

THE
PREVERTEBRAL HÆMOLYMPH GLANDS.

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IN this paper is given an account of a set of blood-glands occurring in the body of some at least of the larger mammals, which have either not hitherto been described or are not generally recognised. They cannot fail, however, to have been often seen in the lower animals; indeed, as a matter of fact, when they were recently brought under the notice of Professor Macfadyean, of the Royal Veterinary College, Edinburgh, he was quite familiar with their naked-eye appearance, though not with their histology. That their structure has apparently not yet been described is probably owing to the circumstance that they have always been regarded as being either small congested lymphatic glands or little blood-clots. Whilst they are very small in size, they occur in such numbers in the animals in which they have been found, and their microscopic structure presents features of such extreme interest, that one feels warranted in assigning to them a position of decided importance. They have been mainly studied in the sheep and bullock, in both of which they are readily found when a dissection is made immediately after death. In the human subject, however, this is not the case, owing, it may be assumed, to the unfavourable conditions under which examinations are necessarily made. It is sufficient, in the meantime, only to mention this point, as it must be referred to again in describing the anatomy and histology of the organs in the human subject. For the suggestion of the name "hæmolymp glands," which has been given to them, I have to thank Dr. Russell.

Macroscopic anatomy.—Hæmolymp glands as seen in the newly killed healthy sheep are small blood-red bodies about the size of a white mustard seed. In shape they are rounded, oval, or lenticular. Their characteristic colour is due to the blood which fills the large sinuses within them, and appears to vary according to the degree of its oxygenation. Frequently side by side may be seen a hæmolymp gland of the bright scarlet colour of arterial blood, and another of the deep purple hue of venous blood. Their capsule in relation to their size is tough, but on section they are extremely soft in consistence, and are readily destroyed by slight pressure. They are found in the abdomen and pelvis amongst the fat and connective tissues lying between the vertebral column and the peritoneum, and in the thorax in the posterior and middle mediastinum. They extend for some distance out in the mesenteries, but do not reach as far as the gut. They are not found in the great omentum, except at its lateral attachments, and they appear to be absent from the appendices epiploicæ. In the thorax they are much less numerous than in the abdomen, but nevertheless considerable numbers of them may be found, especially in the fat and connective tissues around the root of the lungs. A few may be found in front of the lower cervical vertebrae. If the sheep under examination is not very fat, the little red dots representing these glands may be readily distinguished shining through the peritoneum in front of the lumbar vertebrae, and for a short distance out on the mesenteries. It is, however, only by careful and close inspection that it can be seen that these small red bodies are really something more than small clots of extravasated blood in the fat, or coagulæ within small veins. If the inspection is roughly made, as, for example, with the aid of the point of the finger, the impression that they are merely blood-clots will almost certainly be confirmed. In order to avoid the capsule being ruptured, it is necessary to remove the bodies carefully, and to take along with them a considerable amount of the surrounding fat. From the results of several careful dissections of newly killed sheep, I have been led to estimate the number of hæmolymp glands occurring in that animal at from three to four hundred. In the bullock the hæmolymp glands are larger than in the sheep. They vary from the size of a white mustard seed to that of a

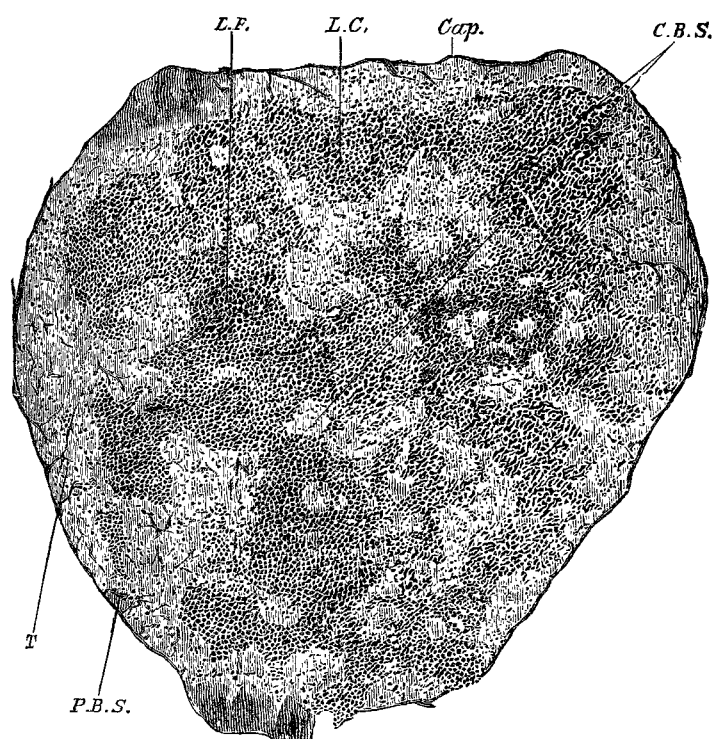
common pea. In other respects their macroscopic anatomy corresponds to that of the sheep. From the human subject I have also succeeded in obtaining organs corresponding in structure to the hæmolymp glands of the sheep and bullock. They occur in the same situations; but I have not yet been able to find them in such numbers as in these animals, owing, possibly, as has been already indicated, to the unfavourable conditions under which post mortem examinations are made. The fat and connective tissues lying in front of the vertebrae are usually so much discoloured by disintegrating blood and by putrefactive changes that the effect of a marked contrast between the colour of the glands and that of the surrounding structures is lost as an aid to finding them. But even more important than this is the condition of the hæmolymp glands themselves. Their characteristic colour, as I have said, is due to the blood with which their sinuses are distended. Now, whatever be the correct explanation, it has been found to be the rule that hæmolymp glands obtained from the human subject have their sinuses more or less empty. Hence it results that, instead of being bright red bodies, as in the sheep and bullock, they have usually a greyish-pink tint, which approximates to the colour of a lymphatic gland. It is to be borne in mind that there are lymphatic glands as small as hæmolymp glands, and if they happen to be congested, as is often the case at post-mortem examinations, it is evident that it must then be practically impossible to distinguish a hæmolymp gland from them by the unaided eye. I have nevertheless been successful in obtaining several human hæmolymp glands with sinuses fairly well distended, and therefore of a deep red colour; and this fact, taken in conjunction with what has been already said as to the normal appearance of hæmolymp glands in the healthy newly killed sheep and bullock, appears to justify the assumption that in the healthy human subject during life a similar general condition of distended sinuses exists. It may be suggested that the real explanation of the difficulty in finding hæmolymp glands in the human subject is that, though highly developed and important organs in the bullock and sheep, yet in man they are not required to perform any correspondingly important function, and are therefore comparatively few in number. In answer to this contention, it is to be pointed out that in all other known important details the organs in man correspond so closely with those of the sheep and ox that it is almost impossible to believe that in this particular close correspondence should fail. The accuracy of such a view is also rendered improbable by the circumstance that in one case, on very careful examination of tissues removed from the posterior mediastinum, I was able to find hæmolymp glands in almost as large numbers as they are to be found in that position in the sheep. Of the presence of these organs in other animals I cannot speak, but from analogy one would expect them to be present in all mammals.

Histology.—It will be most convenient in describing the microscopic structure of these glands to take that of the sheep as the type, and afterwards to point out how those of man and the bullock differ from it. A hæmolymp gland may be regarded as consisting of three portions (Fig. 1): (1) A capsule immediately within which there lies (2) a large irregular sinus distended with blood, which extends, as a rule, right round the gland; and (3) a central or lymphoid portion, into which the peripheral blood sinus sends processes. The capsule is thick in relation to the size of the organ. It is formed of dense fibrous tissue, with many non-striped muscular fibres, chiefly in the deeper layers, and a few yellow elastic fibres. The fat in which the organ is embedded is immediately external to the capsule. The peripheral sinus is in its average width about one-twelfth of the diameter of the gland. It is intersected by trabeculae of similar structure to the capsule, which freely anastomose and form a sparse network extending from the capsule to the central or lymphoid part. The meshes of this network are filled with red blood-corpuscles and other cells similar to those found in the central part, and evidently derived from it. The central lymphoid portion is broken up into irregular segments by prolongations of the peripheral blood sinus, which vary greatly in size. The largest of them are crossed by trabeculae similar to those of the peripheral sinus. They give origin to smaller finger-like processes, which still further break up the lymphoid part. All these sinuses are lined by a delicate endothelium. The lymphoid part (Fig. 2) consists of a framework of long spindle-shaped cells, some of which are non-

striped muscular fibres. A few elastic fibres are also present. The spaces in the framework are closely packed with cells of various kinds. (Fig. 3) Many of them appear to be merely lymphoid cells similar to those forming the follicles of a lymphatic gland. They are found everywhere; but aggregations of them, varying in number from three to six in each section, occur, especially near the margin, forming small rounded masses closely resembling the splenic lymph follicles, but differing from them in having no arterial relations. Another form of cell which is almost equally abundant is one differing only slightly from the preceding. It is rather larger, its nucleus tends to be oval instead of circular, and the surrounding protoplasm is more abundant. It differs most markedly from a lymphoid cell in its staining reaction, and may thus be readily distinguished from it. In specimens stained with logwood its nucleus, instead of staining very deeply as occurs in the case of the lymphoid cell, stains very lightly, although darkly stained nucleoli are always present in it. These cells occur throughout the lymphoid portion, but special masses of them are present in the centre of the lymph-follicles. A third form of cell is one which occurs in considerable numbers and is larger than either of the preceding. It exactly resembles a uninucleated white blood-corpuscle, consisting of a large deeply staining, often reniform nucleus, with well-defined

ing nucleolus. In some, however, no nucleolus can be seen, and in others the nucleus has also disappeared, so that there is left only a large usually rounded protoplasmic mass which stains with eosine. A fifth form of cell is one of considerable interest, but it is not always very numerous. It is about the size of a multinucleated cell and usually oval in shape. It has a large nucleus, faintly stained with logwood (in specimens stained with logwood and eosine), and a small amount of surrounding protoplasm. A few cells are to be seen, however, in which no perinuclear protoplasm

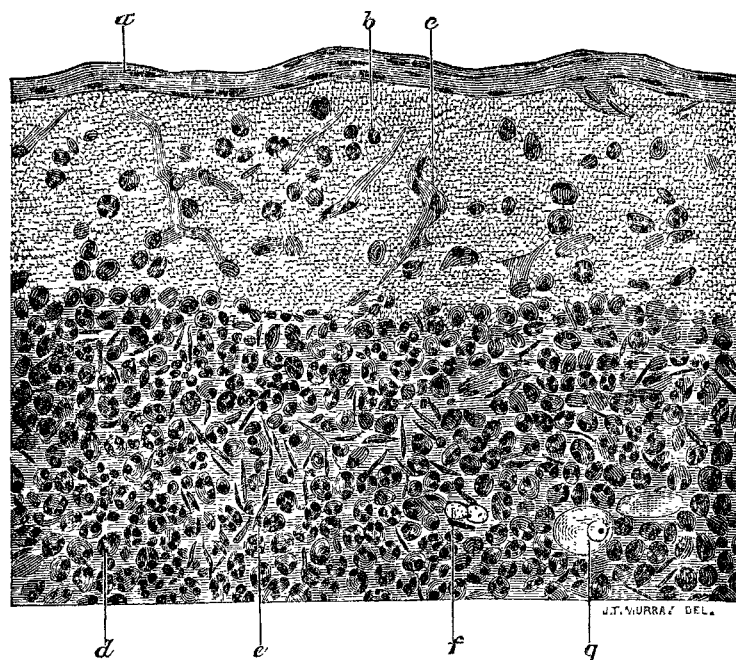
FIG. 1.



Section of hæmolympth gland of sheep ($\times 50$). *Cap.*, Capsule. *T*, Trabecula. *P.B.S.*, Peripheral blood sinus. *L.C.*, Lymphoid centre. *L.F.*, Lymph-follicle. *C.B.S.*, Central blood sinuses.

perinuclear protoplasm. The nucleus of this cell undergoes repeated division, so that there is ultimately formed a multinucleated cell. These multinucleated cells are most numerous near the blood sinuses. In some glands they are not very abundant, but in others they are so numerous as to constitute the most conspicuous feature in the field of the microscope. As the nuclei multiply the cell itself increases in size until those containing several nuclei have nearly three times the diameter of a lymph corpuscle. They evidently enter the blood sinuses in which they appear as multinucleated white blood-corpuscles. The number of nuclei in them varies within considerable limits. Many have seven or eight, and some have been seen with even more. In specimens stained with logwood and eosine it may be noticed that the nuclei as they increase in number gradually lose their affinity for logwood and become tinted with eosine, and from their size and contour strongly suggest the possibility that they become red blood-corpuscles. A fourth form of cell is one of large size which is probably developed from the second variety described above, as cells forming an intermediate series may readily be made out. It is from two to three times the size of a multinucleated cell, and is often somewhat triangular in shape. It has a large nucleus which stains lightly with logwood, and a small deeply stain-

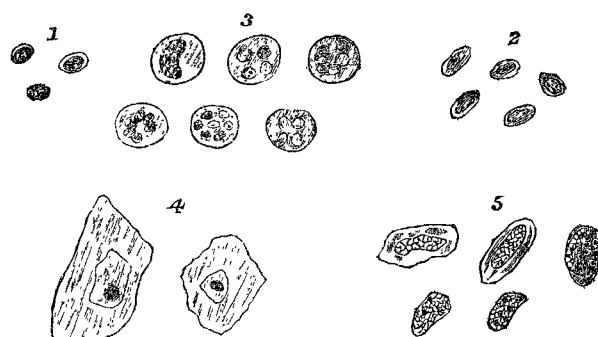
FIG. 2.



Section of hæmolympth gland of sheep ($\times 600$). *a*, Capsule. *b*, Peripheral blood sinus. *c*, Trabecula. *d*, Group of multinucleated cells. *e*, Non-striped muscular fibre. *f*, Two cells of the fifth form described. *g*, Large protoplasmic mass with nucleus. To the right is a similar mass without a nucleus.

can be detected. In some the nucleus is seen to contain many minute nucleoli stained deeply with logwood. In others, many of these nuclei are stained with eosine instead of logwood, and in a very few it has been observed that all the nucleoli are stained with eosine. In places where the cells are not densely packed together red blood-corpuscles are to be seen lying amongst them. There are also present in considerable numbers small homogeneous cells, about one-third the diameter of a red corpuscle, which stain with eosine in logwood and eosine preparations. These are found

FIG. 3.



Drawing of different forms of cell seen in central part of hæmolympth gland of sheep. Description in text.

in the blood sinuses as well as between the cells of the central part.

Regarding the course of the blood through these glands I cannot speak positively, as injections have not been made. A large artery passing to the centre of the gland is a conspicuous feature in some specimens, and probably indicates the course taken by the blood. From what can be made out in uninjected specimens, I am inclined to think that the circulation is extremely simple. The central artery appears to divide into small vessels, which in turn divide into capillaries, most of which ramify in the lymphoid

portion, while others run in the trabeculæ, all ultimately opening into the sinuses. The peripheral sinus communicates with the exterior of the gland by openings which pass obliquely through the capsule, and which are formed, as it were, by a splitting of the laminae of that structure. These intracapsular sinuses may be seen in many specimens extending for one-fifth or more of the circumference of the gland. Immediately outside the capsule the blood is received into a vein of the usual structure. While this may be taken as the typical structure of the hæmolymph gland of the sheep, there are to be found many which differ markedly from this description in one particular feature. Whether it is to be regarded as a pathological or a physiological condition is uncertain; but in the glands in question it is found that the fibrous tissues and non-striped muscular fibres are present in such abundance as to very markedly lessen the size of the blood sinuses, and to diminish the spaces left for the cells of the pulp, which consequently are comparatively few in number.

The hæmolymph gland of the bullock is formed on the same plan as that of the sheep, and does not differ from it in any essential details. Several of the trabeculæ which pass towards the centre of the gland from the capsule are, however, much larger than in the sheep, and the masses of cells with large pale nuclei, which occur in the centre of the lymph-follicles, are much more conspicuous, in logwood and eosine specimens coming out quite a different colour from the surrounding lymph-corpuscles. The cells in the central portion are essentially the same as in the sheep, but the number of red corpuscles lying between them is usually greater. Some of the large protoplasmic masses contain orange-coloured pigment. The large trabeculæ are in places broken up by small blood sinuses. These are also frequently present in the capsule towards its inner half. In fluid taken from a fresh hæmolymph gland of the bullock, and examined in normal saline solution tinted with an aniline dye, in addition to the cell appearances already described as occurring in the sheep, there have been noticed very large rounded, homogeneous-looking masses which stain lightly. They are probably identical with the large protoplasmic masses which have lost their nuclei. Hæmolymph glands obtained from the human subject resemble very closely those of the sheep. The only important difference that has yet been observed is that the peripheral blood sinus is interrupted at places by the lymphoid portion reaching the capsule. When the sinuses are empty or nearly so, as is usually found to be the case, it is often extremely difficult to tell whether one is looking at a small lymphatic gland or a hæmolymph gland. In some of the best specimens obtained the same forms of cell as occur in the sheep and bullock have been clearly made out. As in the case of the sheep, several glands have been seen in which the typical appearances are greatly altered by the presence of an unusually large amount of fibrous and non-striped muscular tissue.

Function.—Regarding the function of these glands very little of a definite character can at present be said. The idea that they are concerned in the formation of the red blood-corpuscles at once suggests itself, but great caution is necessary in coming to so important a conclusion. There are no doubt appearances in the glands which strongly suggest that some process connected with the development of the red corpuscles is taking place within them, and more than one plausible theory defining its steps might be advanced. For example, it may be seen that the nuclei of the multinucleated cells, as already stated, gradually lose their affinity for logwood as they increase in number, while at the same time they approach both in staining reaction and in form to small red blood-corpuscles. Nevertheless I have not yet been able to see any appearances sufficiently definite to justify one in coming to the conclusion that these eosine staining bodies within the multinucleated cells are really young red corpuscles. Again, as has also been already mentioned, it may be seen that the nucleoli of certain cells in the glands undergo an exactly similar change in their staining reaction. In logwood and eosine specimens cells may be seen with large nuclei which are lightly stained with logwood and contain many small pink bodies corresponding to nucleoli. Now exactly similar eosine-tinted bodies may be seen between the cells of the lymphoid part and also in the sinuses, but that these have actually been derived from the nucleoli of the cells in question, or that they represent any stage in the development of red blood-corpuscles, cannot yet be asserted absolutely, notwithstanding the suggestiveness of the appearances. It must therefore be

admitted that the function of hæmolymph glands is in the meantime undetermined. Only one definite statement regarding them can be made, and that is that they are the source of some at least of the lymphoid cells and the uninucleated and multinucleated corpuscles which occur in the blood. That they have very important relations to the development of the blood, notwithstanding that these relations cannot yet be defined, can scarcely be doubted, and I think it is probable that when further investigation has thrown more light upon the changes that take place in their cells, it will be found that they contribute in an important manner to our at present very incomplete knowledge of the life-history of the red corpuscles.

In conclusion, I have gratefully to acknowledge the guidance and assistance Dr. Russell has given me in working out the histology of these glands and in the preparation of this paper.

AN IMPROVEMENT IN INTERNAL PHLEBOTOMY.

By GEORGE HARLEY, M.D., F.R.S.

IN your issue of Nov. 1st is an interesting and instructive paper by Dr. Christian Simpson, entitled "A New Method of Bleeding in some forms of Pulmonary Congestion," in which he relates four cases in which he had practised it with benefit to the patients. I notice that he alludes to his new method of extracting blood directly from the inflamed lungs as being an extension of the method of performing hepatic phlebotomy which I laid before the profession in 1886, and which led to so much discussion at the time. He has, however, added thereto a suggestion which I deem of so much importance that I desire herewith to call special attention to it, in the hope that others, when practising either pulmonary or hepatic phlebotomy, will adopt it. The improvement suggested by Dr. Simpson is embodied in the following sentence: "After the withdrawal of twelve ounces of blood, the cannula was held *in situ* with the finger over the end to allow of a clot forming, and then it was slowly withdrawn altogether. A piece of plaster was applied over the puncture, but a flannel bandage could not subsequently be retained in position. The patient was immediately and markedly relieved." This suggestion of encouraging the blood to form a clot, which will act as a plug, and thus prevent subsequent hæmorrhage, I consider a most valuable one, and I venture to propose a slight modification in the mode of procedure, which will make the plugging of the wound by the coagulum, I believe, still more secure and effective. It will no doubt have occurred to some of the readers of THE LANCET that when the stream of blood from the lung has been interrupted by stopping the mouth of the cannula with the finger, the coagulum formed within it will be in a continuous mass with the one formed at the distal orifice of the instrument. So that on the withdrawal of the cannula there will exist considerable danger of the small blood-clot that has formed between the extreme end of the cannula, and the lesion made in the tissue by the point of the trocar becoming detached from its surroundings, and withdrawn along with the coagulum inside the cannula, to which it will of necessity not alone be continuous, but likewise intimately adherent. In order to reduce this risk to a minimum, as well as the equal danger of any oozing of blood taking place from the walls of the passage after the removal of the cannula which bleeding would of itself to a certain extent tend to defeat the object held in view in encouraging the formation of the blood-clot, I propose a simple modification in Dr. Simpson's mode of procedure, which will be equally applicable to cases of pulmonary and hepatic phlebotomy.

What is wanted is, of course, not only to encourage the formation of an intra-pulmonary or an intra-hepatic blood-clot, but at the same time to ensure its fixation in the wound, in order to avoid all risk, after the withdrawal of the cannula, of hæmorrhage either into the pleural cavity on the one hand, or into the abdomen on the other. My proposal is this: As the trocar has always to be thrust some distance into the tissues of the organ from which it is desired to extract blood, I think before placing the point of the finger on the mouth of the cannula, with the view of arresting the blood-flow, it should be slightly withdrawn—say, about