

XXXIII. *On the Figure and Composition of the Red Particles of the Blood, commonly called the Red Globules.* By Mr. William Hewson, F. R. S. and Teacher of Anatomy.

Read June 17,
and 24, 1773.

THE red particles of the blood in the human subject have, since the time of Leeuwenhoeck, been so generally allowed to be spherical, that in almost all books of physiology they are denominated red globules. A few authors, however, have at different times doubted whether they were spheres, and amongst the rest Father de la Torr , whose curious observations, together with his glasses, were presented to the Royal Society, Anno 1766. As I flatter myself that I have made some new observations on these particles, I shall do myself the honour of communicating them to the Society.

It is a curious and important fact, that these particles are found so generally through the animal kingdom; that is, they are found in the human species, in all quadrupeds, in all birds, in all amphibious animals, and in all fish, in which animals they are red, and colour the blood. The blood even of insects contains particles similar in shape to those of the blood of more perfect animals, but differing

fering in colour. In water insects, as lobsters and shrimps, these particles are white; in some land insects, as the caterpillar and the grass-hopper they appear of a faint green, when in the vessels as I am persuaded from experiments. I have seen them in an insect no bigger than a pin's head, and suspect they exist almost universally through the animal kingdom.

What is so generally extended through the creation must be of great importance in animal œconomy, and highly deserving the attention of every enquirer into the works of nature. This subject becomes the more interesting from so much of reasoning in the theory of medicine being built in the properties of those particles.

It is by the microscope alone that we can discover these particles; and as some dexterity and practice is required in the use of that instrument, there have not been wanting men of character and ingenuity, who, having been unsuccessful in their own experiments, have questioned the validity of those made more fortunately by others. Some have gone so far as to assert, that no credit can be given to microscopes, that they deceive us by representing objects different from what they really are. These assertions, though not entirely without foundation, when we speak of one sort of microscopes, are very unjustly applied to them all. In compound microscopes, when the object is viewed through two or more glasses, if these glasses be not well adapted to the focus of each other, the figure of the object may be distorted; but no such circumstance takes place, when we view an object through a single lens. All who use spectacles agree, that the figures of objects appear the same through them, as they
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do to the naked eye. And as the single microscope has, like the spectacle, but one lens between the eye and the object, there is no reason to suppose the one can deceive us more than the other. The compound, having a larger field, is more pleasant than the single microscope for many purposes; but the single should be always preferred by those who wish to ascertain the figures of minute bodies. It was this instrument supported on a scroll, as delineated by Mr. Baker (Microscope made easy, plate II. chap. 3.) that has been used in these experiments: and almost all the observations were made with lenses, as they are prepared by some of our more skilful workmen in London. One observation only was made by means of those globules made of glass, which the ingenious Father de la Torr e presented to the Royal Society, and which they were so obliging as to lend to me. Of these globules but two were fit for use, when they came into my hands, viz. that which, according to Father de la Torr e, magnifies the diameter of the object 640 times, and that which magnifies 1280 times. The lenses of the greatest magnifying power made in London are those of $\frac{1}{30}$ th of an inch focus, which, even allowing eight inches to be the focal distance of the naked eye, magnifies the diameter of the object only 400 times; a power much inferior to what may be obtained by globules, and particularly by that globule, which according to Father de la Torr e magnifies the diameter 1280 times; and this globule I have used in some of these experiments. But our lenses, though inferior in magnifying power to these globules, are much superior in distinctness; the
globules

globules are full of clouds, made by the smoke of the lamp used in preparing them, and the object can be seen only through the transparent parts of the globules, which makes it difficult to get a satisfactory view of it; this, with the trouble of adapting the objects to the focus of the glass, made me prefer our own lenses for all the experiments mentioned in these sheets, except one; and it is but doing justice to the ingenious gentleman abovementioned, to acknowledge, that the greater power of his glasses was found in that experiment more than to compensate for their want of distinctness.

These particles of the blood, improperly called globules, are in reality flat bodies. Leeuwenhoeck and others have allowed, that in fish and in the *amphibia* they are flat and elliptical; but in the human subject and in quadrupeds almost all microscopical observers have agreed in their being spherical. When we consider how many ingenious persons have been employed in examining the blood with the best microscopes, it will appear wonderful, that the figure of these particles should have been mistaken; but our wonder will be lessened, when we consider how many obvious things are overlooked, till our attention is very particularly directed to them; and besides, the blood in the human subject and in quadrupeds is so full of these particles, that it is with great difficulty we can see them separate, unless we find out a method of diluting the blood. It is to such a discovery that I attribute my success in this enquiry; for, having examined the blood as it flows from the vessels of the human body, it appeared a confused mass, notwithstanding
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I spread it thin on a glass, or a piece of talk. It then occurred to me to dilute it, but not with water, for this I knew dissolved the particles; but with serum, in which they remain undissolved. By the serum I could dilute it to any degree, and therefore could view the particles distinct from each other; and in these experiments I found that these particles of the blood were as flat as a guinea. I likewise observed that they had a dark spot in the middle, which Father de la Torr  took for a hole; but, upon a careful examination, I found it was not a perforation, and therefore that they were not annular. I next made experiments by mixing these particles with a variety of other fluids, and examined them in many different animals; and the result of these experiments was, that their size is different in different animals, as is seen in plate XII, where they are represented of the size they appeared to my eye, when viewed through a lens of $\frac{1}{3}$ of an inch focus, which, allowing eight inches to be the focal distance of the naked eye, magnifies the diameter 184 times.

It may not be improper to observe here, that the accurate Leeuwenhoeck not having diluted the human blood, or that of quadrupeds, so as to see these particles separate from each other, was thence not qualified to describe them from his own observation, as he has done those of fish and of frogs; and, suspecting a round figure was more fit for circulating in our vessels, was thence led to suppose these particles spherical in the human subject. But I shall hereafter be able to shew from his own words, that it is not his observations, but

his speculative opinions, or his theory, that differs from what I have discovered by these experiments.

In plate XII. it appears, that of all the animals which I have examined, the particles are largest in the fish called a skate; next to the skate they are largest in a frog and a viper, and other animals of this class; they are somewhat smaller in the common fish, as the salmon, cod, and eel. In birds they are smaller than in fish; in the human subject smaller than in birds; and in some quadrupeds still smaller than in the human subject. Leeuwenhoek, speaking of their size, says, he is confident the red particles of the blood are no larger in a whale than in the smallest fish *. And others have, since his time, said they are of the same size in all animals; but it is evident, from comparing their size, as delineated in the abovementioned plate, that it differs considerably, and that they are not largest in the largest animals; for we find that in an ox they are not so large as in a man; and so far are they from being larger in the whale than in the small fish, it appears probable, from comparing their size, as delineated plate XII. N° II. from a porpus, which belongs to the same genus as the whale, that they are smaller in those animals than in fish. Neither is their size inversely, as the size of the animal; for they are as large in an ox as in a mouse. The difference in their size therefore depends on some other circumstance than a difference in the size of the animal.

* Conf. Arcan. Nat. p. 220.

As to their shape, I have already mentioned that they are flat in all animals, even in the human subject; of which any one may be convinced by repeating the following experiments.

EXPERIMENT I. Take a small quantity of the serum of human blood, and shake a piece of the crassamentum in it, till it is coloured a little with the red particles; then with a soft hair pencil spread a little of it on a piece of thin glass, and place this glass in the microscope in such a manner as not to be quite horizontal, but higher at one end than the other, by which means the serum will flow from the higher extremity to the lower, and as it flows, some of the particles will be found to swim on their flat sides, and will appear to have a dark spot in their middle; others will turn over from one side to the other as they roll down the glass. No person who sees them turn over can doubt of their being flat; he will see them in turning have all the phases that a flat body has; first he will see them on one side, then rise gradually upon their edge, and turn over to the other side. I have in this way shewed their figure to a number of curious persons, and particularly to many students of anatomy, who have attended lectures in London within the last six years.

If, instead of serum, the particles should be diluted with water containing rather more salt than serum does; or if, instead of human blood, that of an animal with larger particles be used: then they will sometimes be seen not only flat, but a little bended, like a crooked piece of money.

These experiments not only prove that the particles of the blood are flat, and not globular; but likewise, by proving that they are flat, they shew that they are not fluid, as they are commonly believed to be; but, on the contrary, are solid; because every fluid swimming in another, which is in larger quantity, if it be not soluble in that other fluid, becomes globular; this is the case where a small quantity of oil is mixed with a larger quantity of water, or if a small quantity of water be mixed with a large one of oil, then the water appears globular. And as these particles are not globular, but flat, they must be solid; a circumstance that will appear still more evident from future experiments.

It is necessary to remark, that in a few minutes after the particles are spread out on a glass, they run in clusters, and stick to each other, and then they appear confused.

When one of these particles is attentively examined, while separate from the rest, it appears, as it lies on its flat side, to have a dark spot in the middle, and round that dark spot it is more transparent. This dark spot was believed to be a perforation, or the particle was supposed to be a hollow ring, by the ingenious Father de la Torr e. But I find, from a great number of experiments, that the dark spot is a solid particle contained in a flat vesicle, whose middle only it fills, and whose edges are hollow, and either empty, or filled with a subtle fluid. This will be evident to every one who will carefully make the following experiments.

EXPERIMENT II. Take a drop of the blood of an animal that has large particles, as a frog, a fish, or, what is still better, of a toad; put this blood on a thin piece of glass, as used in the former experiment, and add to it some water, first one drop, then a second, and a third, and so on, gradually increasing the quantity; and in proportion as water is added, the figure of the particles will be changed from a flat to a spherical shape. When much water is added, the vesicle will by degrees become thinner, and more transparent, and will at last be dissolved. When the vesicle has thus assumed a spherical shape, it will roll down the glass stage smoothly, without those phases which it had when turning over whilst it was flat; and as it now rolls in its spherical shape, the solid middle particles can be distinctly seen to fall from side to side in the hollow vesicle like a pea in a bladder. Sometimes, indeed, instead of falling from side to side, the solid middle particle is seen to stick to one part of the vesicle; and in proportion as the vesicle, instead of being flat, assumes a spherical shape, its longest diameter is shortened as might be expected, on the supposition of its being hollow and flat.

After this experiment has been made on the blood of such animals as have large vesicles, it may be made on human blood, where the water will be found to have the same effect; the vesicles will become spherical, the diameters of these spheres will be less than the largest diameter of the vesicle was, in its flat state.

It is remarkable that more water is in general required to produce this change on the vesicles of the human blood than on those of frogs, or other amphibious animals; and those of the amphibia require still more than those of fish; for the substance of these vesicles being thicker and more coloured in man and in quadrupeds than in the amphibia, is therefore later in being dissolved in water; and being thinnest in fish, it thence most readily dissolves. Those who are desirous of repeating these experiments had best begin with the blood of toads and frogs, whose vesicles are large, and remain some time without dissolving in the water (when that is used with the above-mentioned precautions); by which means any one accustomed to microscopical experiments may readily be satisfied of these curious circumstances.

From the greater thickness of the vesicles in the human subject, and from their being less transparent when made spherical by the addition of water, and likewise from their being so much smaller than those of fish or frogs, it is more difficult to get a sight of the middle particles rolling from side to side in the vesicle, which has become round; but with a strong light *, and a deep magnifier, I have distinctly seen it in the human subject, as well as in the frog, toad, or skate.

Since water makes these particles round, and makes the dark spot in their middle disappear, it is evident the red particles of the human blood are not perforated, but that dark spot is owing to something else than a hole: and this is likewise con-

* These experiments were all made with day-light, in clear weather.

firmed by observing that although the particle does in an obscure glass appear only to have a dark spot which might be supposed to be a hole, yet, with a very transparent lens, and a good light, after diluting the blood with serum, that middle part can be distinctly seen to be only of a deeper red than the rest of the vesicle, and thence appears darker.

In these experiments, made by adding water to the blood, the middle particles appear to be less easily soluble in water than the flat vesicle which contains them; so that, a little time after the proper quantity of water has been added, the flat vesicles disappear, leaving their middle particles; which seem to be globular, and very small.

That these red vesicles of the blood, although flat, are not perforated, is evident likewise from a curious appearance which I have repeatedly observed in blood that has been kept three days in the summer season, so that it was beginning to putrefy; the vesicles of this blood being diluted with serum, and examined with a lens $\frac{1}{3}$ of an inch focus, but more particularly when examined with M. de la Torr e's glass, which, by his computation, magnifies the diameter 1280 times, were found to have become spherical; the diameter of these spheres was less than their largest diameter when flat, and their external surface was corrugated in such a manner as to make them appear like small mulberries.

I have seen the same appearance on mixing serum that had been kept three days in a warm place, and smelt putrid, with fresh-drawn human blood; the vesicle assumed this globular and mulberry-like appearance.

In these experiments on human blood beginning to putrefy, I have likewise observed some of these vesicles break into pieces without becoming spherical; and I have distinctly perceived the black spot in the center fissured through its middle, another proof that it is not a perforation.

In the blood of an eel, which was beginning to putrefy, I have seen the vesicles split and open, and the particle in its center come out of the fissure.

As the putrefaction advances, those vesicles which had become rough spheres, or like mulberries, and those which had been merely fissured, each break down into smaller pieces. M. de la Torr e seems to think they have joints, and break regularly into seven parts; and Leeuwenhoek suspected these globules, as he called them, were constantly made of six lesser globules. But from observations I am convinced there is nothing regular or constant in the number of pieces into which they break. I have seen them fall into six, seven, eight, or more pieces, by putrefaction; for putrefaction breaks them down in the manner it destroys other animal solids.

I need hardly take notice, that the small pieces into which the vesicles break are equally red as the vesicle itself. The theory of the red globules being composed of six ferrous ones compacted together, and the ferrous globules of six of lymph, has not the least foundation, and is intirely overthrown by the simple experiment of mixing the blood with six or with thirty-six times its quantity of water; for the water dissolving the globules ought to reduce them to yellow serum, or colourless lymph*: but it does

* See Gaubii Pathologia.

not ; on the contrary, it is coloured red by these particles, even when used in much greater proportion than thirty-six parts of water to one of blood.

These red vesicles of the blood have not only been commonly supposed globular and fluid, but they have with equal injustice been imagined to be oily and more inflammable than the rest of the blood. That they are not oily is evident from their so readily dissolving in water ; and that they are not more inflammable than the rest of the blood is manifest by burning them after they are separated from the rest of the blood, which separation may be effected by shaking the crassamentum in the serum so as to diffuse the particles through it ; and then, by pouring off the clear serum, when they have subsided in it. I have separated them in this manner, and compared their inflammability with that of inspissated serum, and of dried coagulable lymph, and have not observed them more inflammable than the serum or the lymph ; nor do they melt like oils, as some have suspected, but burn like a piece of horn.

Some authors, who have written on the figure of these vesicles in quadrupeds, and in the human subject, have expatiated on the great advantages of their (supposed) spherical shape, in order for their more easy circulation ; as it is probable that no form is preferable to a-spherical one for easy motion. But as these vesicles are evidently not spherical but flat in all animals, we must believe that nature has some good purpose to answer by making them of that form.

It has been objected, that, notwithstanding they appear flat out of the body, they may possibly be

globular in the body, while circulating; and it has been said, that it is almost inconceivable that so many ingenious men should at different times have viewed them through a microscope, and have concluded them spherical, if they be really flat. But, however that may have happened, it is a fact that they are as flat in the body as out of it. Of this I am convinced by having repeatedly observed them whilst circulating in the small vessels between the toes of a frog, both in the solar microscope, and the more simple one abovementioned. I have seen them with their sides parallel like a number of coins laid one against another. I have likewise in that animal, where they are elliptical, seen them move with one end foremost, and sometimes with an edge turned towards the eye. I have moreover seen them, when entering a small vessel, strike upon the angle between it and the larger trunk, and turn over with the same variety of phases that they have when turning over upon a piece of glass.

Upon this occasion I may remark, that it has been said by some microscopical observers, that in passing through very small vessels they seem to alter their shapes, and to be lengthened. This conclusion, I suspect, has taken its rise from the observer having seen them with their edge turned towards his eye; in which case they would appear long and small, as if lengthened by compression, especially to one who sets out with the notion of their being globular. I have seen them in blood vessels, which would admit only single vesicles, move with difficulty, as if streightened for room; but never saw them altered in their shape by the action of the vessels.

If then they really be not globular but flat, and if water so readily alter their shape, whence is it that the serum has the property of preserving them in that form which seems so necessary, because it is so general through the animal creation?

It is principally by the salts of the serum that this effect is produced, as is proved by adding a small quantity of any neutral salt to water, when the water is no longer capable of dissolving those particles, nor does it alter their shape when the salt is used in a certain proportion.

EXPERIMENT III. If a saturated solution of any of the common neutral salts be mixed with fresh blood, and the globules (as they have been called, but which for the future I shall call flat vesicles) be then examined in a microscope, the salt will be found to have contracted or shriveled the vesicles, so that they appear quite solid, the vesicular substance being closely applied all round the central piece. In proportion as the solution of salt is diluted with water, it has less effect; and, when diluted with six, eight, ten, or twelve times its quantity of water, it produces no change in the figure of the vesicles, whose flat shape can then be seen even more distinctly than when mixed with serum itself.

The neutral salts, which, when diluted with water, have been observed to have the effects above-described, are Glauber's salt, Epsom salt, a salt formed of the volatile alkali and the vitriolic acid, common nitre, cubic nitre, a salt made with the volatile alkali and the nitrous acid, as well as the salts made with the nitrous acid and magnesia, or

with the nitrous acid and chalk, and also common salt, digestive salt of Sylvius, and a salt made with vinegar and the fossil alkali. These experiments were sufficient to convince me, that this property was very general among those salts which consist of acid and alkali; and therefore it seemed unnecessary to prosecute this enquiry farther *.

But acids and alkalies have different effects on these vesicles from what neutral salts have.

The fixed vegetable alkali, and the volatile alkali, were tried in a pretty strong solution, and found to corrugate the vesicles; and in proportion as they were diluted, their effects became similar to water alone, but it is not easy to find the point of strength where the vesicles would remain unaltered in the solution. And here we may observe, that since these vesicles are found to dissolve so readily in water, and not to be dissolved in these solutions of alkali, it is a strong argument against their being either oily or saponaceous, as they have been suspected.

The effects of acids are very different. I have tried the vitriolic, nitrous, muriatic distilled vinegar, and the acid of phosphorus; these, when much diluted, have the same effects as water in making the vesicles spherical; and, in proportion as they are less diluted, they dissolve the vesicles without making them spherical, as water does. I never

* These experiments were made by putting one drop of the saturated solution of the salt into a tea cup, and then adding distilled water by a few drops at a time; and to this mixture the serum of the blood, highly tinged with the red vesicles, was added.

could find any point of dilution where the acids like the neutral salts produced no change on the figure of the vesicles. This experiment is the more to be attended to, as these vesicles have been supposed to be oily and saponaceous, which is improbable, since they dissolve more readily in acids than in alkalies.

Salts made with earth of alum, and any of the acids, always corrugate those vesicles, unless they be very much diluted; when their effects are similar to those of the water alone, that is, they make the vesicles assume a spherical shape. I could not discover any point of strength in these solutions where the particles would remain in them without being changed in their shape.

The same was observed of spirit of wine: some of the metalline salts, as copperas, sublimate, and Roman vitriol, were tried; and when much diluted; their effects were not different from those of water; but in proportion as the solution was stronger, they corrugated the vesicles more and more.

Urine, when containing much of its salts, has effects similar to the serum; but in proportion as it is weaker, its effects are more like those of water.

The use therefore of those salts which enter into the composition of the blood is probably to preserve the red vesicles in their flat form; for we must suppose some advantages attend that shape, since nature has made use of it so generally in the blood of different animals. And as both a very strong solution of neutral salts and a very diluted one alters the shape of the vesicles, it is probable nature has
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limited the proportions of the water and the salts in our blood. A degree of latitude in these proportions however seems to be admitted ; for I observed the vesicles equally unchanged when mixed with a solution of salts consisting of eight drops of water to one of the saturated solution, and when added to a mixture of fifteen drops of water to one of the same solution.

Not only the neutral salts in the blood are capable of preventing the serum from dissolving the vesicles ; but the mucilage or lymph with which the serum is so much impregnated, seems to contribute to the same effect.

When the vesicles have been made spherical, by being mixed with water, if a small quantity of pretty strong solution of a neutral salt be added, they are immediately shriveled, a few of them recover their former flat shape, but the greatest part are contracted irregularly into smaller spheres. When these vesicles thus recover their shape, after having been a short time mixed with water, they are generally more transparent, and appear thinner, a part of their substance having been dissolved in the water ; and thence it is more easy to distinguish the little solid particle which is contained in them. By this experiment I have had the pleasure of convincing many curious persons of the composition of this part of the blood, who were not quite satisfied from some of the other experiments.

I have mentioned above, and have shewn in plate XII. that these vesicles are of different sizes in different animals. I have likewise observed, that they are not all of the same size in the same animal,
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some being a little larger than others ; and some dissolve in water more readily than others. In the same species of animals they even differ in size in the different periods of life. In a chicken on the sixth day of incubation I found them larger than in a full-grown hen, as is represented in the plate ; and I found them larger in the blood of a very young viper than in that of its mother, out of whose belly it was taken. I have not however been convinced from experiments, that there is any difference in size between those of a child at its birth and those of an adult person.

In the blood of some insects the vesicles are not red, but white, as may easily be observed in a lobster (which Linnæus calls an insect); one of whose legs being cut off, a quantity of a clear *sanies* flows from it ; this, after being some time exposed to the air, jellies, but less firmly than the blood of more perfect animals. When it is jellied, it is found to have several white filaments ; these are principally the vesicles concreted, as I am persuaded from the following experiment.

EXPERIMENT IV. If one of the legs of a lobster be cut off, and a little of the blood be caught upon a flat glass, and instantly applied to the microscope, it is seen to contain flat vesicles that are circular, like those of the common fish, and have each of them a lesser particle in their center as those of other animals. But there is a curious change produced in their shape by being exposed to the air ; for soon after they are received on the glass, they are corrugated ; or from a flat shape are changed into regular spheres, as is represented in plate XII. N° XII.

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This change takes place so rapidly, that it requires great expedition to apply them to the microscope soon enough to observe it.

I have observed the *sanies* or blood of a shrimp, by cutting off its tail, and found vesicles in it similar to those of the lobster, which have been a short time exposed to the air. But I never could apply the blood so as to see them in their flat form; but, since they changed by exposition to the air, I conjecture that like them they were flat in the blood vessels; but being more susceptible of changes from the contact of air, they were corrugated before I could get them applied to the microscope.

The ingenious Leeuwenhoeck has observed that in the blood of a grasshopper, its vesicles or globules, as he calls them, are green. I have seen the same circumstance in the white caterpillar, whose serum appeared green when in its vessels; but when let out from this animal or from a grasshopper, the colour cannot be distinguished.

The smallest animal in which I have discerned these vesicles is an insect no bigger than a pin's head, that is seen almost constantly in the river water which we have in London. This insect, which is a species of the *Monoculus*, being put into a concave glass with a little water, and the rays of the sun being made to pass through it, the heart may be seen to beat, and the transparent blood or *sanies* found to have a few vesicles, which appear to move one after the other; being made visible, though transparent, by the light passing in such a manner as to be refracted by them.

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A comparative view of the **FLAT VESICLES** of the Blood as they appear thro' a Lens $\frac{1}{23}$ of an Inch Focus.


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| Fig. I. | | Their Size in an Ox, a Cat, an Ass, a Mouse, & a Bat. | VII. |
| II. | | _____ in a Man, in a Rabbit, a Dog, & a Porpus. | VIII. |
| III. | | _____ in Birds, - viz a Pigeon, a Hen, a Chafinch, & a Duck. | IX. |
| IV. | | _____ in a Chick from the Egg, on the 6 th day of Incubation. | X. |
| V. | | _____ in the common Fish, as the Salmon, Carp, & Cel. | XI. |
| VI. | | _____ in a full grown Viper, & in a Turtle. | XII. |
| | | | XIII. |

lood in different Animals, exhibiting their size & Shape as they

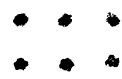
VII.  Their Size in a small Viper taken from the Belly of its Mother.

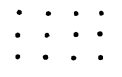
VIII.  _____ in a Slow Worm.

IX.  _____ in a Frog.

X.  _____ in a Skate.

XI.  _____ in a Lobster.

XII.  The Vesicles of the same Lobster, as they appear after being a short time exposed to the Air.


XIII.  The size of the Globules of Milk.

Since so small an animal as this has these curious vesicles equally as the larger and more perfect animals, is it not probable that they are diffused through the whole animal creation? And what is found so generally amongst animals must be of great use in their œconomy.


P. S.


Mr. Hewson begs leave to add, that since these experiments open a new field for enquiry; and as he has already so far prosecuted the subject as to be persuaded that he has thereby discovered not only the use of the lymphatic glands and of the Thymus, but also of the spleen: in order to have the opinions of the ingenious concerning the facts mentioned in this paper, he ventures to solicit, that such gentlemen as are curious in natural knowledge, and particularly the Members of the Royal Society, would honour him with their company, at his house in Craven-street, in the Strand, where he will repeat the experiments before them.

A comparative view of the **FLAT VESICLES** of the Blood in different Animals, exhibiting their size & Shape as they appear thro' a Lens $\frac{1}{25}$ of an Inch & Focus.

Fig. I.  Their Size in an Ox, a Cat, an Ass, a Mouse, & a Bat.

II.  _____ in a Man, in a Rabbit, a Dog, & a Porpus.

III.  _____ in Birds, - viz a Pigeon, a Hen, a Chafinch, & a Duck.


IV.  _____ in a Chick from the Egg, on the 6th day of Incubation.


V.  _____ in the common Fish, as the Salmon, Carp, Eel.

VI.  _____ in a full grown Viper, & in a Turtle.


VII.  Their Size in a small Viper taken from the Belly of its Mother.

VIII.  _____ in a Slow Worm.

IX.  _____ in a Frog.

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XII.  The Vesicles of the same Lobster, as they appear, after being a short time exposed to the Air.

XIII.  The size of the Globules of Milk.