V. *The Croonian Lecture. Microscopical observations on the following subjects. On the Brain and Nerves; showing that the materials of which they are composed exist in the blood. On the discovery of valves in the branches of the vas breve, lying between the villous and muscular coats of the stomach. On the structure of the Spleen. By Sir* EVERARD HOME, *Bart. V. P. R. S.*

Read December 7th, 1820.

THE Croonian Lectures for the three preceding years, contain Mr. BAUER's microscopical observations on the blood. That fluid we find is made up of a greater number of ingredients than it was known to contain; indeed we find in it materials ready prepared, for the formation of most of the structures of an animal body.

In the present Lecture, the brain and nerves form the first subject of investigation. Having found upon a former occasion that the retina is perfectly transparent in the living body, and is only rendered visible by coagulation after death, this, the only expansion of medullary substance in the body with which I am acquainted, was examined by Mr. BAUER in the microscope.

He found the optic nerve to consist of many bundles of extremely delicate fibres, formed of minute globules connected together by a gelatinous substance, which readily dissolves in water. The dimensions of the globules, measured on the micrometer, explained in the preceding Lectures, are from $\frac{1}{2800}$ to $\frac{1}{4000}$ parts of an inch, mixed with very few of $\frac{1}{2000}$ parts, the size of the red globules deprived of their colouring matter.

The retina appeared as a continuation of the bundles composing the optic nerve, and consists entirely of the same sized globules connected into fibres, and forming bundles, which go off distinctly from the end of the nerve, like rays: towards the circumference they almost disappear, and end in smooth membrane.

The whole retina is interwoven with innumerable blood vessels, both arteries and veins; the gelatinous substance that holds the globules together, dissolves in water very readily; so that if the parts are soaked in water for three or four days with a portion of the optic nerve, they become a mass of globules, and the blood vessels, when separated, form a beautifully delicate net-work, their branches anastomosing freely with one another. These appearances are represented in Pl. II. fig. 4. magnified 400 times.

By the discovery of this transparent substance, we become acquainted with the nature of the medullary structure of the nerves; and can form some idea of their action, which, till now, I confess myself to have been totally unacquainted with. The nerves, as well as the retina, are composed of this newly discovered transparent substance, which is very elastic, and soluble in water, and globules of $\frac{1}{2800}$ and $\frac{1}{4000}$ parts of an inch in diameter. Its transparency and solubility account for its having remained concealed; and were it not coagulable, in which state it becomes opaque, its existence might even now be considered as equivocal.

Before I say more of this transparent jelly, I will state Mr. Bauer's observations on the structure of the brain, of which it makes an essential part. If the mass of the brain is kept in water for 48 hours, and a thin slice is cut from the medullary part of the cerebrum, and laid upon a glass plate previously wetted with water, and a drop of water is allowed to fall upon the slice, holding the glass a little obliquely, so that the water must run across the surface of the glass, the force with which it moves is sufficient to break down the medullary substance of the brain, so as to bring distinctly into view innumerable loose globules, many fragments of fibres of single rows of globules, and bundles of fibres, some of them of considerable length, as represented in Pl. II. fig. 1.

If the substance of the brain is laid upon a piece of dry glass, and the separation of its parts is attempted by instruments, it is impossible to effect it, as the viscous mucus adheres strongly to the glass, and the substance would be indistinctly daubed on the glass, in the manner of a pigment, a state in which the globules are not discernible.

It is impossible to distinguish the fibres composed of globules, in an opaque state of the substance; for, although in the section of any part of the brain, by means of a very strong magnifying lens, lines are discernible, these lines are produced by the light and shade on the substance, and only denote the bundles of fibres of which the brain is composed, but not the simple globular fibres.

The gelatinous mucus seems to dissolve readily, and mix with the water; and, being perfectly colourless and transparent, is entirely invisible while the substance of the brain is fresh, or whilst it is immersed in water; but if the water is left to evaporate, and the substance gets dry, the mucus collects round the loose globules and fibres in considerable quantity, or forms irregular flakes or splotches upon the glass, perfectly transparent, and of a yellowish tinge, as represented in Pl. II. fig. 2.

If a portion is cut off from the brain in a fresh state, before it has been put in water, and laid upon a dry glass plate, and covered by a cup, so as to prevent evaporation, a perfectly colourless aqueous fluid is exuded, which evaporates on exposure to the air, and hardly leaves any mark upon the glass.

The cortical substance of the cerebrum contains also a fluid resembling the serum of the blood; it has a yellower tint than the fluids in the medullary substance, or any other part of the brain; and, when dry, it assumes the glassy appearance, and forms the same cracks that the serum does when dried on glass.

The above are all the visible materials that can be distinguished in the different parts of the human brain by means of the microscope; and, making allowance for slight modifications, are the same in different parts of the organ.

The globules are from $\frac{1}{2400}$ to $\frac{1}{4000}$ of an inch in diameter; but the general or predominant size is $\frac{1}{3200}$. They are semi-transparent, and of a white colour, arranged into fibres of single globules, and seem to be held together by the viscid mucus. The fibres form bundles connected in the same way.

The principal difference in the appearance of the different parts of the brain, consists in the proportions the quantity of mucus and fluids bear to the quantity of globular tissue in the same part, and in some respects in the size of the globules; as for instance, the cortical substance of the cerebrum and cerebellum, (which are in all respects alike) consists chiefly of globules from $\frac{1}{3200}$, to $\frac{1}{4000}$ of an inch in diameter; and the smaller globules prevail. The single globular fibres are not so readily distinguished as in the other parts of the brain; the gelatinous mucus and fluid resembling serum, are very abundant. The finest and most delicate branches of the arteries and veins are only found in the cortical substance.

The medullary substance of the cerebrum and cerebellum differs from the above in the large globules prevailing; the mucus being more tenacious and less in quantity in proportion to the globular tissue, and the single globular fibres being more distinct, and the arterial and venal branches being larger.

The crura cerebri and cerebelli resemble in general the medullary substance, only that the mucus and fluids are more abundant; and there appears a greater proportion of mucus than globules; the blood vessels are larger than in the medullary substance.

The medulla oblongata, the corpora pyramidalia and olivaria have nearly the same structure as the medullary substance; the single globular fibres, and their bundles, are composed of the larger globules; the mucus, however, is very abundant, and is sooner dissolved in water than the mucus in any other part of the brain.

The pons verolii is principally composed of globules $\frac{1}{3200}$ of an inch; the fibres not quite so distinct as in the medulla oblongata; the mucus very abundant. The medulla spinalis has the globules of $\frac{1}{2400}$ to $\frac{1}{3200}$ of an inch predominant; the mucus and fluid less tenacious, but in greater quantity than in any part of the brain; for this reason, the single globular fibres are not so readily discovered; for if the part is not sufficiently soaked in water, they cannot be separated; and if macerated too much, the whole is dissolved into a mass, like cream. The corpus callosum resembles the medulla spinalis, but contains a greater quantity of globules $\frac{1}{2400}$ of an inch than any other part of the brain; the quantity of mucus and fluid are at least equal to the globular tissue.

Every part of the substance of the brain is pervaded by innumerable blood vessels, which are of considerable size towards the centre, but branch out to an extreme degree of minuteness, less than the half diameter of a red globule with its colouring matter; and even when of that size the fluid they carry is red, as in Pl. II. fig. 4.

These arteries in the brain never anastomose, as in the retina; their branches are accompanied by veins of still less diameter, having valves. The valves are at very short distances, particularly near their extremities; and when the brain is fresh, these veins contain a red fluid. See Fig. 3.

The circumstances noticed by Mr. BAUER, namely, the cortical substance of the cerebrum and cerebellum being made up of the small globules; containing the gelatinous fluid soluble in water in great abundance; and having branches more minute than the other arteries of the brain; also the corresponding veins having valves similar to those found in absorbent ves sel and their canals carrying a red fluid,—throw considerable light upon the functions of the brain, and show that the cortical substance is one of the most essential parts of this organ, although the pons verolii, as the commune vinculum between the different portions of this complicated structure, may be the most essential to life.

That the cortical part of the brain is the seat of memory, is an opinion I have long entertained, from finding that any continued undue pressure upon the upper anterior part of the brain entirely destroys memory, and a less degree materially diminishes it. Pressure upon the dura mater, where the skull has been trepanned, puts a temporary stop to all sense, which is restored the moment that pressure is removed; and the organ appears to receive no injury from repeated experiments of this kind having been made. In hydrocephalus, when the fluid is in large quantity, and there only remains the cortical part of the brain and pons verolii connecting it to the cerebellum, all the functions go on, and the memory can retain passages of poetry, so as to say them by heart; but a violent shake of the head produces instant insensibility. Pressure in a slight degree upon the sinciput, produced in one case complete derangement, with violent excesses of the passion of lust, both of which went off upon removing, by the crown of the trepan, the depressed bone.

The veins being so minute, and being supplied with valves, explains the circumstance of lymphatics never having been met with in this organ; these veins performing that office, carrying the absorbed matter into the superior longitudinal sinus, which appears more a reservoir than a vein; for the fluid that passes through it is not simply circulating blood; it contains the colouring matter in a decomposed state as black as ink, a change we shall find it undergoes in the spleen after death.

The superior longitudinal sinus may be considered as the common receptacle of the absorbent veins of the pia mater from its triangular form, it always remains full. The aqueous liquid, by which the ventricles are filled, varying in quantity, answers the purpose of equalizing internal pressure.

As the transparent mucus not only is one of the most abundant materials of which the brain itself is composed, but is the medium by which the globules of the retina are kept together, and serves the same purpose in the medullary texture of the nerves, there can be no doubt that the communication of sensation and volition, more or less, depend upon it. And it would appear from the following case, that when parts are regenerated, they contain a sufficient quantity of this mucus to connect them with the nerves of the body, and enable them to partake of its sensibility.

A lady, who had a wound on the breast in a healing state, had a prominent spot of a black colour suddenly make its appearance on the surface; it was very tender to the touch; next day it disappeared, and the tenderness was gone. This must have been blood coagulated upon the termination of a nerve, and therefore the impression made by touching it was communicated along the nerve; but when it was absorbed, the bare nerve received a coating of coagulable lymph, and there was no more pain.

Mr. HUNTER's comprehensive mind grasped at the idea of the existence of something of this kind, although he had not arrived at a knowledge of the substance employed to produce the effect. He said, that so wonderful was the connection between the brain and every structure of the body, that it was to be explained in no other way than by considering, that the materia vitæ was every where; that it was in two forms collected into one mass in the brain, which he called coacervata;

and diffused through the body, which he termed diffusa, and the nerves communicated between them. This grand idea of Mr. HUNTER'S, Mr. BAUER, by his discovery of this transparent mucus, soluble in water, has realized.

To complete the investigation of this subject, it only remained to determine, whether this transparent substance, soluble in water, is actually an ingredient in the blood, or is formed after the first changes of that fluid into the solids of the body have taken place.

To ascertain this point, two ounces of blood were drawn from the arm of a healthy man, and allowed to stand at rest till all the serum separated from the coagulum, which required 36 hours; the serum was then carefully poured off, and the phial filled up with distilled water, and the changes that occurred were attended to. In 24 hours, the upper parts of the coagulum, particularly at the edges, became tumid, apparently from having imbibed some of the water. This part was of a light red colour, and semi-transparent. A small portion of it was cut off and put into a saucer with distilled water, covered over by a watch glass. In 24 hours, carbonic acid gas was seen in bubbles round the edge of the watch-glass, the colouring matter had mixed with the water, and the whole of the substance was nearly dissolved.

From this experiment, confirmed by many others, this mucus is not only readily discovered in the blood, but proves to be the medium by which the colouring matter is attached to the surface of the red globules; and therefore when these red globules are put into water, they lose their colour from the medium dissolving by which it was attached to them.

From this investigation of the blood, it appears that the principal materials of which the body is composed, are met with in the blood. The fat is by many considered a secretion; for this opinion there is however no foundation. That the fat is formed in the colon, and is thence taken up into the blood vessels, and distributed to the different parts of the body, is sufficiently proved by the mode in which adipocere is made, and by the observations on the colon in different animals, that have been long since laid before the Society. No direct experiment has been made, that I am acquainted with, for detecting the presence of fat in the blood; possibly the reason is, that its failure would prove nothing, since the blood contains an alkali with which the oil will become united. That I might not be said to have neglected this part of the enquiry, I instituted the following experiment.

Twelve ounces of blood were drawn from the arm into a glass vessel of a globular form capable of containing a pint, with a tube rising out of the globe six inches long, and half an inch in diameter; at the end of 24 hours the serum was poured off, and the vessel and tube filled up to the orifice with distilled water; after this vessel had remained 24 hours at rest, no appearance of oil took place upon the surface. The coagulum was then broken down by a long wire, which produced an immediate evolvement of carbonic acid gas, in such quantity that the water fell in the tube an inch in length; but there was no appearance of oil seen on the surface. The blood was examined for several days successively; it became very offensive, but showed no appearance of oil. In the blood of the salmon and skate, oil is met with in such quantity as to render blotting paper greasy.

In the skate, the blood globules are of a very large size, and have an oval form; the colouring matter in them is of a light yellow; they very readily change their appearance when decomposition begins to take place: at this time the oval becomes flattened, and the central part appears more dense than the margin, by which it is surrounded in the form of a ring, and when this ring dissolves, the globule it contained is seen of a spherical form, and the surrounding fluid has oil floating in it, distinguishable by the naked eye, as well as by other tests.

The globules are represented in Pl. III. fig. 5. magnified 4000 diameters.

The salts in the skate's blood must be very abundant, since they are found in it crystallized, as represented in Pl. III. fig. 6: magnified 200 times.

On the branch of the vas breve carrying the fluids from the stomach through the splenic vein to the vena portarum.

The discovery of valvular vessels in the brain, acting as absorbents in that organ, immediately led me to suspect that there must be a similar provision for carrying off the fluids taken into the stomach, whenever the quantity or quality interfered with the process of digestion. To do this by the route of the thoracic duct, was not only too circuitous to correspond with the general simplicity of the operations of nature, but was mixing these heterogeneous liquids in too crude a state, with the general circulation of the blood. That there was some unusual mode of conveying fluids from the stomach to the urinary bladder, I have upon a former occasion established, since they arrived there when both the pylorus and thoracic duct were tied up, and the spleen was removed out of the body; but till the fact of valvular vessels supplying the office of absorbents was ascertained, any opinion respecting the route of fluids from the stomach, must continue to be entirely hypothetical.

Upon the present occasion, through Mr. BAUER'S means, *I am not only enabled to demonstrate vessels so constructed* in the coats of the stomach, but to give abundant collateral evidence of their acting as absorbents, even more than can be produced respecting those of the brain.

It immediately suggested itself to me, that this was the probable use of the branches of the vas breve, the presence of which upon the coats of the stomach, so well supplied with veins from other trunks, is not easily accounted for.

In the first instance, with the assistance of Mr. CLIFT, I injected the splenic artery, and requested Mr. BAUER to ascertain, whether any minute branches, spread upon the great curvature of the stomach, in a contrary direction to those injected arteries, had valves. Such vessels were found, and quite empty. They had valves very distinctly marked: he showed them to me, so as perfectly to satisfy me of the fact. Having got thus far, I requested the assistance of Mr. CHEVALIER, House Surgeon to St. George's Hospital, who has given, at different times, considerable time and attention to preparing the stomach and spleen for Mr. BAUER'S observations; which he has been better enabled to do, from being more in the habit of injecting the blood vessels, than students in surgery generally are; Mr. CLIFT's important occupations at the College depriving me of his valuable assistance. I requested Mr. CHEVALIER to inject, as minutely as possible, the branches of the splenic artery and vein going to the stomach. In one instance, he succeeded so well that the arteries were filled to the most minute branches, and some of the injection had passed into the stomach, without any apparent rupture of the vessel. No part of this coloured injection had got into the veins, which in other parts of the circulation generally happens. Between the villi and the muscular coats of the stomach there is a very fine elastic cellular membrane: it admits of being drawn out to more than three times its natural thickness; and it was by doing so, Mr. BAUER caused these smaller arteries to be exposed, and, along with them, small valvular vessels quite empty; the valves were very numerous, and nearly at equal distances. In tracing these towards the cavity, they became indistinct just as they entered the villi. These appearances are shown in Pl. III. fig. 2, 3, 4. This representation of the valves in these vessels, as well as that of the valves of the vessels in the brain, may be considered as demonstrations of the fact; and still more valuable than preparations, since the appearance can be better preserved.

To show the course of the absorbed fluids, as well as to give a clear idea of every thing connected with so *important* a discovery, a drawing of the spleen, the vas breve, and cardiac portion of the stomach, is annexed [Pl. IV;] and as the trunk of the splenic vein forms one of the trunks of the vena portæ, the liquids are directly carried to the liver, forming a part of the materials employed in producing the bile; *the remainder* only returning by the vena cava to the heart.

This additional quantity of liquids passing along the splenic vein, accounts for its being five times the size of the artery, as well as for the blood in that vein having a greater proportion of serum than the blood in any other, which has been long asserted, and which I found by actual experiment to be the case; but being unable to account for it, as I can now, I was willing to admit that the mode of measuring might be erroneous.

On the structure and uses of the spleen.

In the different investigations that have been made of this organ, the following facts have been ascertained; but *still* neither the more minute texture, nor the ultimate use has been, till now, discovered.

It was known that a man could live without his spleen; but there is no satisfactory account upon record of the inconvenience he suffered from its loss.

It has been ascertained that the spleen, under different circumstances, is larger or smaller in size. In an ass after fasting two days, it was half the size that it was met with in another, killed two hours after drinking freely. In the diminished state there are no corpuscules; in the enlarged state they are very numerous.

The spleen was believed to consist of a net-work of ligamentous structure, with numerous arterial and venal branches, having cells containing small corpuscules or glands; but this appearance vanishes when the parts are more minutely examined. Its structure was made out in the following manner.

Wednesday, August 23, 1820, at 12 o'clock, a healthy large spleen, taken from a man twenty-eight years of age, was cut into eight transverse slices, nearly of the same thickness; four of these were put into one flat dish, and four into another; both of these were filled with distilled water; no colouring matter was given out, although the surfaces had all a red colour; the cells were unusually distinct, and had a degree of uniformity in their appearance. On examining the cells under water with a common lens, they appeared full; on turning them over in the water, something colourless fell out, carrying no colouring matter along with it. The same thing happened on turning up the opposite side. This appearance is represented in Pl. VI. fig. 1. and 2.

Aug. 24th, 12 o'clock. Some colouring matter was discharged round each slice, forming a circle round it, but not in contact with the edge. It had the appearance of red serum, but not that of the globules parting with their colour; the surface lost its red colour, becoming darker. The cells were examined by a lens, when those on the upper surface appeared hollow and empty, but those on the under surface appeared full of a mucus soaked in water, and a film was spread over the surface of several of them. The water was changed every day.

25th, at 12 o'clock, both the upper and under surfaces were obscured by flocculent mucus over the cells, which were equally distinct; the red colour was discharged in greater quantity.

26th. Both surfaces had the mucus filling the cells, of a paler red colour than the surrounding substance, looking exactly like plum-pudding stone. The cells were tumid, rising above the surface.

27th. No material change.

28th. The surface of the cells had become flat, the discharge of colouring matter considerable.

29th. The cells still flatter, and a light coloured point in the centre of each.

30th. No change, the colouring matter still discharging.

31st. The surface so slimy that the slices were very slippery ; no other change, except a number of round deep black spots : in some places they appeared as if filling the orifices of divided arteries ; in others, as if the surface of one or two cells was blackened

September 1st. The black spots more numerous ; on the surface of the water much colouring matter, but no mucus separated.

2nd. A greater extent of black surface ; more mucus.

4th. The colouring matter nearly gone ; more black along the surface ; mucus on both surfaces ; their cells more distinct.

5th. Black colour more extended ; little mucus or colouring matter.

6th. The slice become very putrid ; cells as distinct as at first ; more extension of black ; no colouring matter ; little mucus.

8th. Upper surface all black ; no appearance of cells, although seen on the under surface. The black colour was produced by the colouring matter becoming putrid.

12th. The whole substance one mass of branches of vessels ; every thing else dissolved.

August 29th. in the same year. The spleen of a woman (who had taken little food for some time,) hardly more than one third the size of the other, contained no cells, and consequently no corpuscules; was treated in the same manner, and the changes it underwent were the same.

These different appearances are represented in Plates VI. VII. VIII. each having a separate explanation.

The spleen, from this account, consists of blood vessels, between which there is no cellular membrane, and the interstices are filled with serum, and the colouring matter of the blood from the lateral orifices in the veins, when these vessels are in a distended state; which serum is afterwards removed by the numberless absorbents belonging to the organ, and carried into the thoracic duct by a very large absorbent trunk.

That all the apparent fibres are vascular, is proved by the representation in Pl. III. fig. 1, in which they are minutely injected; and the injection is carried into the cells, and moulded into their form. The lymph globules carry along with them into the interstices carbonic acid gas, and the mucus soluble in water, in great abundance; but no blood globules, since none are found in the cells. As soon as the lymph is at rest, the carbonic acid gas being let loose, forms the cells that surround the lymph globules, the sides of which are held together by the mucus, putting on the appearance of corpuscules without colour, and are thus mistaken for glands; the gas is absorbed by the blood in the arteries and veins.

The spleen, from this mechanism, appears to be a reservoir for the superabundant serum, lymph globules, soluble mucus, and colouring matter, carried into the circulation immediately after the process of digestion is completed.

EXPLANATION OF THE PLATES.

PLATE II.

IN this Plate several small parts of glass micrometers are represented, in which the inch is divided into 400 parts in diameter, which divides the superficies into 160,000 parts; so that every object is magnified 400 times in diameter, and 160,000 in superficies.

Fig. 1. In the first square at A, are represented the globules of the cerebrum that are predominant. These, it is evident, are $\frac{1}{3200}$ part of a lineal inch. The rest of the micrometers of fig. 1. contain many loose globules of various sizes, and fragments of bundles and simple globular fibres of the medullary substance of the cerebrum in a fresh state, immersed in water.

Fig. 2. represents the same objects in a dried state, when the accumulated mucus, and some newly produced globules, become visible.

Fig. 3. represents a very small portion of the medullary substance of the cerebrum diluted with water; also displaying fragments of single globular fibres, many loose globules, and a portion of the venal branches with valves.

Fig. 4. represents a small portion of the retina of the human eye diluted with water, consisting of loose globules and globular fibres of the same size as those of the brain in its various

parts ; also a branch of an artery whose anastomoses compose a beautiful net-work almost over the whole membrane of the retina.

This representation of an arterial branch, may serve as an illustration of those that pervade every part of the substance of the human brain ; but such branches do not any where anastomose except in the retina.

Plate III.

This Plate consists of six figures. The first representing a portion of the spleen. The second, third, and fourth, the vessels with valves passing from the internal membranes of the stomach. The fifth and sixth, the blood globules and salts in the blood of the skate.

Fig. 1. A surface of $\frac{2}{16}$ parts of a square inch of a slice of the spleen of a child five years old, minutely injected for the arteries ; magnified 8 diameters. It shows the termination of the arteries in the empty cells, which are also filled with the injection, in the same manner as the corpuscules themselves are originally formed.

Fig. 2. A small slice of the coats of the cardiac portion of the human stomach, magnified 8 diameters, from a man 48 years old. The blood vessels were minutely injected soon after death, the arteries with red, the veins with yellow ; the cellular membrane, or rather the filamentous substance between the villous and muscular coat, is in this figure stretched out to more than three times its natural thickness, and it is in this space that the empty valvular vessels are distinctly shown.

Fig. 3. and 4. Portions of the small valvular vessels, showing that they vary in appearance ; magnified 400 diameters.

Fig. 5. Some globules of the blood of the skate floating in the coloured serum. The blood was taken from the heart of a fish quite alive at the time the heart was opened. In these globules the enveloping substance is quite smooth, and the globules are perfectly in the shape of eggs; and the contained spherical globules are not visible.

B. A group of seven globules floating in the serum, diluted in water, upon a piece of glass; the globules are attracted and adhere closely to each other, and become flat; the inner spherical globule is distinctly seen, the enveloping matter forming an elevated rim round it.

C. represents the same group, after having been 20 minutes in the diluted serum; the enveloping substance is dissolved; and after all the moisture is evaporated, the spherical globules appear still closer drawn together, and quite clear and distinct, and the enveloping substance almost entirely gone, leaving only some greasy marks on the glass; magnified 400 diameters.

Fig. 6. A group of crystals of salts formed on the surface of the decomposed blood of the skate, when the blood begins to putrify; magnified 200 diameters.

PLATE IV.

The human stomach and spleen in their relative situation, of the natural size, from a young man of 15 years of age.

A. shows the vas breve where it joins the splenic vein. When the branches are traced to the stomach, some dip in between its coats, the others run on the surface, anastomosing with the branches of the other trunks belonging to that viscus.

Plate V.

The human spleen of the natural size, from a man 48 years of age. The arteries and veins are injected with the same colour, showing that they run in pairs, enclosed in a common theca.

Plate VI.

Represents two sections of the spleen, one prior to maceration, the second after being in distilled water three days.

Fig. 1. A transverse section of the same spleen, as represented in Pl. V. of the natural size. Upon immersing it in distilled water, the cells emptied themselves of lymph globules; and upon turning it over, the same thing happened to the opposite side.

Fig. 2. A surface of $\frac{2}{16}$ parts of a square inch of Fig. 1. showing distinctly the cells; and also a small portion of a vein laid open, exposing the perforations met with near the sinus in the concave part of the spleen; magnified 8 diameters.

Fig. 3. A transverse slice of the spleen of a boy 15 years of age. This portion had been kept in distilled water, in an open dish, for three days, when the mucus, which with the globules forms the lining of the cells of the spleen, was so much swoln, that not only all the cells were filled with it, but the mucus was raised above the surface, giving it an uneven appearance. The parts are of the natural size.

Fig. 4. A surface of $\frac{2}{16}$ parts of a square inch of the above slice, magnified 8 diameters.

Plate VII.

Two sections of the spleen in different stages of maceration.

Fig. 1. A transverse section of the same spleen, as represented in Pl. VI. fig. 1. After remaining 12 days in distilled water in an open dish the mucus is nearly dissolved, and the black spots

(which are produced by the colouring matter becoming putrid) are rapidly extending; the cells are nearly empty. Natural size.

Fig. 2. A surface $\frac{2}{16}$ parts of a square inch of the above slice, magnified 8 diameters.

Fig. 3. A transverse slice of the same spleen soaked in distilled water 20 days, when the mucus was almost wholly dissolved, and all the colouring matter discharged; but this slice having been kept in a deep glass quite full of distilled water, and closed with a glass stopple, no atmospheric air could penetrate; the mucus and colouring matter were washed out before putrefaction could take place; the remaining globular substance then was so loose, that by the least motion of the section of the spleen the margins of the cells crumbled and fell to pieces. Of the natural size.

Fig 4. A surface of $\frac{2}{16}$ parts of a square inch of the above slice, magnified 8 diameters; showing more distinctly the crumbling of the sides of the cells.

PLATE VIII

Represents a section of the spleen completely macerated.

Fig. 1. A transverse slice of the spleen of a boy ten years of age; the spleen being kept in water 48 days, the mucus and the colouring matter were entirely dissolved and discharged; and fresh water being pumped every second day upon it, the globular substance was gradually completely washed out, and the arteries, to their most minute branches, became perfectly clear and distinct, no other parts being left.

Fig. 2. A surface of $\frac{4}{16}$ parts of a square inch of the above figure, magnified 8 diameters.

Fig. 1.

A

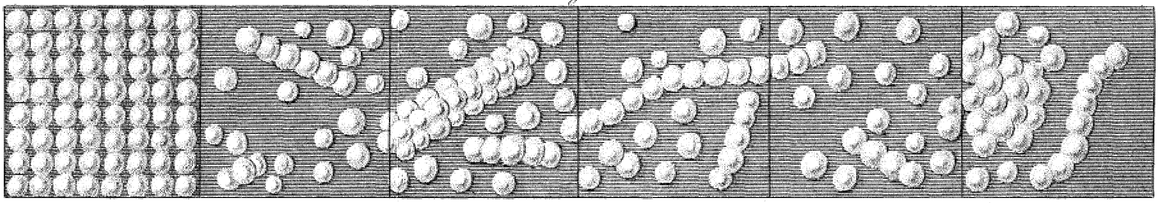


Fig. 3.

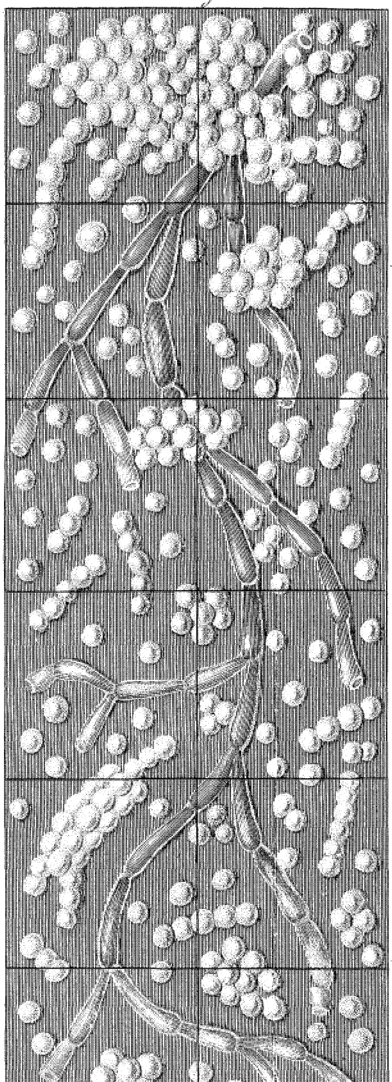
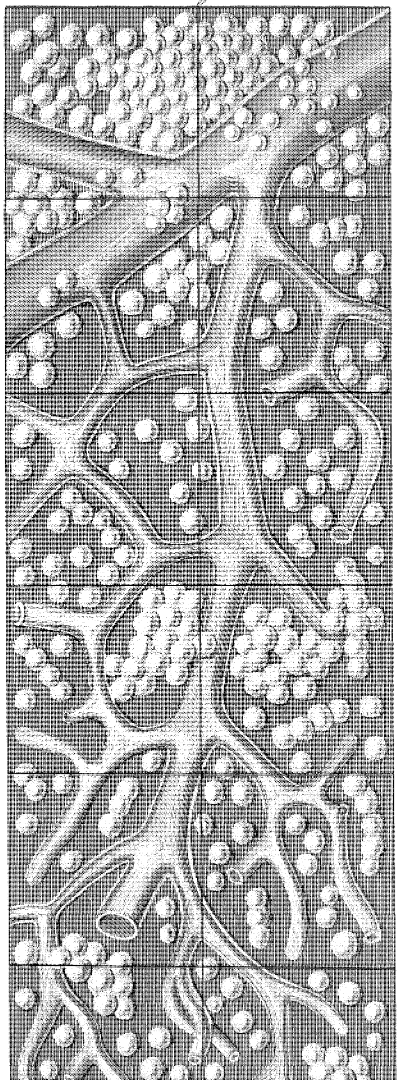


Fig. 4.



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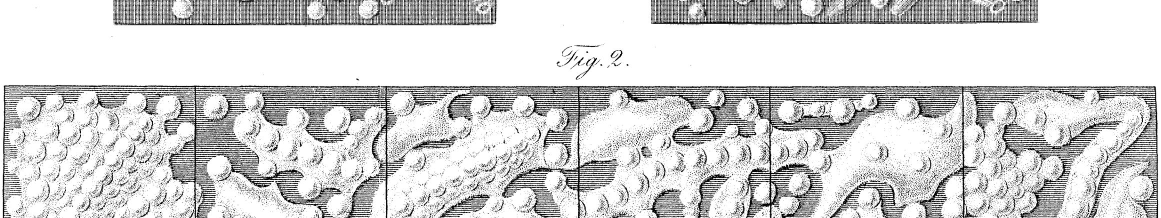

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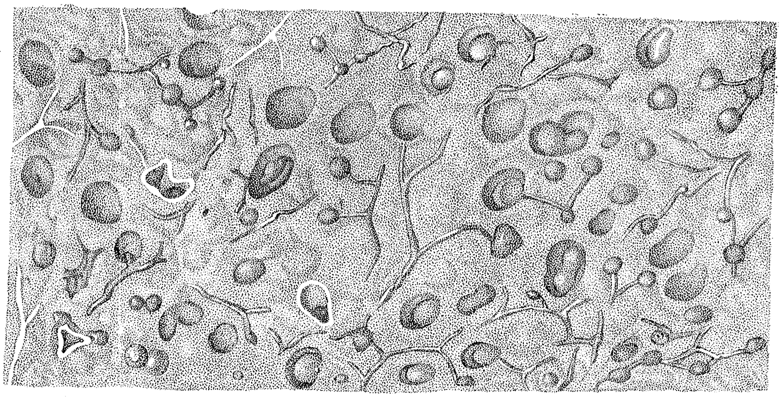
Fig. 1.



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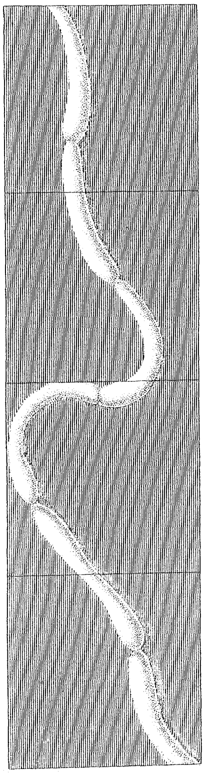

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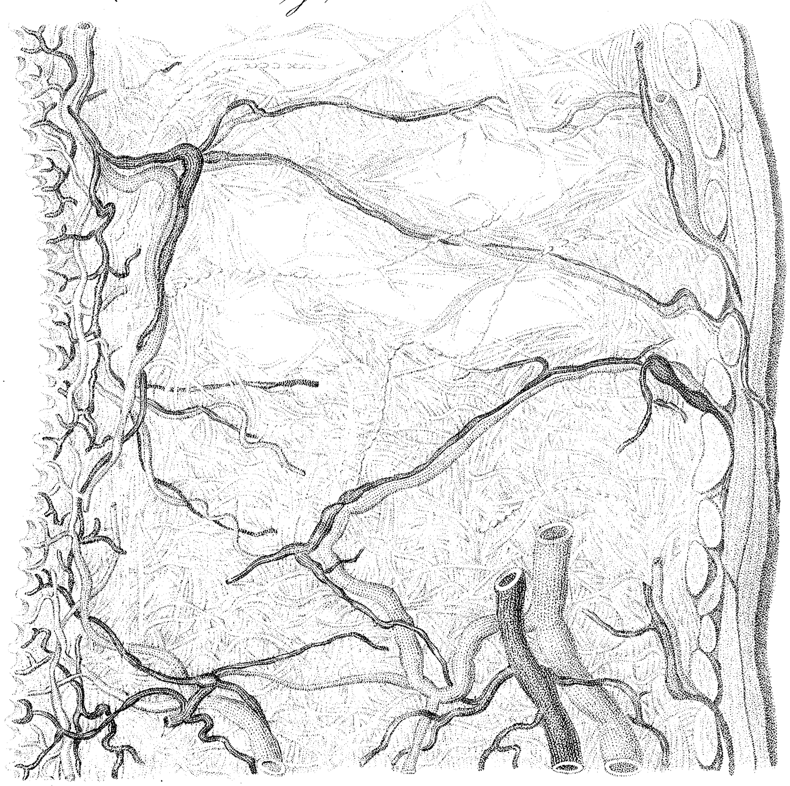

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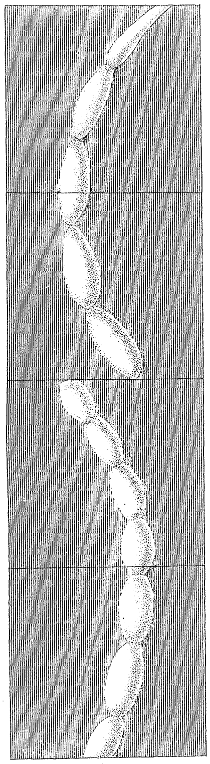

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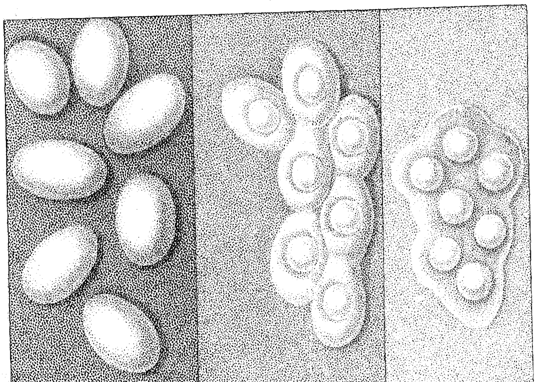

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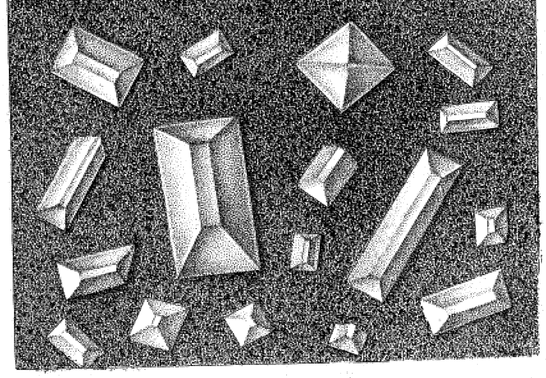

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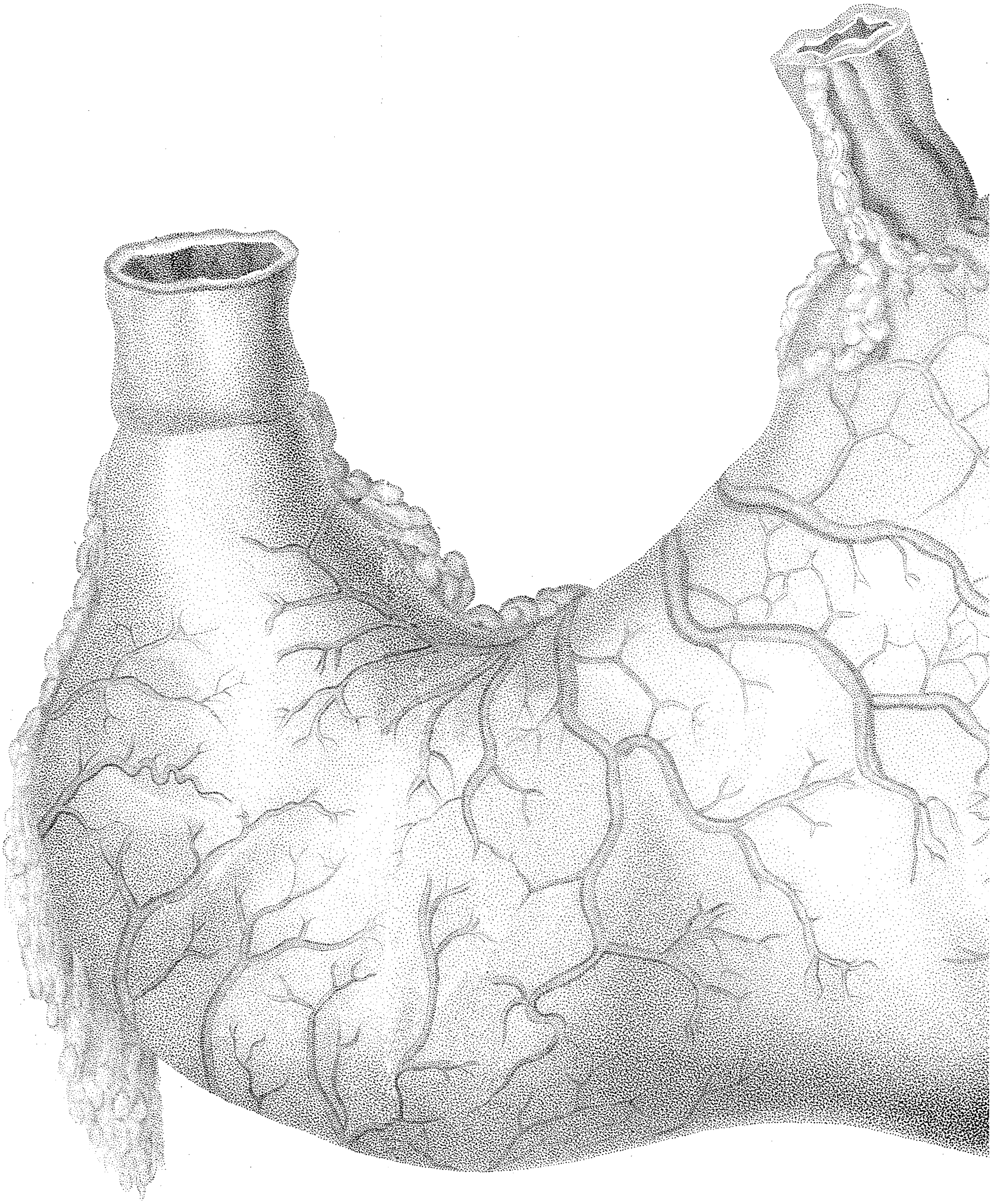

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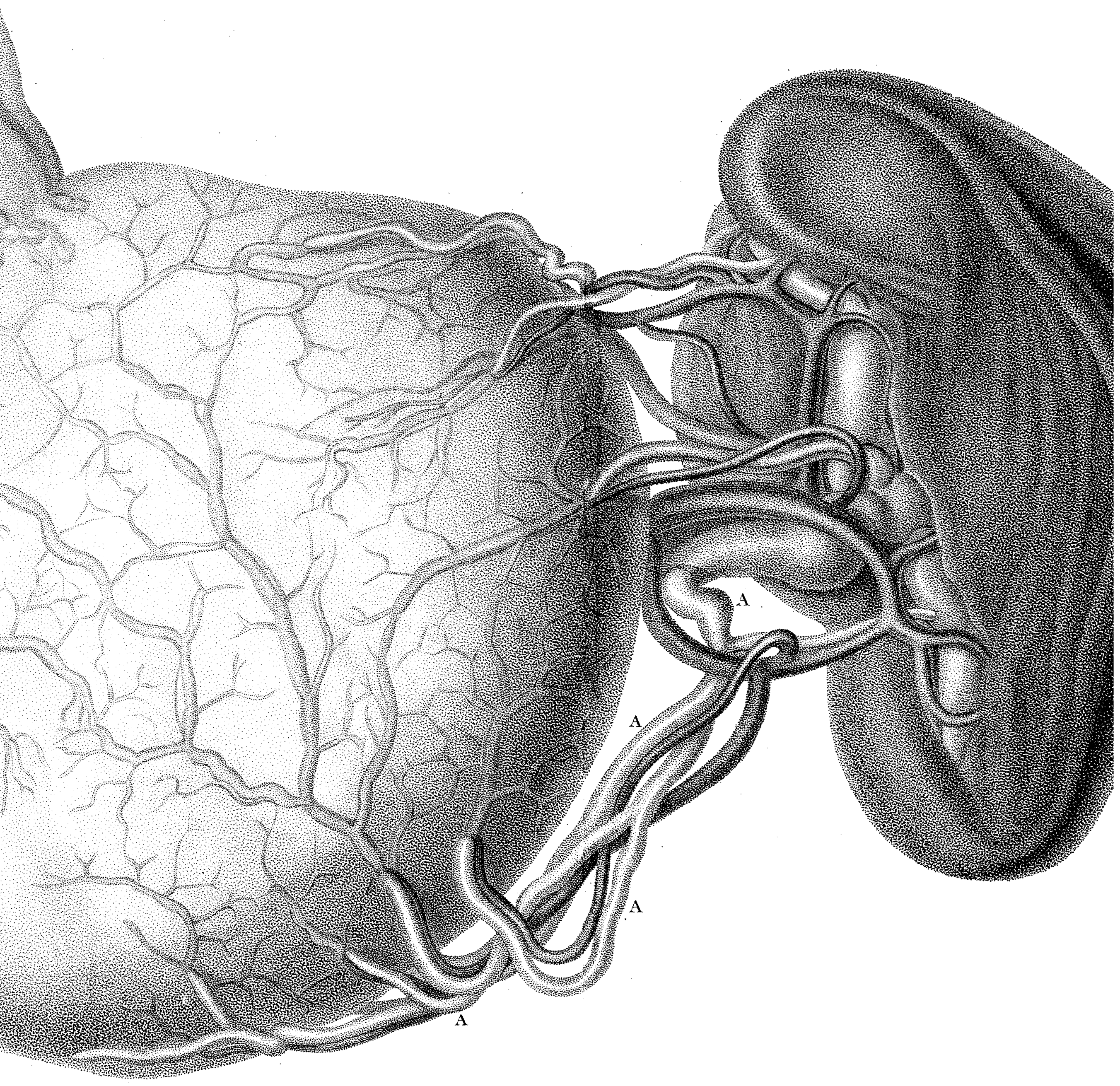
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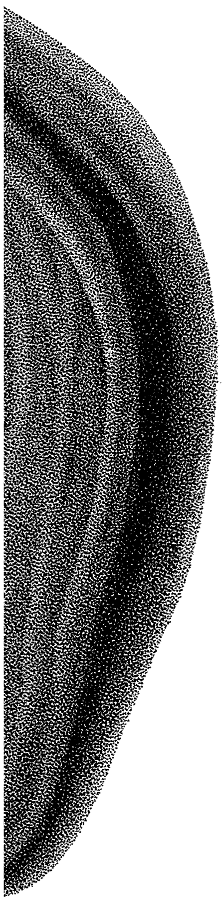

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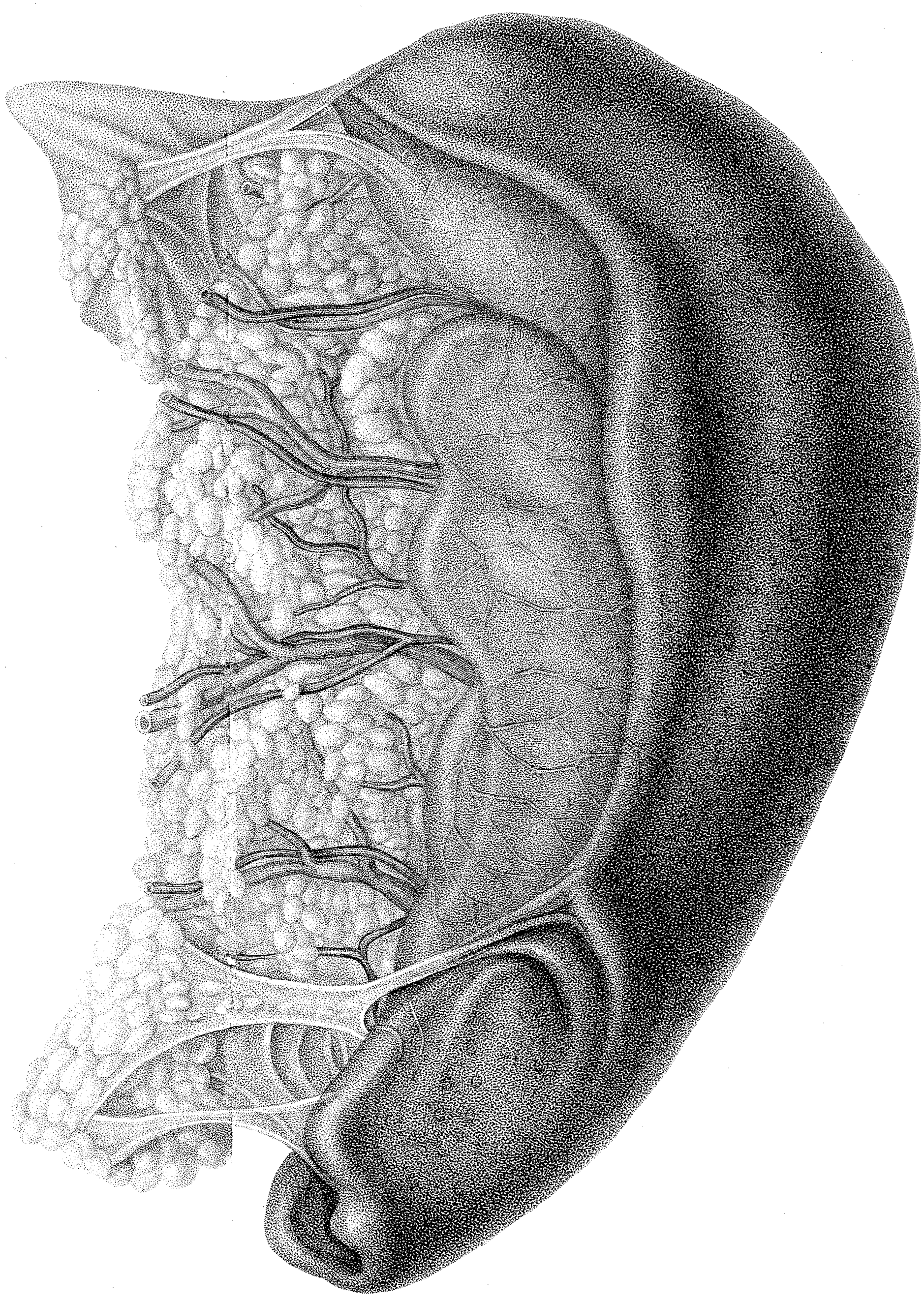

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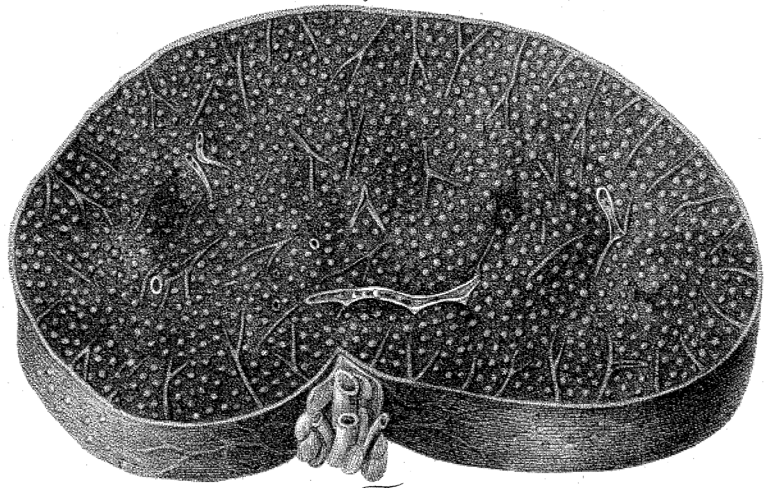
Fig. 1.



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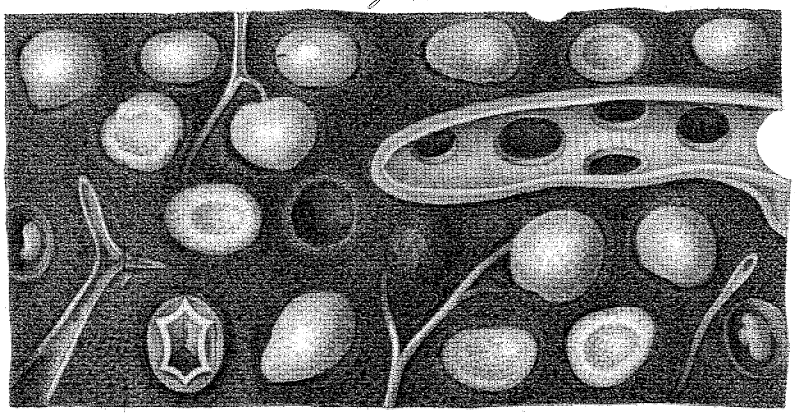
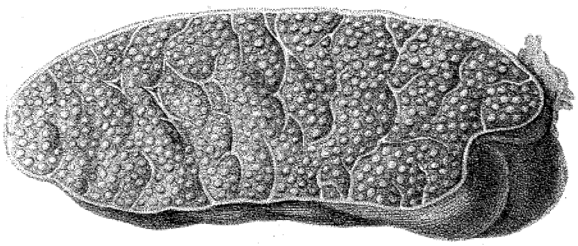


Fig. 3



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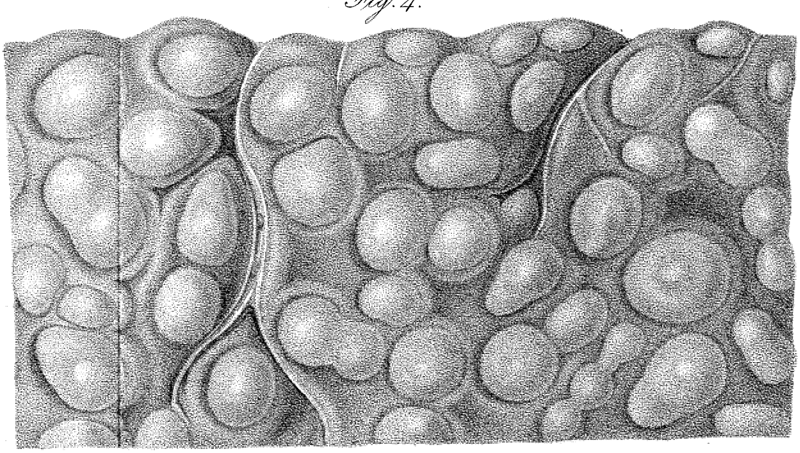

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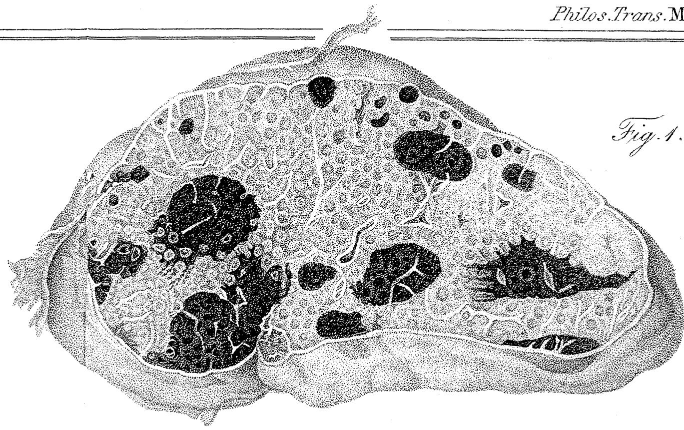

Fig. 1.

Fig. 2.

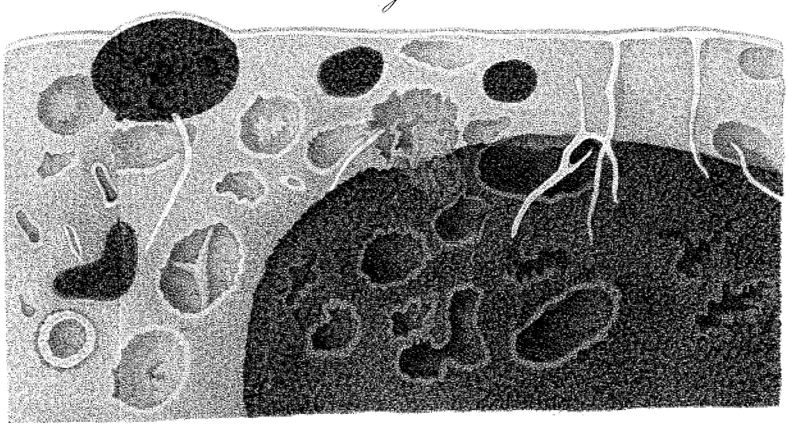

Fig. 3

Fig. 4.

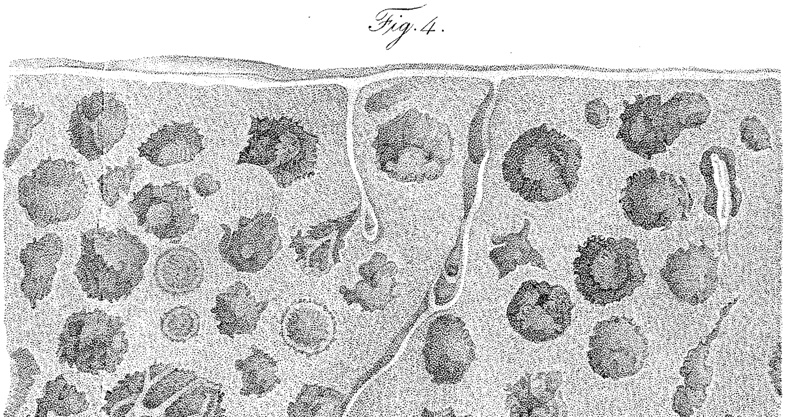

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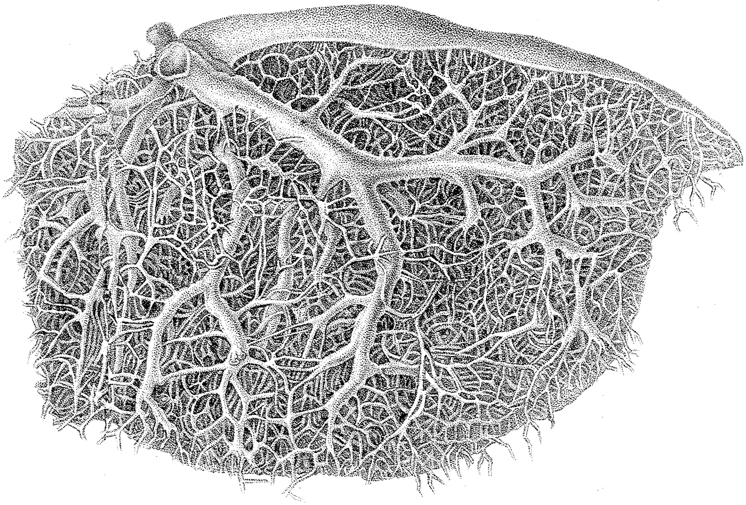
Fig. 1.



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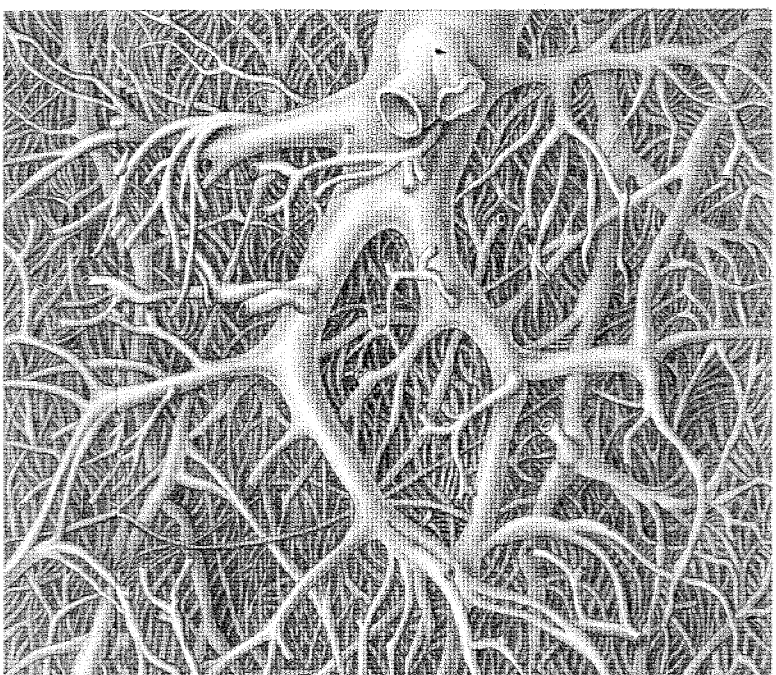

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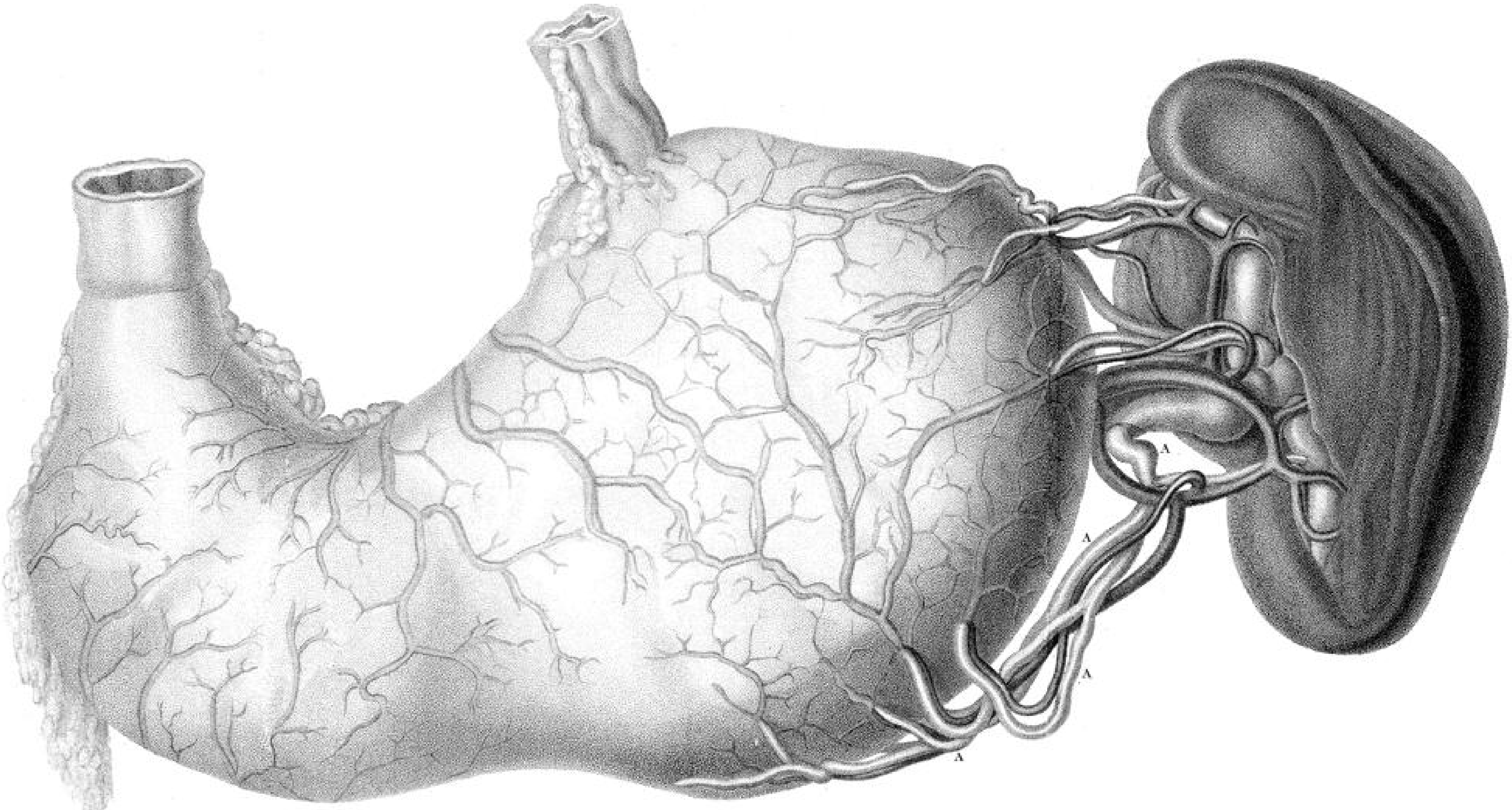

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