returned, although its reaction to stimuli was sluggish. Its colour, which had been a pink, became a yellowish-white. The oedema about the tentacles continued to a slight extent. The pedicular contraction lasted for many days. Ammonia in its effects more nearly resembles a high temperature than even oxygen does, for in small quantities it increases the rapidity of the corpuscular pulsations, whilst the latter gas renders them slow. Its operation on the body of the animal is also closely similar to that of a temperature of about 30 deg. centigrade—namely, great shrinking and

corrugation of the pedicle. The slight oedema of the tentacular rings observed when the animals are exposed to this gas serves possibly to distinguish the effects of the two agents from one another.

A CASE OF POST PARTUM HÆMORRHAGE : TRANSFUSION.

By THOMAS SAVAGE, M.D., F.R.C.S.,
Surgeon to the Hospital for Women, and to the Lying-in Charity, Birmingham.

MRS. J., aged 38, in her third confinement, was attended by Mr. Turner, of this town, on December 30th. The child was born at 8 P.M., after a natural labour, and about 8.30 the placenta had to be removed. She was left, but Mr. Turner was sent for shortly afterwards, as she was very faint and ill. He found her about 10 P.M. very faint, and sent for the nearest local surgeon, who saw her, said her case was a hopeless one, and prescribed a diffusible stimulant. As she was now growing worse, I was sent for. I saw her at 11 P.M. She was very faint and restless; lips blanched, and countenance anxious. I suggested internal hæmorrhage as a probable cause of her condition, as Mr. Turner told me there had been very little external loss during the labour. Externally, I felt a soft swelling extending to just above the umbilicus. Here she complained of constant pain. The vagina was full of blood-clot. I introduced my left hand and arm, and, with my right on the abdomen, I extracted a quantity of clots, together with a piece of placenta, perhaps one-twelfth in size of a normal placenta. I then passed a long tube and injected into the anterior of the uterus a pint of cold water, in which had been mixed an ounce of the stronger solution of perchloride of iron. This immediately caused uterine contraction, and no more bleeding followed.

As she did not rally, but appeared to be gradually sinking, I suggested transfusion. Her condition was now as follows: pulse quite imperceptible, pupils dilated, breath cold, skin clammy; and she was moaning and jactitating about the bed. I sent for the assistance of my friend Mr. Thomas. We then placed her on her back, with dry clothes round her, and an abdominal bandage, on the left side of the bed. The only available blood-donor was a young woman, a shop-assistant, who volunteered it; she was small, thin, but healthy. She sat upright in the chair, to the left of the patient, and eighteen inches from the side of the bed, with her back to the bed's head. I exposed the median basilic vein of the patient's left arm, by transfixing the vein and passing a probe under the vein. Mr. Thomas then made an ordinary venesection incision into the median cephalic vein of the donor, and with Aveling's syringe tried to insert the nozzle, but it did not seem to go in very easily, and the blood also did not flow out readily. I then exposed the median basilic in the same way that I had done in the patient, punctured it, and inserted the nozzle. The contrast between the distended vein of the donor, and the flaccid perfectly empty vein of the patient, was very remarkable. The syringe had been previously filled with lukewarm water. I then punctured the patient's exposed vein, and easily inserted the other nozzle. I sat by the patient's head and took charge of the expanded portion of the syringe. Mr. Thomas sat opposite to me, the syringe being between us, and worked the valve action with his fingers. Mr. Turner guarded the nozzle in the donor's vein. Mr. Thomas and I worked in concert, and we pumped in fifteen syringes full of blood, or about five ounces; when, as the donor was becoming faint, the apparatus was removed. The patient was now very restless, throwing herself about, declaring herself to be sinking, and rubbing her chest, where, she said, the oppression was greatest. We thought her dying; the respirations were very hurried; in a few minutes, the pulse at the wrist was felt feebly beating, and we fancied the carotids and brachials were beating with more force; the heart-sounds were very feeble, especially the first, and at times seemed scarcely audible on account of the hurried breathing sounds; the breath was cold, and also the extremities, back, and chest. She very slowly rallied; we gave her brandy and ammonia. The operation was done about 12.30, and I stayed with her until 4 A.M., when she was decidedly better, she said so herself; her voice returned, and the pulse was felt. She gradually improved, became quite cheerful, and took abundance of nourishment. On the sixth day, there were evident signs of septicæmia, which terminated fatally on the 9th instant, i.e., ten days after transfusion.

The operation of transfusion by means of Aveling's syringe is all that can be desired; its great simplicity being its chief recommendation. There is no doubt at all in the minds of myself and of the two gentlemen who assisted me, that the operation, *per se*, was a complete success.

* I reckon from the time when oxygen gas commenced to pass through the whole apparatus.