

element of tension characteristic of the nephritic state. Whether this effect was due to the low vasomotor tone of the accompanying exophthalmic goiter or was directly attributable to the weak cardiac state I am unable to say, although inclining to the latter opinion, since exophthalmic goiter is a hypertensive disease rather than the reverse. In view of these facts, we may conclude that the cardiac lesions are the result of antecedent endocarditis although it is fair to presume that the circulatory state is greatly aggravated by the associated diseases. The absence of a rheumatic history can not be taken as negative evidence.

No direct association exists between exophthalmic goiter and nephritis, although transient albuminuria has been noted during the periods of acute disturbance. Chronic Bright's disease is not numbered among the epiphenomena of exophthalmic goiter, although there is no reason to believe that the toxemia of the latter disease is incapable of setting up degenerative renal change if long enough continued.

Diabetes and chronic Bright's disease, on the contrary, are very frequently associated. In a consideration of this subject presented before the American Medical Association in 1903,<sup>1</sup> I demonstrated that the average of diabetics displaying albuminuria was over 43 per cent. The renal changes are of the nature of chronic interstitial nephritis and result from long-continued irritation of the renal secreting structure.

In the case under discussion there is small likelihood of any relation existing between the diabetes and Bright's disease. The latter is out of proportion to the former and displays an activity seldom observed in the nephritis of diabetes, which is, as a rule, a mild and slowly-progressive dystrophy. The mild character of the diabetes in this case precludes the possibility of such connection.

The interpretation of retinitis in cases displaying both glycosuria and albuminuria offers considerable difficulty. The retinitis of diabetes possesses no distinguishing mark that will enable us to differentiate it from retinitis nephritica. We must depend on other evidence than that furnished by the ophthalmoscope to determine this point. The prognostic value of retinitis is practically the same in diabetes as in Bright's disease, i. e., it is a terminal symptom. Retinitis does not develop in diabetes until late in the disease and is attended by a fully-developed diabetic state, with the patient in bad general condition. Under such circumstances, the glycosuria is not likely to prove amenable to diabetic control and polyphagia, polyuria, etc., will exist with progressive emaciation and increasing adynamia. In this case some doubt existed after ophthalmoscopic examination as to whether the retinal changes were produced by the diabetes or by the nephritis. This uncertainty was dispelled by the behavior of the case under treatment and the subsequent complete development of the retinitis.

103 State Street.

1. THE JOURNAL A. M. A., Aug. 8, 1903.

The profession of the Northwest should be largely represented at the Portland session, and, since the opportunity is offered to take a most interesting journey at a comparatively slight expense, we advise every one of our readers who can possibly do so to take his vacation this year in this way.—*St. Paul Med. Jour.*

## THE NORMAL AND PATHOLOGIC HISTOLOGY OF THE AORTIC AND MITRAL VALVES.

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At the suggestion of Dr. Councilman, we have undertaken in the last few years the study of the aortic and mitral valves from hearts of different ages, representing both normal and pathologic conditions. The study was undertaken in the first place to obtain more definite ideas of the normal structure of the valves, particularly the amount and relation of different tissues entering into their composition; further, to determine the period at which degenerative lesions first appear in the valves and the relation of these degenerations to the different tissues; and finally, to study the relation between such degenerative changes and acute infections.

The work will be considered under these heads:

1. Normal structure of valves and normal variations of structure with age.
2. Degenerative lesions.
3. Acute infections in relation to degenerative lesions.

### TECHNIC.

The specimens were obtained from autopsies on 42 hospital patients, varying in age from a child, which died at birth, to a man of 60. The autopsies were made from 12 to 48 hours postmortem. All the hearts were apparently in a good state of preservation. In almost all cases the mitral and aortic rings were cut out together, washed gently, and hardened at once in Zenker's fluid—celloidin was used for mounting in all but a few cases, for these paraffin was used.

The sections were cut out as follows: A segment about one-fourth inch wide was cut from one of the cusps of the aortic valve, including its widest portion. Longitudinal sections of these were used for staining. In the same way, a segment of the broadest portion of the mitral curtain (at the base of the aortic valves) was taken and cut longitudinally, or sometimes several segments were removed when the valve presented any peculiar appearances.

Three sets of stains were used for each specimen. One section was stained with Mallory's differential connective tissue stain, a second with Weigert's elastic tissue stain, and a third with hematoxylin and eosin.

The first of these was found most useful for studying the general anatomy of the valves. The second gave beautiful pictures of the elastic tissue. The third brought out some peculiarities of the staining reactions of the various tissues, and showed best the morphology of the cells and muscle tissue.

### 1. NORMAL STRUCTURE OF VALVES AND NORMAL VARIATIONS OF STRUCTURE WITH AGE.

Standard works on histology give very meager descriptions of the heart valves. Kölliker describes the auriculoventricular valves as composed of a strong layer of fibrous tissue with abundant elastic fibers running out from the fibrous ring about the valve orifice, each surface being covered with a layer of endocardium which is thicker on the auricular side. He says that the semilunar valves have the same structure, but are thinner.

The works of most of the older writers are either insufficient or inaccurate. Luschke<sup>2</sup> was one of the

1. Kölliker: *Handbuch der Gewebelehre*. Sixth edition, vol. iii, p. 607.

2. Luschke: *Virchow's Arch.*, vol. iv, 1852.

earliest to describe, and to demonstrate by injections, blood vessels in the auriculoventricular valves (1852). Later (1878), he stated the vascularity of the semilunar valves.<sup>3</sup> There was considerable controversy over these observations. Coen<sup>4</sup> found the mitral valves vascular, but the aortic valves not vascular. Darrier,<sup>5</sup> in a careful work in 1895, found that semilunar valves never contained blood vessels; that a normal tricuspid never contained them; that the large curtain of the normal mitral valve, where its base is applied to the aortic valve, contained numerous vessels as far out toward its edge as the muscular layer extended (i. e., one-fourth way in the infant and one-sixth in the adults); that in pathologic conditions the whole valve might be abundantly supplied with vessels.

We find no accurate observations on elastic tissue

lunar valves, but does not describe them in detail. Veraguth<sup>8</sup> describes various layers of the auriculoventricular and semilunar valves according to the appearance of the cells and intercellular substance, and according to the embryology of the structures as given by Hertwig.<sup>9</sup>

According to Veraguth, the valves consist of five layers, as follows:

1. Under the endothelial covering of the valve a thin layer of tissue rich in cells with small spindle-shaped nuclei and some with larger nuclei.

2. Under this, a more distinct zone of a few large cells (as 6-1 to cells in first layer) with much intercellular substance.

3. In the center, a layer of fibers running parallel to the rim of the valve and especially marked (in case of auriculoventricular valves) where the chordæ tendineæ are attached. This layer also possesses a few large cells.

Nos. 4 and 5 correspond to 2 and 1, respectively, on the other side of the valve.

In the mitral valve the central layer is pronounced, but in the semilunar valves it is practically wanting, so that the valve by the union of layers 2 and 4 consists of but three layers.

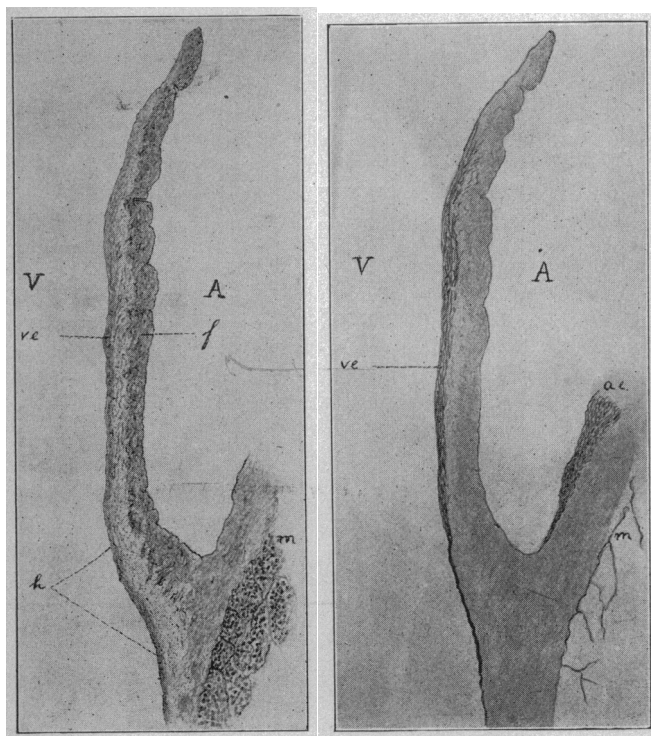


Figure 1.

Figure 2.

Fig. 1.—Aortic valve. Age 15 months. V, ventricular side; A, aortic side; ve, ventricular elastic layer; f, aortic fibrous layer; h, hinge area; m, muscle. (Mallory's stain, low power.)

Fig. 2.—Aortic valve. Age 15 months. V, Ventricular side; A, aortic side; ve, ventricular elastic layer; ae, aortic elastic layer; m, muscle. (Weigert's elastic tissue stain, low power.)

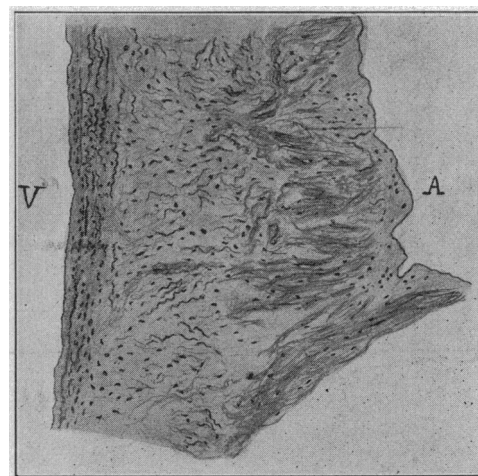


Fig. 3.—Aortic valve. Age 15 months. Shows "hinge area." V, ventricular side; A, aortic side. Shaded area on ventricular side contains elastic tissue and a few scattered connective tissue fibers. Central portion composed of very loose tissue fibers. Denser tissue on aortic side. (Mallory's stain, high power.)

in the valves up to 1895, when Seipp,<sup>6</sup> in a work on elastic tissue of the heart, goes into the subject at length. A summary of most of the literature on the subject can be found here. Seipp states that the stains used by most previous observers did not give a correct impression of the elastic tissue in the valves. He used orcein and seems to have obtained very good results. In the main, our observations agree with his.

Only a few writers give a detailed description of the tissues entering into the various layers of the valves. Curtis<sup>7</sup> enumerates four distinct layers of the semi-

This arrangement, he says, is borne out by the developmental appearances of the valves in the embryo. According to Hertwig,<sup>9</sup> the auriculoventricular valves are formed by a fibrous degeneration of muscle tissue, which originally surrounded a small auriculoventricular opening. This fibrous tissue is covered on both sides by a layer of "gelatinous" tissue lining the heart. The semilunar valves, being composed only of an out-folding of this same "gelatinous" tissue, have not the same fibrous center.

Veraguth<sup>8</sup> concludes that the two outer layers he describes are remains of the embryologic "gelatinous" tissue mentioned above, and that his central layer in the auriculo-ventricular valves is the fibrous degenerated muscle layer. The valves, according to him, are symmetrical as to their two faces, and if slit down the middle between them would show similar halves.

8. Veraguth, O.: Untersuchungen über normale und entzündete Herzklappen. Arch. f. pathol. Anatomie, vol. cxxxix, pp. 59-80.

9. Hertwig: Embryologie. Third edition, 1890, p. 457.

3. Luschke: Verhandl. der phys.-med. Gesellschaft in Würzburg, 1878.

4. Coen, E.: Ueber die Blutgefässe der Herzklappen. Arch. f. microsc. Anat., vol. xxvii, pp. 397-403.

5. Darrier, J.: Les vaisseaux des valvules du coeur chez l'homme à l'état normal et à l'état pathologique. Arch. de Physiol., No. 5, July, 1888, pp. 35-59.

6. Seipp, L.: Das elastische Gewebe des Herzens. Anatomische Hefte, No. 17, vol. vi, 1895-6, pp. 63-116.

7. Curtis, F.: Structure des Valvules sigmoïdes de l'aorte, etc. Société de Biologie, vol. xi, 1888, pp. 591-594.

This assertion we find to be more nearly true of the aortic valves than of the mitral; but even in the latter the distribution of the elastic tissue on the two faces is not at all the same, and the layer of muscle so often seen is always near the auricular surface. Of the aortic valve, this is not true at all, as can be seen from the drawings accompanying this article.

The following description is from normal aortic and mitral valves of various ages, cut and stained by the methods already described.

*A. Normal Aortic Valves. From Birth to Perhaps Five Years of Age.*—The valve is composed of (1) fibrous and (2) elastic tissue.

1. **Fibrous Tissue:** This tissue is densest on the aortic side of the valve. It is denser toward the tip than at the base. The fibers of the aortic side are for the most part cut in cross section, i. e., their direction is circular. Some, however, are longitudinal or nearly so. Cells are not numerous. In the middle plane of the valve, the fibrous tissue is not dense. The fibers are arranged in small spiral bundles, some of which run in the long axis of the valve (especially near the ventricular side), while others run from one surface toward the other. The cells are larger and more numerous. Many of the fibers are extremely fine and

2. **Elastic Tissue:** This tissue is densest on and practically confined to, the ventricular side of the valve. The fibers run for the most part longitudinally, immediately beneath the surface endothelium. Among them are a few crosscut (i. e., circular) fibers, and beneath the main layer of longitudinal fibers these crosscut fibers form a fairly distinct band.

The elastic layer begins at the base of the valve as a very dense band of fibers in which the individual threads can not be distinguished. It broadens as it goes out on the valve so that the individual fibers can be clearly seen, being, at its broadest part, from two-thirds to three-fourths of the distance from base to tip. Here the fibers invade the middle layer of the valve to a considerable extent. Beyond this the layer thins out rapidly, though tissues having the same appearance as that in which the elastic fibers are embedded run to the end of the valve as a definite layer containing almost no connective tissue fibers. This appearance is well shown in specimens stained by Mallory's connective tissue stain. Here this layer is seen extending well to the tip of the valve, but with the elastic stain no elastic fibers are seen beyond the inner three-fourths. Just at the tip of the valve, on the ventricular side, a well-marked layer of circular fibers is often seen (Fig. 1).

On the aortic side of the valve there is a thin layer of crosscut elastic fibers, immediately beneath the endothelium. This layer keeps its same character throughout the length of the valve. Among the fibrous tissue at large, occasional elastic fibers are found, running in various directions.

The "hinge portion" of the valve is that part particularly adapted to easy bending. In it the fibrous tissue of the aortic side is thin, the central loose tissue is abundant, and the elastic layer of the ventricular side is thin, dense and strong. Its size varies considerably in different valves. It often takes a peculiar blue stain with hematoxylin (i. e., the loose central part), analogous to myxomatous tissue, but the continuation into the main part of the valve seldom shows this reaction (Fig. 3).

*B. Normal Adult Aortic Valves.*—The fibrous tissue is again densest on the aortic side. The bundles are thicker, less wavy, and with more tendency to longitudinal arrangement than in the infantile valve. The valve is less cellular. The middle plane of the valve, which in the infant is occupied by a fairly broad band of very loose cellular tissue, is much narrower in the adult, being encroached on by the dense fibrous tissue of the aortic side and driven up against the ventricular elastic tissue layer. The latter contains rather more fibrous tissue.

The elastic tissue is arranged as in the infantile valve, but is denser and continued on both sides more distinctly to the tip of the valve. It seems as if the elastic forming layer (noticed along the ventricular side of the valve) of the infant had formed its elastic fibers completely in the adult. There are also more elastic fibers mingled with the fibrous tissue at large and in the "hinge area."

While the relation of fibrous and elastic tissue is constant in valves of different ages, there is a progressive change toward an adult type. This consists of a thinning of the valve in proportion to its length; in a condensation of the fibrous tissue, the densest part of which, lying in the infant near the aortic surface, comes to occupy the greater proportion of the width of the valve,

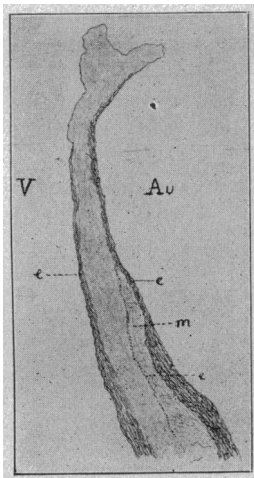


Figure 4.

Fig. 4.—Mitral valve. Age 15 months. V, ventricular side; Au, auricular side; e, elastic layer; m, muscle. (Weigert's elastic tissue stain, low power.)

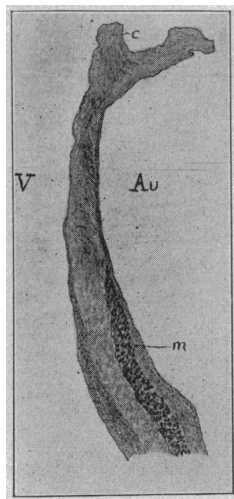


Figure 5.

Fig. 5.—Mitral valve. Age 15 months. V, ventricular side; Au, auricular side; c, chordae tendinae; m, muscle. (Mallory's stain, low power.)

wavy (this layer which we have spoken of as lying in the middle plane, is really nearer the ventricular side, directly beneath the ventricular elastic layer. It is so spoken of because it lies between this layer and the dense fibrous tissue of the aortic side. If this latter layer is unusually narrow it really appears to lie in the middle.) On the ventricular side of the valve there are only a few wavy, longitudinal fibrous bands mingled with the elastic tissue of the part.

At the base of the valve, in what might be called the "hinge area," the middle layer of very loose fibrous tissue is so broad as to occupy nearly the whole width of the valve, but immediately beyond this it becomes much thinner. Toward the end of the valve it is invaded by a few longitudinal bundles of fibers of the ventricular side, and finally is obliterated, the dense layer of the fibrous tissue on the aortic side meeting the ventricular elastic layer (Fig. 1).

while the loose layer in the middle plane becomes reduced in thickness; and in a considerable increase in the quantity of the elastic tissue both on the valve surfaces and in the valve substance.

In many infantile valves the tip of the valve forms a sort of knob connected with the rest by a very thin portion. This arrangement we have never seen in adult valves. In one adult valve in our collection a few isolated bundles of muscle fibers, circular in direction, are seen in the ventricular elastic layer.

*C. Normal Infantile Mitral Valves (large mitral curtain).—*The mitral valve is somewhat stronger, thicker and less flexible than the aortic. It consists of a fibrous plate which tapers a little from base to free edge, where it becomes differentiated into the chordæ tendineæ. It is supplied at its base and for a variable part of its length with cardiac muscle. It possesses a thick covering of elastic tissue on both its surfaces at its base, but the layer on the ventricular surface thins out rapidly as it passes out on the valve (Figs. 4 and 5).

The fibrous tissue occupies the greater part of the thickness of the valve. It is densest on the ventricular side. The fibers are more generally circular in direction and the cells rather few in number. Under the elastic layer of the auricular side of the valve the fibrous tissue is thinner, more cellular and consists of wavy bundles either longitudinal in direction or running from one surface of the valve toward the other. This arrangement corresponds to that of the aortic valves, but in the mitral valve the dense fibrous layer occupies much more of the thickness of the valve. As the region of the chordæ tendineæ is reached the fibrous bundles becoming longitudinal in direction stream out into them from the ventricular surface.

The elastic tissue is seen on both sides of the valve. On the ventricular side it is continuous with the elastic layer of the ventricle and is thick and strong at the base of the valve, being composed of wavy layers of fibers longitudinal in direction. It thins out rapidly and dwindles to nothing about two-thirds of the way from base to tip. On the auricular side the elastic layer is equally thick and sometimes denser. It is composed of many layers of fibers longitudinal in direction and diminishes in thickness as it extends outward. At a point from two-thirds to three-fourths of the distance from the base to the tip it spreads out away from the auricular surface, but part of it can be seen continued beneath the endothelium nearly to the tip. It is embedded in the same sort of tissue as that on the ventricular side of the aortic valve and has among its fibers and beneath it a few fine wavy bundles of fibrous tissue. Between the main fibrous layer and the wedge-shaped area of muscle at the base of the valve is a layer of elastic tissue generally circular in direction. There are a few elastic fibers among the muscle fibers.

In a general way the arrangement of elastic tissue resembles that of the aortic valve, but differs in the thickness of both layers at the base. There are occasional elastic fibers in the fibrous tissue occupying the middle plane of the valve.

*Muscular Tissue.*—The mitral curtain possesses a strong wedge-shaped area of muscle at its base. The muscle is of the usual cardiac variety and its fibers are circular in direction. The amount of this muscle and the extent to which it runs out on the valve vary widely. In some cases it extends out as a long wedge for nearly half the length of the valve. In other cases it ends abruptly at the base. It is always found immediately

beneath the auricular elastic layer. Sometimes the main mass of muscle is confined to the base, while a thin band of muscle broken up into small bundles extends out nearly to the tip. In such cases it lies in the auricular elastic layer. Occasionally isolated bundles are seen scattered along the layer.

*D. Adult Normal Mitral Valve.*—The adult mitral valve bears the same relation to the infantile as does the aortic. The elastic tissue is much more fully developed and the fibrous tissue more dense. The chordæ tendineæ can now be seen to possess a thin longitudinal layer of elastic fibers close to their surface.

The valve is much longer in proportion to its thickness, and the muscular portion shorter as a general thing in proportion to the whole length of the valve. In all cases in which muscle tissue is seen definite blood vessels are found and may extend well out to the edge of the valve. They are always with the muscle on the auricular side.

## II. DEGENERATIVE LESIONS.

Under this head will be considered thickenings whose pathologic character is in doubt. There is little in the literature on this subject. Veraguth<sup>8</sup> describes certain thickenings on the valves, which apparently are not pathologic in character. These are seen at any age. They are apt to appear at the points where the valve surfaces come in contact with each other in closing, and are apparently developed from his "second" layer. They consist, he finds, of a very dense connective tissue formation, sometimes almost homogeneous in appearance and containing a few drawn-out, shrunken cells. He considers them to be a development from embryologic remains which take on growth, perhaps, because of irritation from the coming together of the valve surfaces. He points out that they are not a result of hypertrophy from work, as they are found in the very young, nor are they remains of acute infections, as the layer between them and the surface is unchanged.

We have frequently found such thickenings accompanied or unaccompanied by definite pathologic changes. In aortic valves they occur on the ventricular surface, where the valves meet in closing. They are conical or rounded in shape. They consist of tissue such as is described above, but contain in addition many fine elastic fibers. They appear to grow, in fact, from the ventricular elastic layer which forms their base. We have found them in a child 5 years old and at various other ages, but in later life they are generally accompanied by certain degenerations in the valves which will be described later. In addition to the hypothesis given by Veraguth as to their origin, it might be suggested that they are an adaptation acting to correct a faulty closure of the valves. They are best seen on the aortic valves and often on one or perhaps on two cusps only.

Degenerative lesions in the aortic valves are of the following types: (a) mucoid, (b) fatty.

(a) *Mucoid Degeneration.*—In the normal anatomy of the aortic valves already described, a layer of loose cellular tissue was mentioned, very wide at the "hinge area" of the valves and running from here toward the free edge, between the ventricular elastic layer and the dense aortic fibrous layer. In young valves this was found to take at times a deep blue stain with hematoxylin, thus resembling myxomatous or mucoid tissue.

In older valves, tissue having this same appearance is seen as a degenerative lesion more commonly than any other. It occurs toward the tip of the valve beneath the ventricular elastic layer and encroaching con-

siderably on the dense fibrous tissue of the opposite surface. Such areas show an increased number of large cells with round or oval nuclei and few connective tissue fibers, many of which appear fragmented. While they generally stain blue with hematoxylin, they sometimes take practically no stain at all, there being little intercellular substance left. Stains for elastic tissue show a few elastic fibers.

This condition very frequently accompanies and may occur in the midst of large thickenings on the valve surface. The youngest valve in our collection which shows such a degeneration is one cusp of an aortic valve (the other cusps being normal) of a woman, aged 24, dead of pneumonia and empyema. The degenerate area is beneath a moderate thickening on the ventricular surface. The natural explanation of this condition is that the thickening by interfering with the nutrition of the valve caused the degeneration, for such myxomatous or mucoid tissue is often seen in the midst of very large thickenings. Attention has already been called to the fact that the layer in which the myxomatous degeneration is found is one which in young valves sometimes presents something of the same appearance throughout its length.

Mitral valves, like the aortic, are apt to show thickenings on the auricular side where the valves meet, but we have not noticed this in young valves, and the thickening is apt to include the whole width of the valve. Mucoid degeneration is very common in the midst of them.

(b) *Fatty Infiltration.*—In aortic valves this occurs most often midway from base to tip, almost never near the base, and frequently throughout the outer half. It occupies the middle plane of the valve encroaching much more on the ventricular elastic layer than on the dense fibrous tissue. The majority of our valves of over 30 years show more or less of this condition, which is usually accompanied, when extensive, by a generally diffused thickening of the ventricular surface, analogous in this respect to the sclerotic changes in arteries. The fat cells are often very large and are apt to lie in groups among the elastic fibers, often pushing them aside.

The fatty changes in mitral valves take place in the auricular elastic layer and just beneath it. In distribution and arrangement they resemble those in aortic valves. They are more often seen, however, near the base of the valve than in the aortics.

### III. ACUTE INFECTIONS IN RELATION TO DEGENERATIVE LESIONS.

We hoped on beginning this investigation to find some degenerative lesions directly connected with acute infections, such as pneumonia, typhoid, diphtheria, etc. It has been disappointing, therefore, to find that in valves of those dead of such diseases there appear only degenerations which are evidently chronic, or at least none which we can recognize as acute. In fact, we find in no valves from pneumonia patients, etc., a predisposing cause for acute endocarditis.

A good account of the pathologic anatomy of acute valve infections is given by Veraguth,<sup>8</sup> who quotes experimental results of other investigations on this subject. We have only seen one instance of an acute infection in valves not previously diseased (i. e., thickened). In this case (mitral valve) there was a destruction of tissue on the auricular side of the valve near the tip, extensive fibrin formation in the necrotic tissue, and beneath this, in the main substance of the valve, a considerable proliferation of large connective tissue cells.

Large masses of streptococci were seen in the necrotic area. The great increase in the number of connective tissue cells about the infected area is spoken of by Veraguth, who states that apparently they take the place of polynuclear leucocytes, which are not present to any extent. These cells are large, round and oval in shape, with a rather deeply stained granular protoplasm and a comparatively small round nucleus. They resemble plasma cells. No blood vessels are seen, new or old. It is an interesting fact that the pulmonic valves were severely infected in this case, while the aortic valves were normal.

A number of our specimens showed acute infections superimposed on chronic thickenings. Most of these were in mitral valves. They showed a fibrinous or fibrino-purulent exudate on the surface and extending into the valve substance for a varying distance, always from the auricular surface. In many cases, when the valve was much thickened, there was a considerable collection of what looked like plasma cells about the blood vessels, which were often numerous and sometimes quite large. In these cases the cells seemed to be connected with the repair of the valve, as young blood vessels and young connective tissue cells were in abundance.

In some cases the relative age of the different depths of a thickening could be told fairly well. Furthest from the auricular surface the tissues and blood vessels were richly supplied with elastic fibers. Nearer the surface the tissue became less elastic and more like ordinary scar tissue, while the vessels were smaller and younger. On the surface, when the repair from the last attack was still going on, the young connective tissue cells were large and abundant, and the vessels thin-walled and capillary. Such conditions would seem to show that the thickening was due to repeated attacks of acute infection. At other times it was impossible to tell whether the thickening was of the benign type described earlier or of the type we have just described. We think that the vascularity of the thickened tissue would generally show the difference, but further observations are needed.

We have not noticed in mitral valves such extensive destruction of a large, thickened flap as in aortic cases. In one of these a very large, thickened tip was practically eaten away from the ventricular side. It seems evident that a valve which has no internal blood supply can not repair itself so well as one in which the blood supply is abundant. This valve in which the destruction of tissue was extreme, possessed only a number of capillary vessels with no elastic tissue in their walls; vessels which were connected apparently with the surface of the valve only, and were little more than blood spaces. Indeed, there was little attempt at repair in this case, and it would seem as if an aortic valve stood a poorer chance of repair without deformity than a mitral valve under similar circumstances.

We can only conclude from our observations on acute infections in degenerate and thickened valves that mucoid and fatty degenerations do not apparently predispose to infection; that "benign thickenings" do not predispose to infection, though it is hard in the case of the mitral valve to tell whether a thickening is benign or due to repeated acute attacks; that the thickenings in mitral valves when infected are better repaired than in those of aortic valves; and that acute toxemias do not cause degenerations (at least none that we can recognize) predisposing to infection.