THE STUDY OF THE DISTRIBUTION OF ARTERIES IN THE GASTRIC WALLS BY MEANS OF THE PLASTIC MEDIUM INJECTING METHOD

by

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FOREWORD

Secrecy has long been unveiled by anatomical researches over the distribution and structure of blood vessels in the stomach wall. With regard to the stomach of the human body, there are detailed reports on the systematic, relative anatomical researches by such scholars as Mall, Disse, Djorup, Usadel, Balow, Tame, Chou, Matsumoto, etc., which are preceded by the studies of Frey (1890). However, these researches are nothing but observations from the horizontal vista.

Regarding the structure of the mural vessels, especially of the submucous and mucous arteries of the stomachs of the rabbit, cat, dog which are most utilized in stomach ulcer and physiological experiments, and the human being, the author carried out minute observations from the vertical angle by using plastic stuff "Methylmetacrylate", succeeding in taking a good look at structural differences in every section that are considered to be one of the causes of stomach ulcer parallel with the comparison by the species of the distribution of blood vessels in the gastric wall.

CHAFTER 1 METHOD OF RESEARCH

According to the Method No. 1 of the Kyoto University Tuberculosis Laboratory (initiated by Nagasawa and Yamashita) that characterizes "instantenuous preparation", "immediate injection", "quick polymerization" and the like, I injected plastic substance into the gastric mural vessels, thereby making out a stomach cast, over which I conducted multi-angle observations. The major components of the injected liquid are Monomer $(CH_2\text{-}C\text{-}COOCH_3)$ & Polymer $(CH_2\text{-}C\text{-}COOCH_3)^n$
CH_3 CH_3
of Methylmetacrylate, compounded with Benzoyl peroxide, Dimethyl aniline and Dimethyl thanolamine as polymerization accelerator, and Dibutyl phthalate as plastic agent. The ratio of preparation for Polymer and Monomer: 1.0 : 4.0 or 1.0 : 5.0 at room temperature (around 15 degrees C) Polymer: more than 300 mesh used. In the summer time (around 25 degrees C), polymerization process tends to be in excess while in operation, so that there is need for Monomer and Polymer to be kept cool down to around 5 degrees C in ice water ahead of mixup. On the contrary, in the winter season (below 5 degrees C), the amount of Benzol peroxide needs to be augumented to 5% with the ratio of concoction for Polymer and Monomer being

set at 1 : 3. For plastic stuff coloration the use of lacquer pigment which is soluble in resin was adopted.

Making of Plastic Cast and Observation Method

1. *Douche and Rinsing*

In animal experiments, cut off the thigh artery, thus causing death by venipuncture. Then slit open the abdomen along the medial line, seeking for the abdominal artery without exstirpation of the stomach, and then inserting cannulas into both the artery and the portal vein. Next douche and rinse by means of water injection under a pressure of approximately 80 to 100 mm of mercury. It is observed that vascular tension takes 30 minutes to 2 hours to pass out of sight, though varying by the stomachs of the human and animals respectively.

2. *Injection of Plastic Medium*

3. *Polymerization of Plastic Medium*

The author, allowing for the time that is necessary for completion of polymerization, immersed the specimens in tepid water up to 25 degrees C, making them stiffened. In the winter time, polymerization procedure is difficult, because it is apt to be delayed keeping near-original form. So there is need to put specimens in the warmer at around 20 degrees C for 48 hours.

4. *Corrosion of Tissues*

Effect corrosion of peripheral tissues by immersing specimens in 30% to 40% caustic soda solution.

5. *Water rinsing*

After completion of corrosion procedure on peripheral tissues, keep rinsing by water carefully for around 3 days, thus enabling security of the leftover cast of every vascular structure injected through with plastic medium. (Fig. 1, 2, 3, 4)

6. *Making of Microscopic Plastic Specimens*

Fix specimens in 10% formalin immediately after completing injection of plastic substance. After fixing procedure, remove a muscular layer from the submucosa, cutting off at chosen places the mucosa and submucosa 2 to 3 cm wide and 2.5 cm long. (Planefigure specimens)

Cut vertically the mucosa inclusive of the submucosa 1 to 2 mm thick. (Vertical section specimens)

Soak these specimens in a Petri dish full of 30 to 40% caustic soda solution, leaving them in the hatcher at 20 to 30 degrees C for around 72 hours. Thus unnecessary peripheral tissues are rotten. Next immerse the specimens in tepid water with care, waiting for them clear of peripheral corrosion tissues, but of plastic vascular system only to surface, then seal them tightly in Glycerin. (Fig. (7, 8, 17, 48 and others)

7. *Materials for Study*

I made the object of study the specimens of normal stomachs 2 to 6 hours postmortem that were obtained at necropsy from unusual corpses (adults 11 samples, 4-month-old babies 2: total 13), rabbits 70, cats 38 and dogs 21. As for animal stomachs, I described here the posture of these animals' when they stand on their

hind legs, simulating the stomach of the human.

CHAPTER 2 RESULTS AND COMMENT

Regarding the stomachs of the human, dog, cat and rabbit, the mural artery is composed mainly of the three branches of the abdominal artery—the sinister gastric artery, splenic artery and common hepatic artery, the splenic artery giving off the sinister gastroepiploic artery and brachygastric artery, and the common hepatic artery sending out the dexter gastroepiploic artery through the dexter gastric artery and gastroduodenal artery. Thus they irrigate every section of the stomach wall. This is a well known fact.

The branches of these four trunk arteries (gastric and gastroepiploic arteries, sinister & dexter each) give off a filamentary subserous artery in the subserosa and also muscular artery in the muscular coat. Besides, they mostly reach the submucosa, forming a network throughout the entire gastric wall. (Fig. 1, 2, 3, 4) The submucous artery not merely constitutes a plane distributory system, but also pierces through the mucosa, distributing numerous tiny arterial twigs with the divergence of encircling branches in the muscular coat, thus laying a groundwork for gastric mural circulation.

SECTION 1 RABBIT STOMACH

1. *The Plexus of Arteries in the Submucosa*

The submucous artery from the sinister gastric artery, centering around the cardiac area, radiates towards the semicircle of the major curvature extending from the fundus ventriculi to the front pyloric valve, forking in 2 to 3 twigs at the extreme end. These twigs anastomose with both the terminal branches of the submucous artery of the sinister gastroepiploic artery and the extremity branches of the submucous artery of the brachygastric artery that irrigate the most part of the fundus ventriculi. (Fig. 1, 5) In the meantime, the collaterals that are given off, sub-branch off and co-anastomose into a delicate, munite plexus of arteries in the submucosa. (Fig. 7, 8) In the minor curvature, they, as shown in Fig. 9, pierce through the muscular coat, radiate asteroidally into lesser ones in the submucosa which anastomose with each other. The submucous artery of the sinister gastroepiploic artery, though varying by the degree of its growth, only intermediates in the partial anastomosis of the sinister gastric artery's peripheral ends in the front and posterior walls. However, in the major curvature, the sinister gastric artery's ramifications in the walls anastomose directly with each other.

Pyloric Region

The submucous arterial trunk of the sinister gastric artery that runs over the front pyloric valve, changes its course at the central line, heading for the fundus ventriculi. As shown in Fig. 1, 6 each twig of the submucous artery in the pyloric region, with its apex at the pyloric entrance, makes its concentric distribution towards the center of a triangular aspect that makes its base the extention of the front pyloric valve, forming a plexus. It is noted here, however, that the division between the digestive section and the excretory section in distributing vasa

is apparent. There is no difference on their status in the front and posterior walls.

2. *Mucous Branches*

The mucous branches that concentrate upon the center of a network organized by the plexus of arteries in the submucosa, make a short run towards the centrum right under the muscular mucosa. With their calibre gradually tapering off, they were split into the following two major classification: 1. A-class branches shifting over into arterial capillaries. (Fig. 13, 14, 16) 2. B-class branches comparatively thicker than the former in calibre, sending out 5 to 6 collaterals while running a long distance, each of which shows the same ramification as the A-class branches (Fig. 13, 14, 15). Some of the B-class branches of larger calibre anastomose at the extreme end with the agnate mucous spray on the opposite side in the submucosa.

The tendency of this two major classification can be recognized in the stomachs of the human and dog save the cat's. The branches in the pyloric area from the sinister gastric artery, pierce through a thick muscular coat almost perpendicularly, radiating asteroidally into ramification. However, the close anastomosis of the submucosa that is observed in the corpus et fundus ventriculi is not formed. In the course of ramification from the submucous arterial trunk, branches of comparatively larger calibre carry out anastomosis, and the majority of mucous branches are distributed in the order of the subserous artery, submucous artery, mucous branches and arterial capillaries without intermediation in between of plexus. (Fig. 10, 11, 12) It is thought that the mucous branches in the pyloric area and arterial capillaries are directly influenced by the blood stream pressure of the subserous artery and consequently the abdominal artery.

3. *Capillaries* (Specially Re Long Perpendicular Arterial Capillaries)

The arterial capillaries in the gastric mucosa, running towards the gastric epithelium vertically along the long stem of a gastric gland tube, anastomose with each other and constitute a long meshed network of capillaries that surround gastric glands. In the corpus et fundus ventriculi that are fraught with distributed gastric glands, the arterial capillaries, as they go upward in the corpus glandula gastricae, get more undulated, and united by 2 to 3 ones into rather thicker capillaries. (Fig. 19, 18) Besides this, as shown in Fig. 17, 18, it is observed that a long vertical tube that branches off from the primordial section where mucous spray sub-branches off, pierces through the muscular mucosa, and then without anastomosis, shifts over directly into venous capillaries. This one is not seen in the front pyloric and pyloric mucous membrane. It is considered that it might function as a blood stream adjusting valve to gastric glands during the secretory period and its suspension. The distribution and anastomosis of arterial capillaries in the pyloric region take place comparatively plainly. (Fig. 20, 21)

SECTION 2 CAT STOMACH

1. *The Plexus of Arteries in the Submucosa*

Different from the rabbit stomach, in order to supply sufficient blood to the corpus et fundus ventriculi which are abundant in gastric glands, the subserous

arterial trunk pierces obliquely or perpendicularly through the muscular coat, without giving off collaterals while on the run. It then arrives at an area where every artery is supposed to irrigate, radiate its branches, anastomoses with each other, and forms an elaborate plexus. Accordingly the minor curvature, especially its gastric street, as compared with the major curvature, is apt more readily to receive the strong abdominal artery's pressure.

The calibre of every arterial tube is widest when piercing through the muscular coat, and is getting narrower as it is ramified gradually with the narrowest at an anastomosing area. However, as seen in the corpus et fundus ventriculi, their artery consistently keeps its integrity all in one piece, diverging its branches at the terminus. At the branches which anastomose with the arterial branches on the other system, their calibre is far wider than the anastomosis branches between collaterals. The sinister and dexter gastroepiploic arteries, different from those of the rabbit, are remarkably developed, the gastric arterial branches, sinister and dexter, anastomosing with them. (Fig. 2, 22, 24, 25)

Pyloric Region

The twigs that are given off parallel respectively from the dexter gastric artery and the dexter gastroepiploic artery, after piercing through a thick muscular coat, branch off in ramification spray-like, anastomosing almost at the center between the major and minor curvatures. However, the anastomosis of the agnate arterial branches in close juxtaposition, as compared to the other section takes place less often, and the plexus is formed delicately. (Fig. 2, 23, 26)

2. *Mucous Branches*

The mucous branches that are given off from every part of the plexus of arteries in the submucosa, making for the center of a network, pierce perpendicularly or spirally through the muscular mucosa. They, right above the mucosa, sub-branch off at the right angle with the stem, anastomose with the adjacent agnate branches or with each other, and form again a plane elaborate vessel plexus. (Fig. 27, 28, 29)

In the corpus et fundus ventriculi, the density is high. As the vessel tube moves towards the front pyloric and pyloric areas, its calibre is gradually tapering off, and the density diminishing. (Fig. 29) This is the most significant view of mine on the cat stomach.

3. *Capillaries*

The arterial capillaries that are given off towards the center of the network formed by the plexus of arteries in the mucosa, partly proceed slantingly towards the upper aspect of the mucosa along the fundus of the gastric glands—mostly forking into two branches-simultaneously so often anastomose with those on the other side. And then they, organizing along the gastric glands quasi-rectangular or oval meshes, skyrocket upward embracing the glands, and shifting over, through unification process by 2 to 3 ones, into venous capillaries. For the other part, the anastomosis with arterial capillaries on the other side is not recognized. (Fig. 30, 31, 32)

At the pyloric region, every collateral pushes up, forming rectangular meshes

along the gastric glands. As different from the arterial capillaries in the pyloric region of the dog stomach which I mention later, the calibre of the vessel tube is widest in the divergent section of the plexus of arteries in the mucosa and is equally getting narrower. In fact, this is similar to the pyloric area of the human stomach. (Fig. 33, 34)

SECTION 3 DOG STOMACH

1. *The Plexus of Arteries in the Submucosa*

The distribution of arteries in the dog stomach is most like that of the human stomach. That is, the arterial branches that are given off into the gastric front and posterior walls from the sinister gastric artery, run a direct course towards an area where every branch irrigates, piercing through the submucosa. After that, they are ramified spraywise or asteroidally, anastomose with each other or, with the terminals of branches on the different system, and constitute an elaborate plexus of arteries in the submucosa. (Fig. 36, 37)

The sinister, dexter gastroepiploic arteries and brachygastric artery give off at every point short-run branches, at the major curvature and fundus ventriculi, forming a plexus of arteries in the submucosa with the anastomosis taking place by the big calibre with the arteries in the submucosa of the sinister and dexter gastric arteries. (Fig. 3) As seen in Fig. 35, the abdominal artery's pressure on the sinister gastric artery at the corpus et fundus ventriculi, is subject to anastomosis and distribution as if it were always absorbed by the branches from the anastomosing tube of the sinister and dexter gastroepiploic arteries. However, the artery in the neighborhood of the minor curvature tends to suffer the abdominal artery's pressure directly. This type of distribution is observed in the cat stomach, but is far prominent.

The plexus of arteries in the submucosa at the pyloric region, is formed by every arterial trunk in the submucosa from the major and minor curvatures anastomosing at its center. Compared with the other section, the plexus is less complex, the calibre being narrow. (Fig. 38, 43, 44)

2. *Mucous Branches*

The mucous branches that are given off towards the center of a network organized by the plexus of arteries in the submucosa, branching off 3 to 4 collaterals, meander along or shoot upright towards the mucosa, piercing through the muscular mucosa. At the corpus et fundus ventriculi, some of the larger calibre among these branches, carry out anastomosis with the ramifications from the opposite of the meshes. However, different from the cat stomach, the anastomosis takes place all in the submucosa. (Fig. 39, 40, 41, 42)

At the pyloric region, it is hardly observed that the mucous branches of comparatively larger calibre that runs a long distance, anastomose with each other. Accordingly, one of the mucous branches governs a wide and circular mucous area, all shifting over into arterial capillaries. (Fig. 43, 44)

3. *Capillaries*

The arterial capillaries shoot up in cypress-like formation and reveal no

capillary anastomosis among the smallest arteries, branches at the extreme end. (Fig. 45, 46, 47) This agrees with the last and arterial branches that were brought to the fore by Dr. Disse.

The same is true of the pylóric region. Among the smallest arterial branches piercing through the muscular mucosa, 2 to 3 branches are relatively narrow in calibre, ramified in one or two pieces and without sub-branching off, immediately shift over into venous capillaries just like the long vertical artery that is observed in the rabbit. (Fig. 48, 49, 50)

Different from those of the corpus et fundus ventriculi, the distribution of a plexus under the dexter gastric artery is delicate, coarse, and the mutual anastomosis of mucous branches is rare, so that it is presumed that the abdominal artery's pressure is brought to bear directly. The question is, however, that this pressure might be adjusted by this particular vas. At the pyloric region of the human stomach bearing a most resembrance, such vas is not recognizable.

SECTION 4 HUMAN STOMACH

1. *The Submucous Artery*

The animal's stomachs as a whole indicate the same distribution, and the vascular distribution in the dog's stomach, as afore-said, is most similar to that of the human stomach.

The arterial branches in the submucosa of the sinister gastric artery are gradually ramified and radiated, anastomosing with the branches of the brachygastric artery and sinister gastroepiploic artery. (Fig. 4)

As a sufficient blood stream is supplied from the both arteries, a vas is formed running. In the meantime, it is presumed that the pressure of the sinister gastric artery directly connected with the abdominal artery might be absorbed by a dozen branches of the sinister gastroepiploic artery. (Fig. 51) Besides the plexus of arteries of larger calibre in the submucosa, the collaterals given off from every arterial trunk in the submucosa, on the both sides, right and left, and from the same place, along the rugae of the gastric mucosa anastomose with the adjacent collaterals of the same type (Fig. 52) thus forming an elaborate vessels' plexus. At the minor curvature, the twigs from the sinister and dexter gastric arterial circle, on reaching the stomach wall, pierce vertically or screwwise through the muscular layer respectively. They then radiate into ramification along the rugae of the mucosa, anastomosing with the adjoining ones. As compared with those of the corpus et fundus ventriculi, however, they are far narrower in calibre. (Fig. 53)

At the pyloric region, the branches from the anastomosing circle of the dexter gastric artery and dexter gastroepiploic artery, appear in the submucosa, gradually being given off in spray, anastomosing by the small calibre with the terminals on the other side of the submucous artery. Furthermore, at the pyloric region, every arterial trunk in the subserosa pierces tortuously or rather spirally through a thick muscular coat, gradually radiating into divergence and carrying out anastomosis with those in close juxtaposition. However, the diameter of their calibre is short compared to the other. The short branches that are in part given off while

on the run in the submucosa, switch over into the mucous branches forthwith. Especially outstanding is the similar process above under control of the first branch at the primordial section of the dexter gastroepiploic artery. (Fig. 54, 55)

As Jatrow, Hoffmann, Nather and the like observed the shortcomings of vascularization at the minor curvature, pyloric region and the primordial section of the duodenum, Usadel later brought forth the equality of arterial distribution. In Japan, Nagayo, Tame, Chou, Matsumoto, etc., are in favor of the theory. As the result of my observations on the vertical angle, the constitution of a plexus in the pyloric region, as compared with that of the corpus et fundus ventriculi, is poor, and part of the mucous branches join up directly with the dexter gastric artery without intervention by plexus.

2. *The Mucous Branches and Capillaries*

The sphere of influence by a piece of mucous branch that is given off from the plexus of arteries in the submucosa, is extensive, its ramification being complicated. One mucous branch of comparatively larger calibre that skyrockets towards the mucosa, prior to piercing through the muscular mucosa or in the process of piercing through, is horizontally ramified into three to four or five. Sometimes its long-run twigs anastomose with those of the same type on the other side (Fig. 56) but contrary to the observations by Dr. Djorup, it is found that they have to be constituted in the submuscular mucosa. There are also not found direct arterial and venous anastomosing branches in the submucosa which were unearthed by Balow's studies; the Knauel's formation that was brought forth by Dr. Disse can hardly be recognized. (Fig. 57, 58, 59)

At the pyloric region, the terminals or collaterals, some of which are given off from the plexus of arteries in the submucosa, some coming up piercing through the muscular coat, immediately become mucous branches, prior to forming a plexus, radiate in ramification equally upon arrival at the mucosa, and shift over into capillaries, encircling the gastric glands. (Fig. 60, 61, 62)

This view applies to the similarity of the rabbit stomach's pyloric region, and it follows that part of the arterial capillaries at the pyloric region are brought to bear on the abdominal artery's pressure directly. Furthermore, it is found that there exist in the human stomach no long vertical capillaries of comparatively larger calibre that are observed in the dog stomach. (Fig. 63, 64, 65)

SECTION 5 *SUMMARY*

At the rabbit stomach, the sinister gastric artery and brachygastric artery place under their control most of the blood irrigation in the corpus et fundus ventriculi. That is, the sinister and dexter gastroepiploic arteries can hardly see anastomosis and only irrigate part of the major curvature. The sinister and dexter gastric arteries, prior to piercing through the muscular layer, send out numerous twigs, every one of which pierces through the muscular coat and radiates in ramification in the submucosa. In the meantime, at the cat, dog and human stomachs, the branches that advance towards the front and posterior walls in the subserosa, pierce through the muscular coat, and make their way into the submu-

cosa, with some plunging into the submucosa in the vicinity of the minor curvature. Moreover, at the middle of the section where the both pierce through the muscular layer, there exist no arterial branches showing up in this layer. Accordingly the arterial branches that push their way through the submucosa in the neighborhood of the minor curvature, extend a comparatively long distance through the front and posterior walls up to the piercing section of the former branches. It comes to this that in the rabbit, the section that is nourished by several pieces of small artery, is, in the other animals, irrigated by one piece of artery each which is of comparatively larger calibre and runs a relatively long distance, while in the dog and human stomachs, a dozen odd branches that are given off from the sinister and dexter gastroepiploic arteries possessing their branches in the roomy omentum majus, after piercing through the muscular coat, anastomose closely with the terminals of the sinister gastric artery's branches. It is considered in this context that the above process no doubt absorbs hydrodynamically the abdominal pressure on the sinister artery. At the minor curvature, this pressure tends comparatively directly to be brought to bear. It is a matter of interest to note that the primordial location of the human stomach ulcer coincides with the minor curvature.

According to Dr. TAME, the plexus of arteries in the submucosa of the rabbit stomach, straddling over both the submucosa and the mucosa, forms a plexus of arteries there. However, the author cannot discover it with the vertical observations. As for the cat stomach, different from the other animals' stomachs, an elaborate, plane plexus of arteries in the mucosa takes shape again against the plexus of arteries in the submucosa.

Generally speaking, the four species of stomachs for study are furnished with the vasa at the pyloric region of smaller calibre than those of the other species, and see anastomosis plain and rough. Accordingly, part of the mucous branches at the pyloric regions of the other animals' stomachs except for the cat stomach's, are connected directly with the subserous artery, the submucous artery, the mucous branches and arterial capillaries, in the above order, without intervention by plexus. In the dog stomach's pyloric region, it is observed that there exist arterial capillaries long and perpendicular which is mentioned in the section dog stomach. At the pyloric region in the human stomach, arterial capillaries, after the mucous branches piercing through the muscular mucosa, are ramified equally, shifting over into the venous capillaries with encircling the stomach glands. Besides they carry out the most complicated ramification, as compared with the stomachs of the other animals. Passing thought over the above-mentioned facts, and the fact that in experimental animals' stomachs, the generation of chronic ulcers won't take place, it is deduced that there must be some relations in the vascular distribution. As afore-mentioned, there exist much differences in the arterial distribution nourishing the stomach walls with regard to the human, dog, cat and rabbit stomachs or among the three respective animals' stomachs. Attention is invited to these points, when such animals' stomachs are utilized for experiments.

CONCLUSION

Through my vertical observations on the blood vessels in the stomach walls by using plastic substance "Methylmetacrylate", the following results were obtained:

1. As regards the rabbit stomach, the growth of the sinister and dexter gastroepiploic arteries is no good, and the walls are irrigated mostly by the gastric arteries, sinister et dexter as well as the brachygastric artery. Besides, the formation of the plexus of arteries in the submucosa is recognizable, but not in the mucosa.

2. The mucous branches are classified in the two major categories: A-class branches and B-class branches. At the corpus et fundus ventriculi only, it is recognized that long vertical arterial capillaries shift over directly into the upper portion of the mucosa short of sub-branching off from the mucous branches.

3. In the cat stomach, the subserous artery, without giving off collaterals, makes directly for every place, and after piercing thru the muscular coat, anastomoses with the terminals of the branches of the sinister, dexter gastroepiploic arteries or with the mutual anastomosis of the branches, forming the plexus of arteries in the submucosa. On top of that, the mucous branches originated there, piercing through the muscular mucosa, arrive at the mucosa in ramification, and then anastomose with each other again, constituting an elaborate plane plexus of arteries in the mucosa.

4. As for the arterial distribution of the dog stomach, the anastomosis of the arterial trunk in the submucosa of the sinister gastric artery with the arterial branches in the submucosa that are given off everywhere from the sinister gastroepiploic artery, is formed as if the abdominal artery's pressure on the sinister, gastric artery were mitigated. However, at the pyloric region under control of the dexter gastric artery, the formation of plexus is plain just like that of the pyloric regions of the rabbit and cat stomachs, part of the mucous branches being hooked up direct with the dexter gastric artery short of intervention by plexus. Contrary to the movement of the mucous branches at the corpus et fundus ventriculi that are equally given off, shifting over into the upper portion of the mucosa, at the pyloric region a piece of branch diverted from the mucous branches, heads for the upper portion of the stomach a long distance perpendicularly without sub-branching off, that observed as a characteristic arterial capillary.

5. In the human stomach, the mitigating distribution of the abdominal artery's pressure on the sinister gastric artery that is observed in the dog stomach, is significant. The submucous artery at the pyloric region, especially the branches given off from the submucous artery under control of the first branch at the primordial section of the dexter gastroepiploic artery, shift over in part into the mucous branches directly with the lack of intervention by plexus.

6. As mentioned above, the arterial distribution in the gastric walls reveals every characteristic and sectional difference, so that in the handling of experimental animals, there is need to consider them with regard to vessel distribution.

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Explanation of the Figures

Fig. 1) Rabbit Stomach Overall view of the plastic mold of arteries and veins in the gastric walls (front & posterior phases)

Fig. 2) Cat Stomach

Fig. 3) Dog Stomach Overall view of the plastic mold of arteries in the gastric walls (font & posterior phases)

Fig. 4) Human Stomach

5) to **21)** The plastic molds of rabbit stomach

Fig. 5) The arteries in the subserosa and the plexus of arteries in the submucosa at the corpus ventriculi (white-arteries, black-veins)

Fig. 6) The arteries in the subserosa at the pyloric region (in part anastomosing branches of arteries in the submucosa recognized) (white-arteries, black-veins)

Fig 7) The plexus of arteries in the submucosa at the corpus ventriculi×25 (Mucous branches (A-class branches & B-class branches) given off the center of the plexus from the plexus of arteries in the submucosa. The black vasa that loom in the background deeper than the plexus of arteries in the submucosa are the network of veins in the submucosa)

Fig. 8) The submucosa & the arteries in the mucosa (oblique view of the corpus ventriculi×25) The thick vessels at the left are the arterial trunk in the submucosa. Shown piercing thru the muscular layer, and branching off.

9) The view of the distribution of arteries in the submucosa at the minor curvature ×25. The branches given off from the sinister gastric artery reach perpendicularly the stomach walls, piercing through and radiating in the submucosa.

Fig.10) The arteries in the submucosa at the pyloric region×25

11) The oblique view of the arteries in the submucosa at the pyloric region ×25

Fig.12) The arteries in the submucosa at the pyloric region ×50

Fig.13) Species of the mucous branches×25

Fig.14) The B-class mucous branches×50

Fig.15) The B-class mucous branches×100. The B-class mucous branches of comparatively larger calibre anastomose with the agnate branches on the opposite side.

Fig 16) The A-class mucous branches×100

Fig.17) The long vertical arterial capillaries×100

Fig.18) The plastic mold of the slice of the corpus ventriculi (reference) ×100. The vasa of large calibre on the both sides are venous capillaries. Two pieces of blood vessel that shoot up vertically towards the mucous epithelium from the mucous base are long vertical arterial capillaries.

Fig.19) The arterial capillaries at the corpus ventriculi×100

Fig.20) The arterial capillaries at the pyloric region×100. Seen sub-branching off directly from the arteries in the subserosa, and shifting over into the arterial capillaries.

Fig.21) The plastic mold of the slice of the pyloric region (reference) ×100. The vasa of comparatively larger calibre are veins.

Fig.22) to **34)** The plastic molds of the cat stomach

Fig.22) The arteries in the subserosa and the plexus of arteries in the submucosa at the corpus ventriculi (black-arteries, white-veins)

Fig.23) The arteries in the subserosa and the plexus of arteries in the submucosa at the front pyloric region and the pyloric region (black-arteries, white-veins)

Fig.24) The plexus of arteries in the submucosa at the corpus ventriculi×25. The vessels of small calibre are arteries in the mucosa.

Fig.25) The plexus of arteries in the submucosa at the minor curvature×25

Fig.26) The plexus of arteries in the submucosa at the pyloric region×25

Fig.27) The plexus of arteries in the mucosa at the corpus ventriculi×25

Fig.28) The plexus of arteries in the mucosa at the minor curvature×25

Fig.29) The plexus of arteries in the mucosa at the pyloric region×25

Fig.30 31) The plastic mold of the slice of the minor curvature (reference) ×80. The arterial anastomosis right above the muscular mucosa is recognized.

Fig.32) The arterial capillaries at the corpus ventriculi×100. The arterial capillaries skyrocket, encircling the gastric glands in network, and shifting over into the thick shadow, that is, the venous capillaries.

Fig.33) The arterial capillaries at the pyloric region×100. Those of large calibre are venous capillaries.

Fig.34) The plastic mold of the slice of the pyloric region×100

Fig.35) to **50**) The distribution of arteries in the dog stomach
Shows the anastomosis of the terminals of the sinister gastric artery and the sinister gastroepiploic artery

Fig.36) The arteries in the subserosa and the plexus of arteries in the submucosa at the fundus ventriculi

Fig.37) The arteries in the subserosa & the plexus of arteries in the submucosa at the corpus ventriculi

Fig.38) The arteries in the subserosa & the plexus of arteries in the submucosa at the pyloric region

Fig.39 40) The plexus of arteries in the submucosa & the mucous branches at the corpus ventriculi×25

Fig.41 42) The plexus of arteries in the submucosa & the mucous branches at the minor curvature×25

Fig.43 44) The plexus of arteries in the submucosa & the mucous branches at the pyloric region ×25. The mucous branches at the pyloric region, compared with the corpus et fundus ventriculi, are of larger calibre, and see little anastomosis in the submucosa, so that one piece of mucous branch controls a wide sphere of influence.

Fig.45) The arterial capillaries at the corpus ventriculi×50

Fig.46) The arterial capillaries at the corpus ventriculi×100

Fig.47) The plastic mold of the slice of the mucosa at the corpus ventriculi×100. The vasa of wide calibre are veins.

Fig.48) The arterial capillaries at the pyloric region×80. The mucous branches given off from the plexus of arteries in the submucosa after piercing through the muscular mucosa, become one or two pieces of arterial capillaries of comparatively wide calibre, and immediately shoot up, shifting over into the venous capillaries.

Fig.49 50) The plastic mold of the slice of the pyloric region×100 The thick shadow is venous capillaries.

Fig.51) **to 65**) The plastic molds of the human stomach

Fig.51) The plexus of arteries in the submucosa at the corpus ventriculi

Fig.52) Part of the plexus of arteries in the submucosa at the corpus ventriculi. Anastomosis of arteries in the submucosa

Fig.53) Part of the plexus of arteries in the submucosa at the minor curvature. Compared with the anastomosis of arteries in the submucosa at the corpus ventriculi, the calibre of the arteries is smaller.

Fig 54) The plexus of arteries in the submucosa at the pyloric region

Fig.55) 〃 (Enlarged) As the same as the pyloric region of the rabbit stomach, the anastomosis in the submucosa takes place less often. Accordingly the arterial branches in the subserosa are given off gradually, shifting directly over into the filamentary arterial branches and capillaries.

Fig.56) The mucous branches at the corpus ventriculi×50

Fig.57) The arterial capillaries at the corpus ventriculi×50

Fig.57) The arterial capillaries at the corpus ventriculi×50

Fig.58) The plastic mold of the slice of the mucosa at the corpus ventriculi×100. Recognize the mutual anastomosis of the mucous branches right below the muscular mucosa.

Fig.59) The plastic mold of the vasa in the mucosa×100. The vasa of large calibre are venous capillaries.

Fig.60 61) Without forming a plexus, shift directly over into the mucosa from the arteries in the submucosa at the pyloric region×25

Fig.62) The mucous branches at the front pyloric region×50. Recognize in part the mutual anastomosis of the mucous branches

Fig.63) The plastic mold of the slice of the mucosa at the front pyloric region×25

Fig.64) The mucous branches at the pyloric region×50

Fig.65) The plastic mold of the slice of the mucosa at the pyloric region×25 (Compare with the pyloric region of the dog stomach)

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和文抄録

合成樹脂注入法による胃壁動脈管の分布に関する研究

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百　瀬　雄　二

合成樹脂 Methylmetacrylate を使用し，人胃，犬胃，猫胃，家兎胃の胃壁血管を立体的に観察して，次の結果を得た．

(1) 家兎胃では，左，右胃網動脈の発育は不良であり，大部分左，右胃動脈，短胃動脈によつて胃壁は潅流されている．なお粘膜下動脈叢の形成は観察されるが，粘膜層内の叢形成は認められない．

(2) 粘膜枝はA類枝及びB類枝に大別出来る．なお胃体及び胃底部のみ粘膜枝より再分岐することなく，直接に胃粘膜上皮に昇行し，静脈性毛細管に移行する長垂直の動脈性毛細管を認める．

(3) 猫胃では，漿膜下動脈は側枝を分岐することなく，各所に直接に到り，筋層を貫通した後，左，右胃網動脈分岐枝末端と，或は，分岐枝相互で吻合を作りここに粘膜下動脈叢を形成するが，これ等からの粘膜枝は，粘膜筋層を貫通して粘膜層に到り分岐し，再び相吻合して緻密，且つ平面的な動脈叢を再形成する．（粘膜層動脈叢）

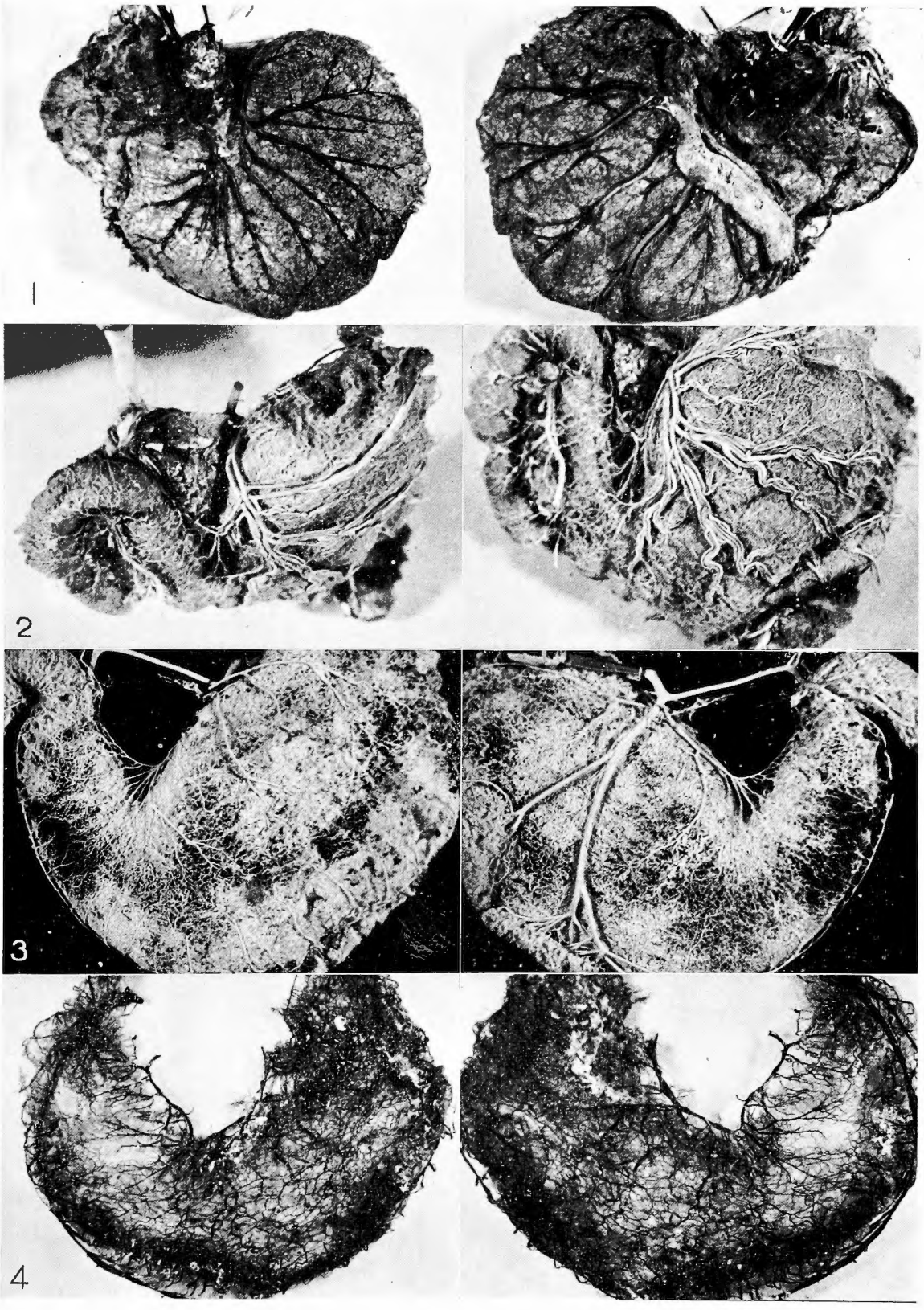
(4) 犬胃の動脈分布では，左胃動脈粘膜下動脈幹に対する左胃網動脈から，随所に分岐された粘膜下動脈枝との吻合状態は，あたかも左胃動脈へかかる腹腔動脈の圧が，緩衝される如くに形成されている．併し右胃動脈の支配下にある幽門部では家兎胃及び猫胃幽門部と同様に，叢の形成は単純であり，粘膜枝の一部は叢の介在なく直接右胃動脈につながつている．

又胃体及び胃底部の粘膜枝が，均等に分岐して粘膜上皮に移行するに対して，幽門部では粘膜枝から分岐する一枝が，再分岐することなく家兎の胃体及び胃底部に観察されたような長垂直の動脈性毛細管に類似して，長垂直に胃上皮に向い，静脈に移行する特有な動脈性毛細管を認め得る．

(5) 人胃では，犬胃で観察される左胃動脈にかゝる腹腔動脈圧への緩衝的分布形体が，はるかに顕著である．

又幽門部，特に右胃網動脈起始部第一枝の支配下の粘膜下動脈から分岐される分岐枝は，一部は全く叢の介在がなくて直接に粘膜枝に移行する．

(6) 以上のように胃壁動脈分布は動物の種類によつてそれぞれ特長があり，且つ部位的差異を認めるもので，各種実験等で動物胃を必り扱う場合には，かゝる血管分布上の相違を一応考慮する必要がある．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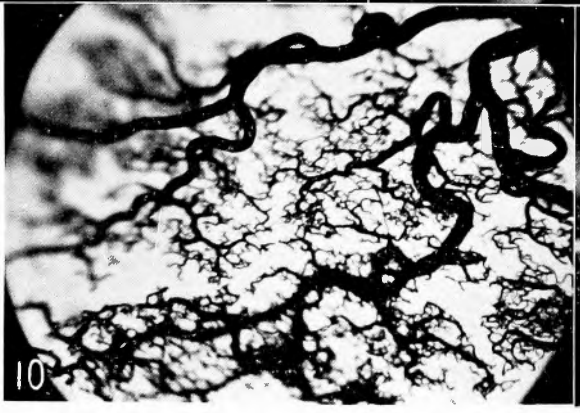
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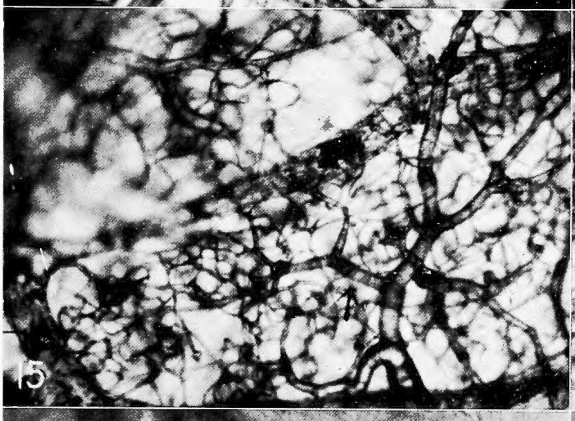
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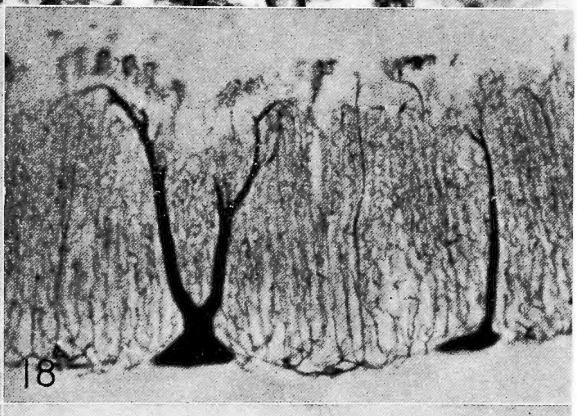
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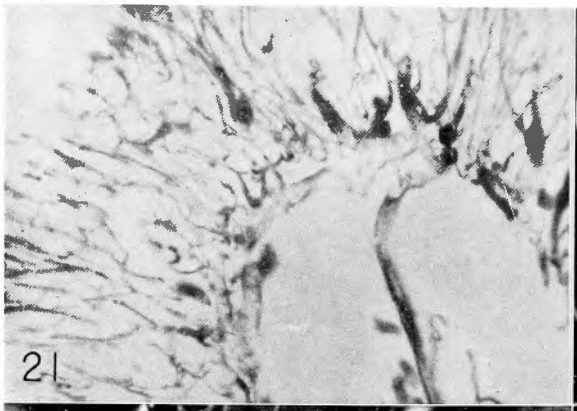
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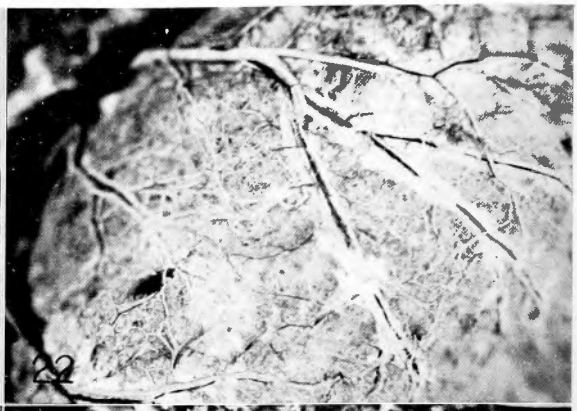
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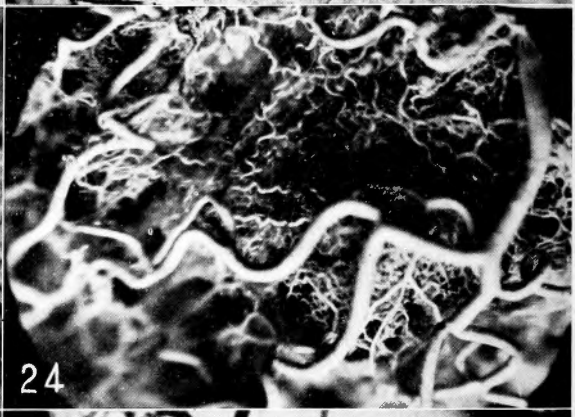
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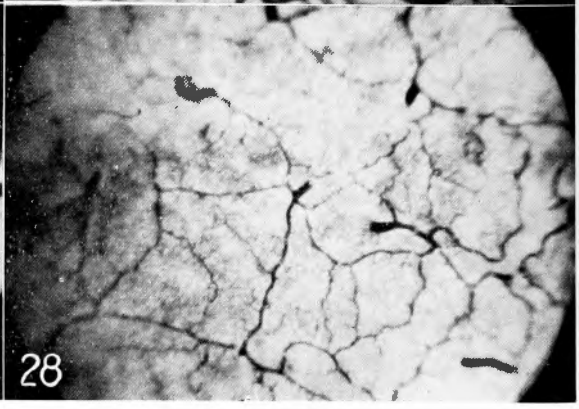
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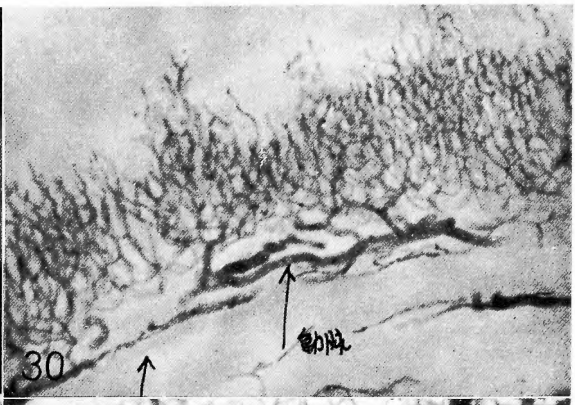
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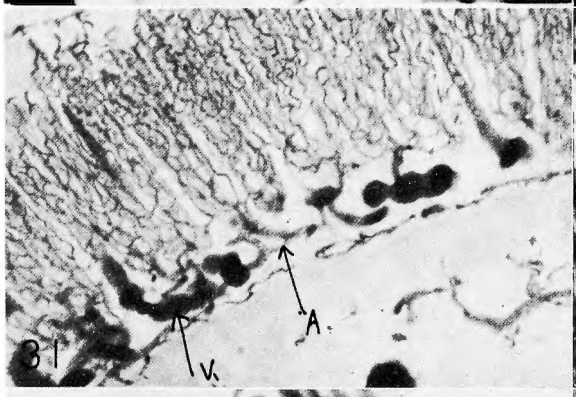
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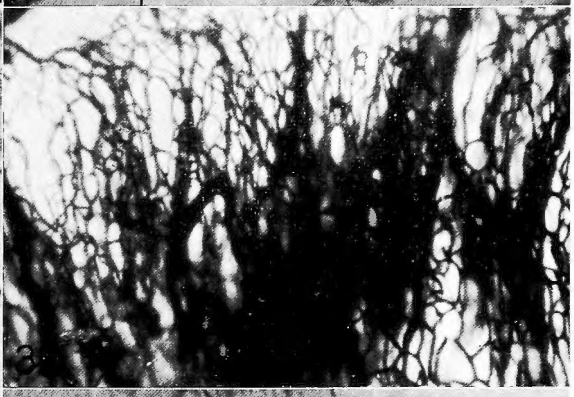


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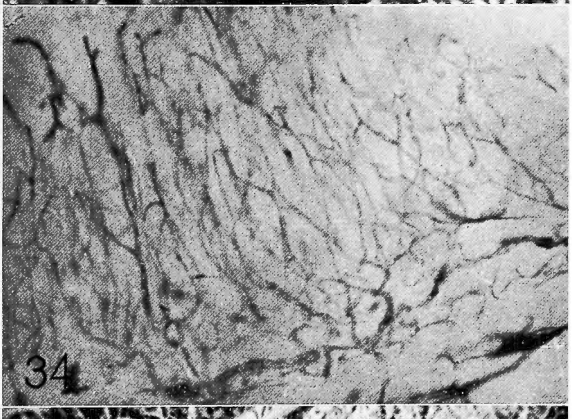
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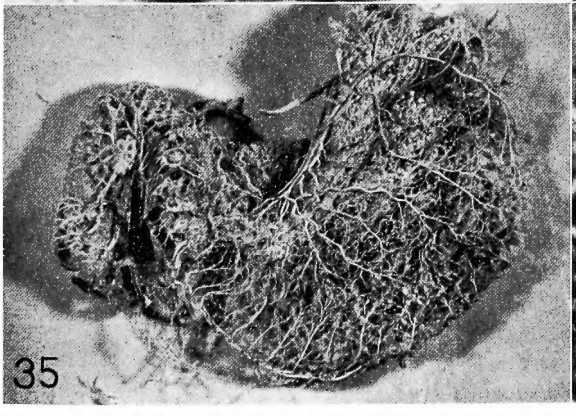
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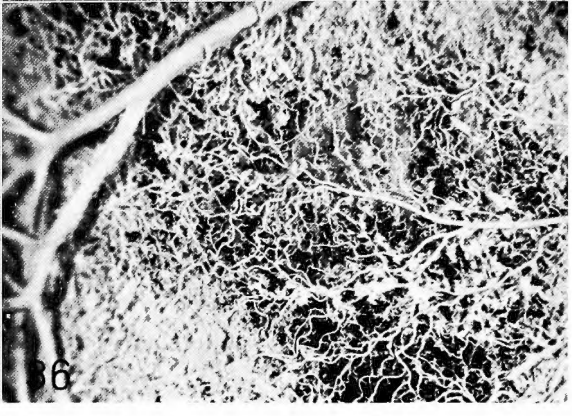
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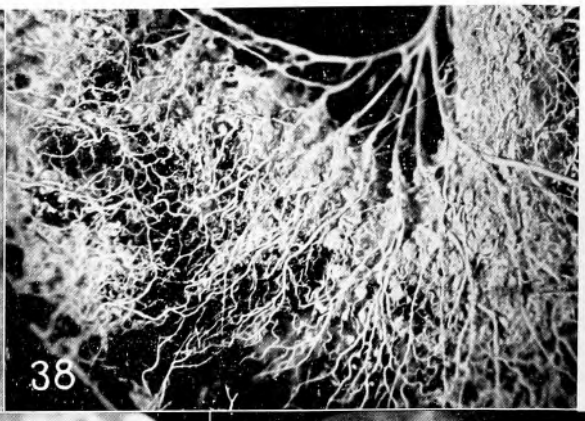
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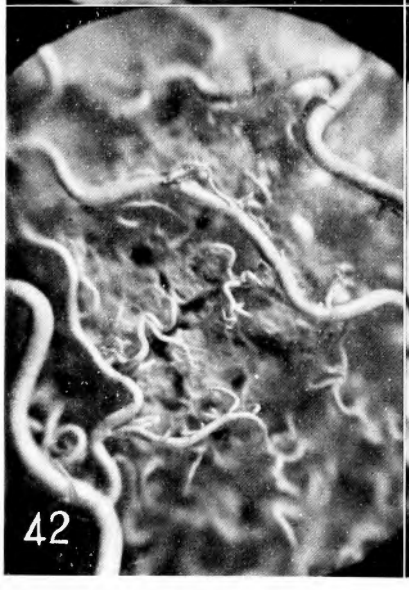
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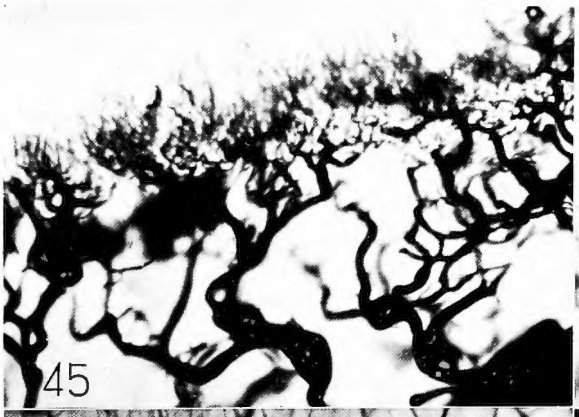
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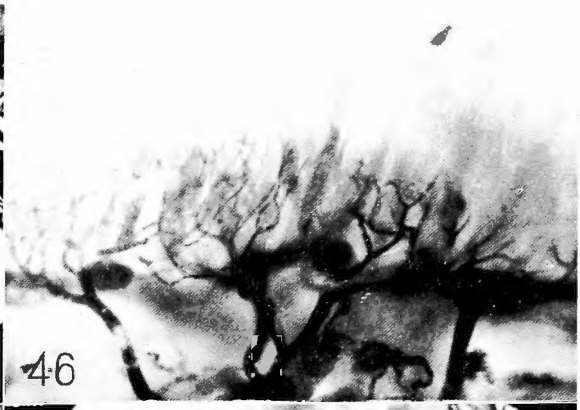
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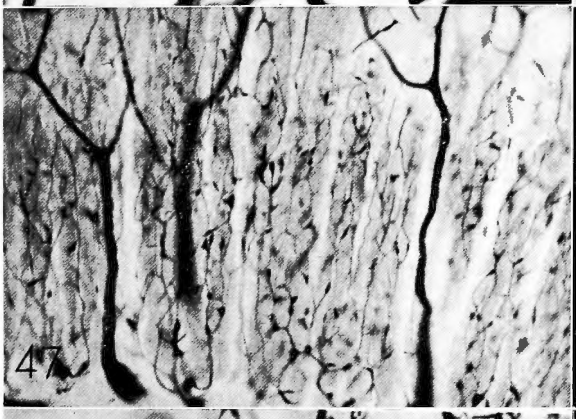
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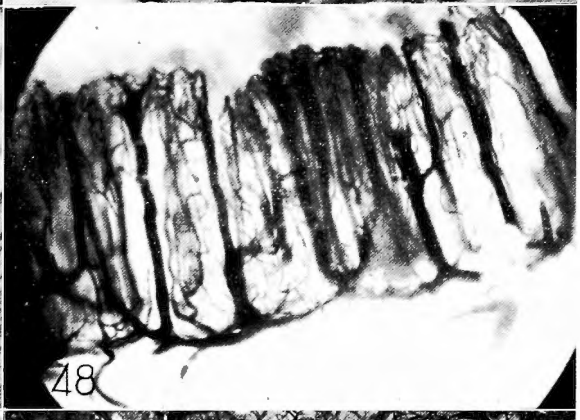
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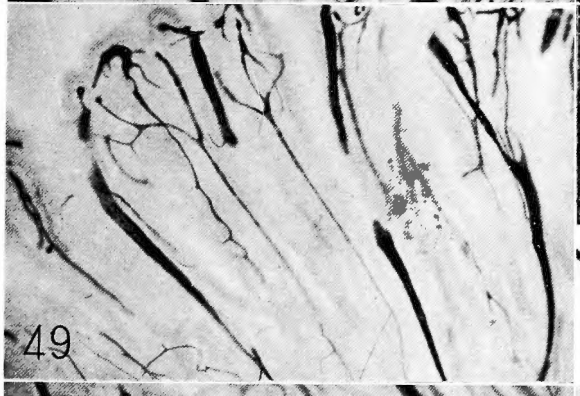
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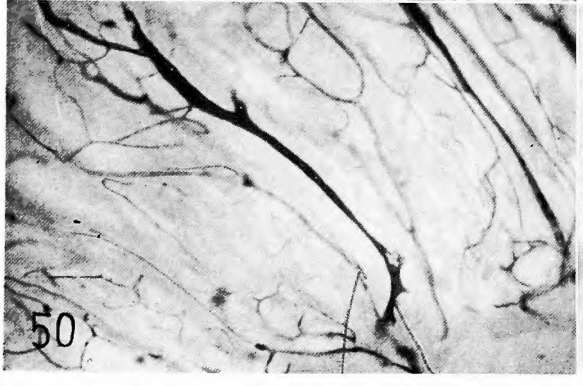
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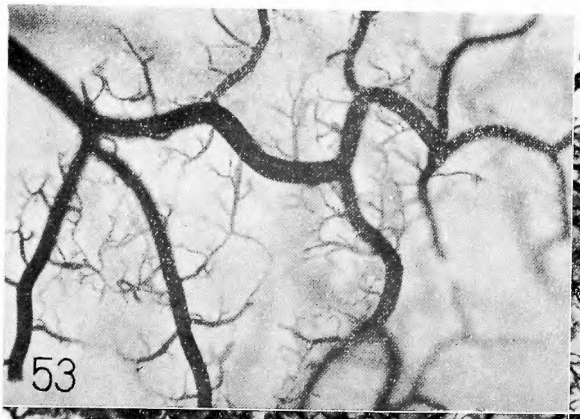
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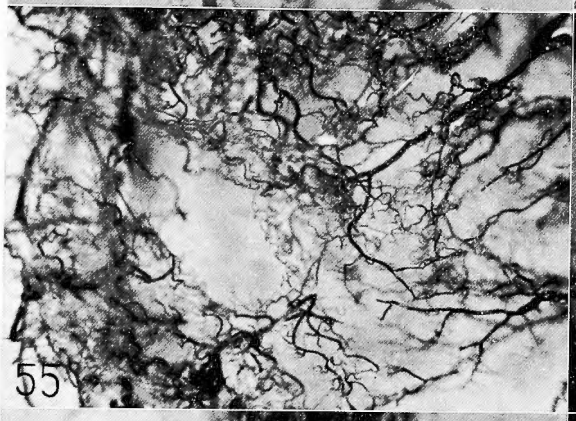
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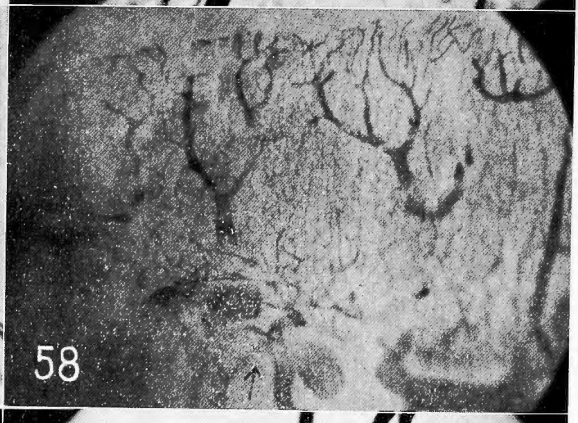
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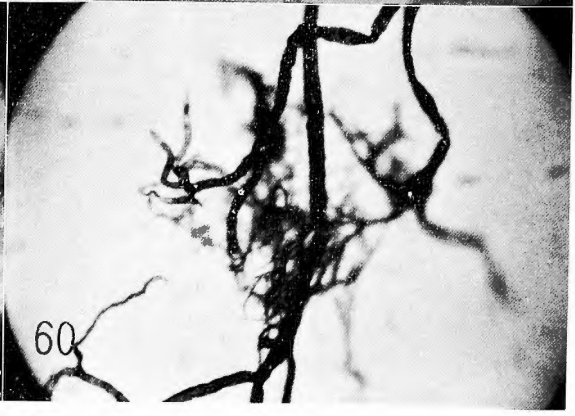
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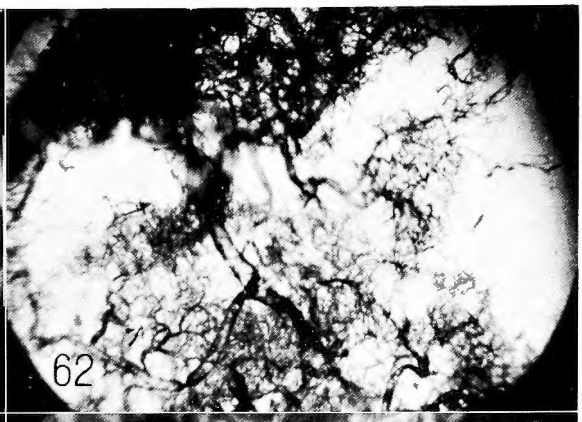
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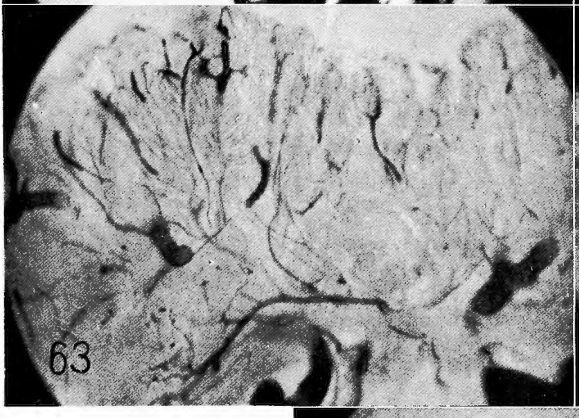
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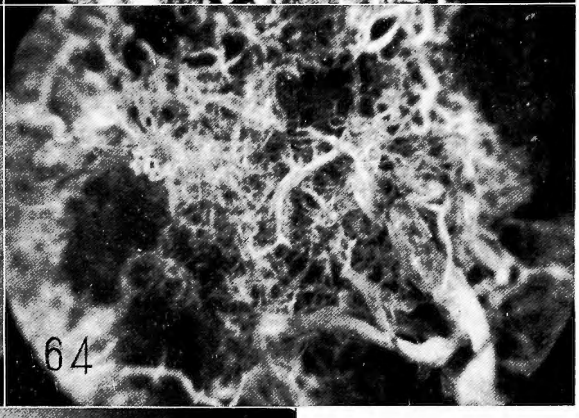
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