THE EXTENSIBILITY OF THE ARTERIES IN MAN

By

J. S. FULTON

M.B., Ch.B.

Being a Thesis submitted for the Degree of Doctor of Medicine of the University of Edinburgh.

March, 1930

V O L U M E T W O

——— ooo ———

PHOTOMICROGRAPHS

illustrating

the

HISTOLOGICAL INVESTIGATION

Figs. 1, 2, & 3.

Sections of the carotid artery from a subject aged 35 years.

Fig. 1. x 100.

Common carotid artery near its origin.

The internal coat is composed of a fairly thick endothelial and sub-endothelial layer. The media exhibits a highly elastic structure, being composed almost entirely of a mass of concentric elastic fibres. There appears to be little or no external coat.

Fig. 2. x 100.

Common carotid artery at its bifurcation.

The intima again appears to merge into the media in which the elastic tissue fibres are less numerous. The external coat is faintly discernable.

Fig. 3. x 100.

External carotid artery.

The intima is sharply outlined and there is a considerable decrease in the number of elastic tissue fibres present, these being grouped mainly towards the inner part of the vessel wall. The external coat is definitely outlined, and contains a number of longitudinally disposed elastic tissue fibres.

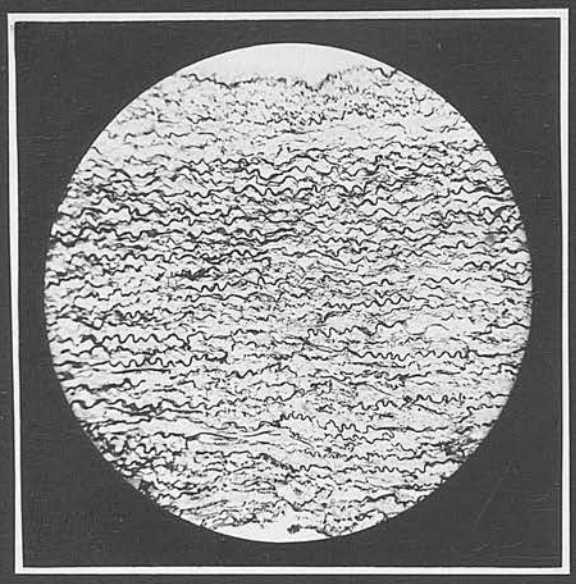

Fig. 1.

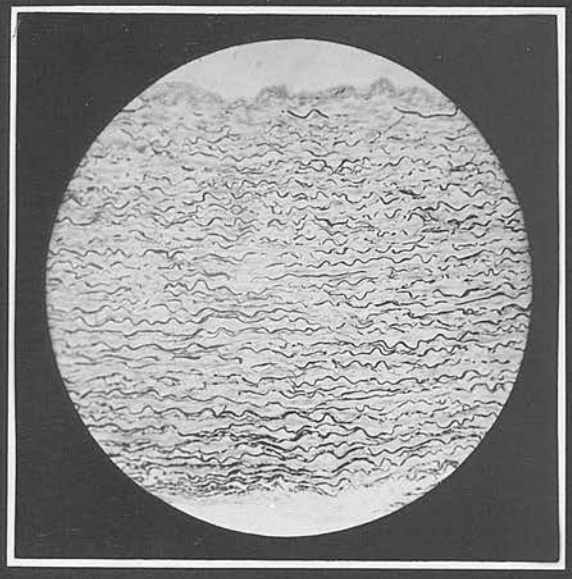

Fig. 2.

Fig. 3.

Figs. 4, 5 & 6.

Sections of carotid arteries from a subject aged 45 years.

Fig. 4. x 100.

Common carotid artery near its origin.

The intima appears to merge into the media. The media contains a large number of elastic tissue fibres arranged circularly. The external coat is not visible.

Fig. 5. x 100.

Common carotid artery at its bifurcation.

The elastic tissue layer of the intima is more clearly defined underneath the endothelial and sub-endothelial layers. The media contains a relatively smaller number of elastic tissue fibres than in the previous section.

Fig. 6. x 100.

External carotid artery.

The elastic layer of the intima is sharply defined, and the endothelial layer is thinner. The media contains a few faintly outlined elastic tissue fibres only. The external layer is shown and contains a number of elastic tissue fibres.

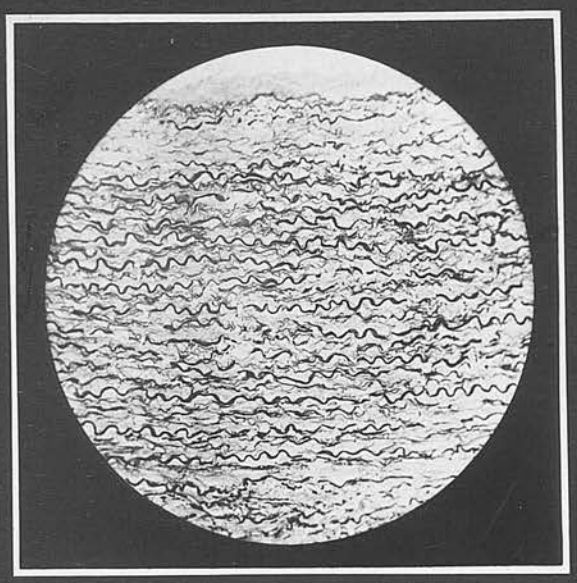

Fig. 4.

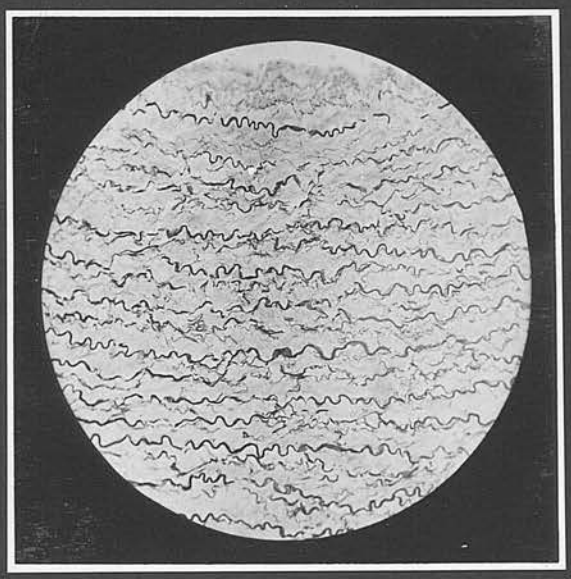

Fig. 5.

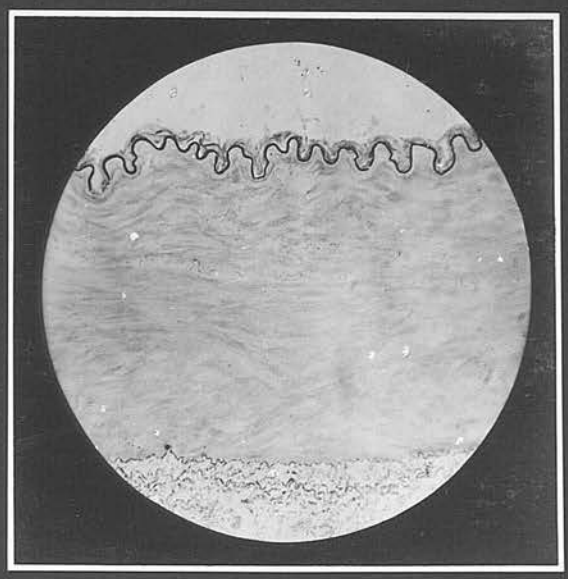

Fig. 6.

Figs. 7, 8 & 9.

Axillary, brachial and radial arteries from a subject aged 45 years.

Fig. 7. x 100.

Axillary artery.

The intima consists of a fairly thick layer of endothelial cells merging into the media. The middle coat contains a large number of closely arranged elastic tissue fibres. The external coat is not clearly defined but may be seen to contain a number of elastic tissue fibres arranged longitudinally.

Fig. 8. x 100.

Middle portion of brachial artery.

The intima is sharply defined and the endothelial layer much thinner. The media contains a fair number of elastic tissue fibres. The external coat is well developed, and contains a large number of longitudinally arranged elastic tissue fibres.

Fig. 9. x 100.

Middle portion of radial artery.

The elastic membrane of the intima is clearly outlined. The media is composed almost entirely of muscular tissue, no elastic tissue fibres being discernable. The external coat appears to be thinner than that of the brachial artery, and contains a relatively smaller number of elastic tissue fibres.

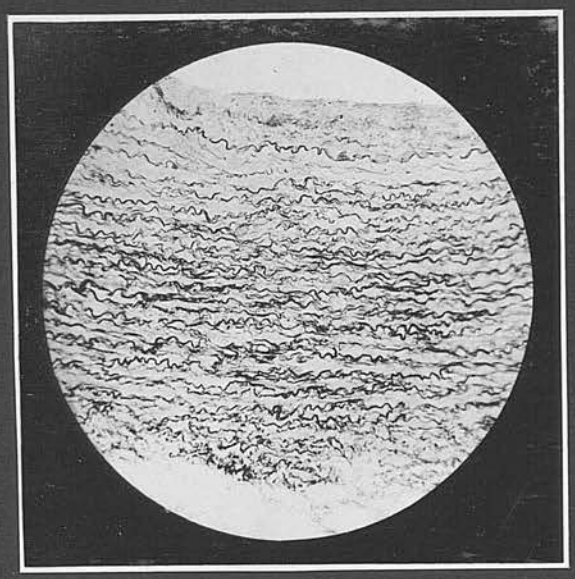

Fig. 7.

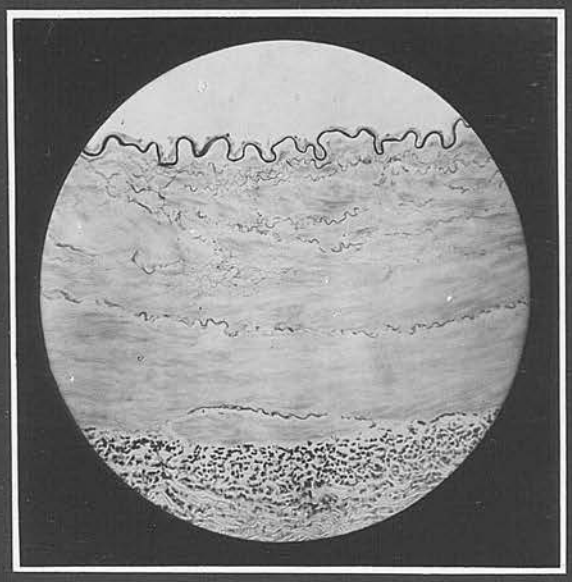

Fig. 8.

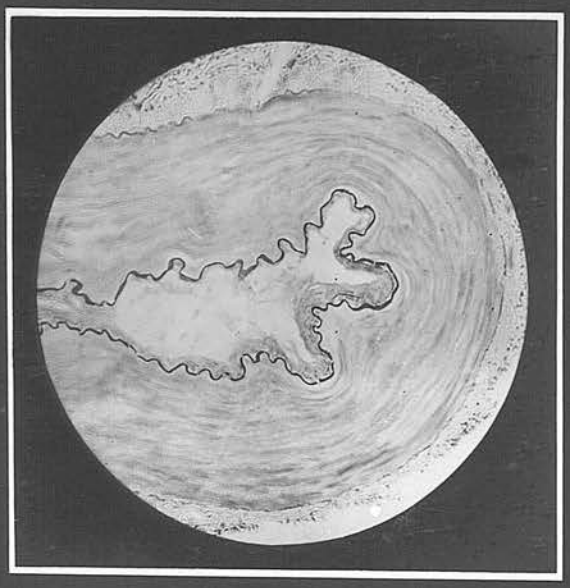

Fig. 9.

Figs. 10, 11 & 12.

Sections of brachial artery from a subject aged 35 years.

Fig. 10. x 100.

Upper portion of brachial artery.

The internal elastic coat is well marked. The media contains a considerable number of elastic tissue fibres concentrically arranged. The external coat is present but appears to merge into the media.

Fig. 11. x 100.

Middle portion of brachial artery.

The internal elastic coat is again well defined. The media contains fewer elastic tissue fibres, and these are situated chiefly towards the inner portion of the vessel wall. The external coat is well marked and contains many elastic tissue fibres.

Fig. 12. x 100.

Lower portion of brachial artery.

There is a well defined internal elastic coat with a thick layer of endothelial cells. The media contains only a few scattered elastic tissue fibres. The adventitia has become detached, but a few longitudinally disposed elastic tissue fibres may be seen in the portion remaining.

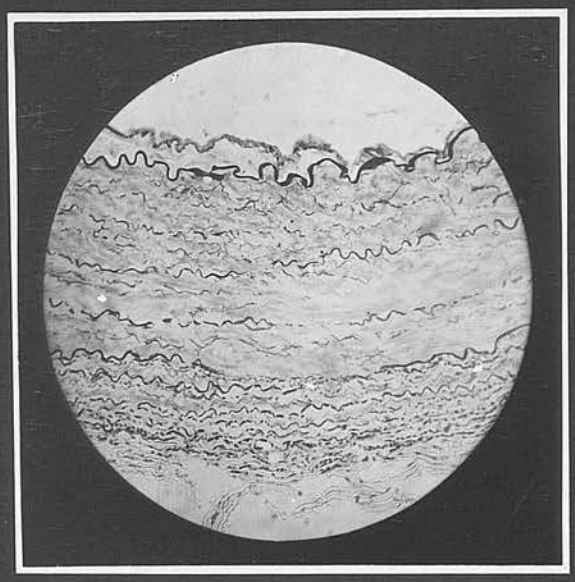

Fig. 10.

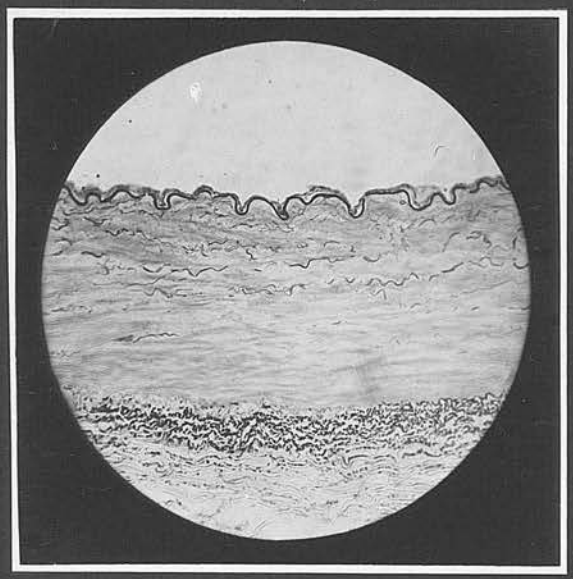

Fig. 11.

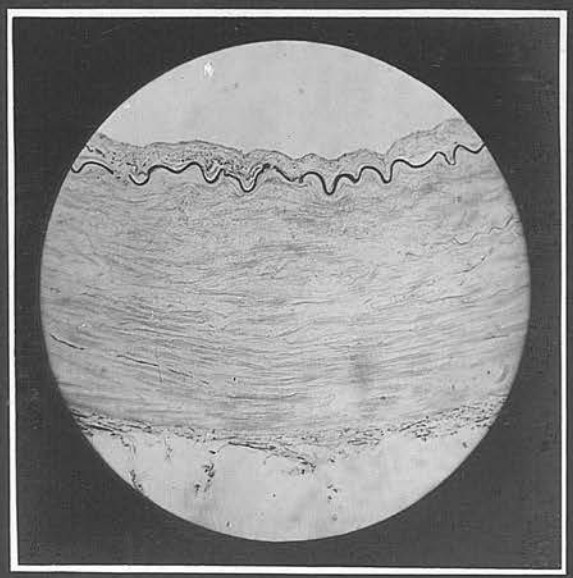

Fig. 12.

Figs. 13, 14 & 15.

Sections of the axillary, brachial and femoral artery from a subject aged 60 years.

Fig. 13. x 100.

Axillary artery.

The intima is not clearly differentiated from the media, and there is a thick endothelial layer. The media contains a large number of circularly disposed elastic tissue fibres. The external coat appears to merge gradually into the media. It can however be seen to contain a number of longitudinally arranged elastic tissue fibres.

Fig. 14. x 100.

Middle portion of brachial artery.

The elastica of the internal coat is sharply defined, and the media contains a number of elastic tissue fibres, mainly in the inner portion of the vessel wall. The external coat is clearly defined, and contains a considerable number of elastic tissue fibres.

Fig. 15. x 100.

Middle portion of femoral artery.

The media is composed largely of muscular tissue and only a few fibres of elastic tissue are to be seen in the section. There is a strong external coat containing numerous elastic tissue fibres.

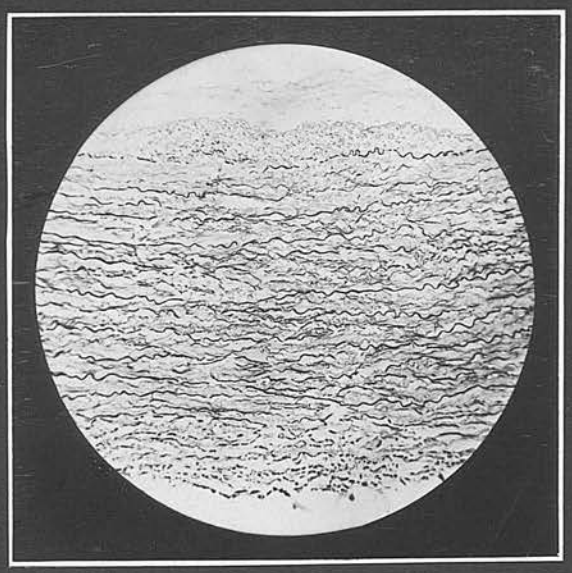

Fig. 13.

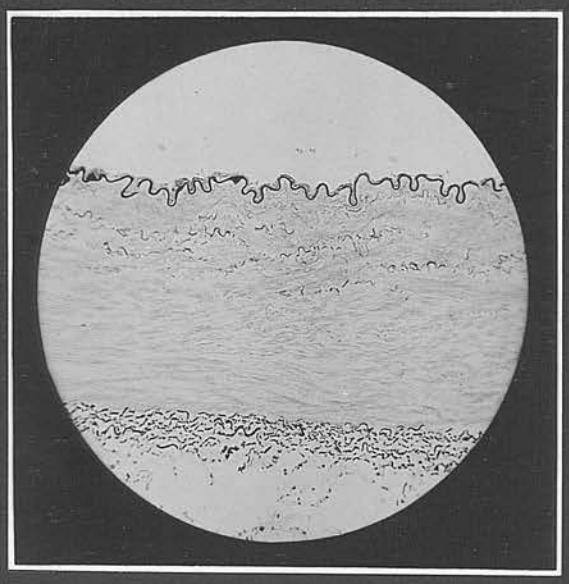

Fig. 14.

Fig. 15.

Figs. 16, 17 & 18.

Sections of the brachial femoral and anterior tibial arteries from a subject aged 40 years.

Fig. 16. x 100.

Middle portion of brachial artery.

The intima is clearly outlined. Numerous elastic tissue fibres are present mainly in the inner portion of the vessel wall. The external coat is well marked and contains many elastic tissue fibres, chiefly arranged longitudinally.

Fig. 17. x 100.

Middle portion of femoral artery.

The intima is well defined. The media is largely muscular in structure, a few elastic tissue fibres only being observed. The external coat is sharply defined and contains a dense network of elastic tissue fibres.

Fig. 18. x 100.

Middle portion of anterior tibial artery.

The intima is outlined and is covered by a layer of endothelial cells. The media is composed mainly of muscular tissue, one or two fibres of elastic tissue only being visible. The external coat is not so dense as in the previous section, and the elastic tissue fibres are fewer in number.

Fig. 16.

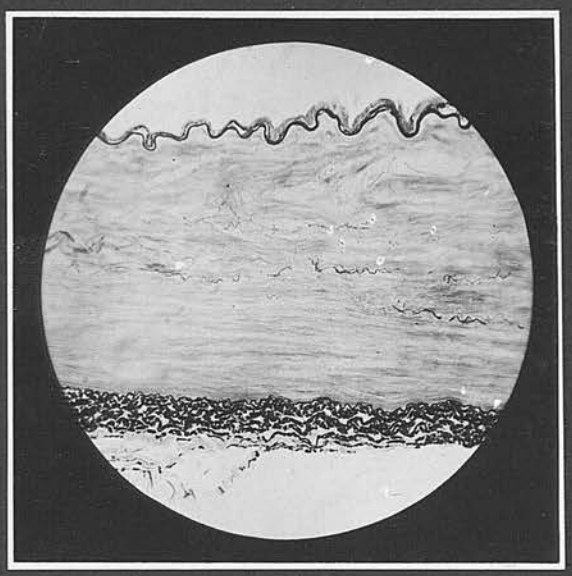

Fig. 17.

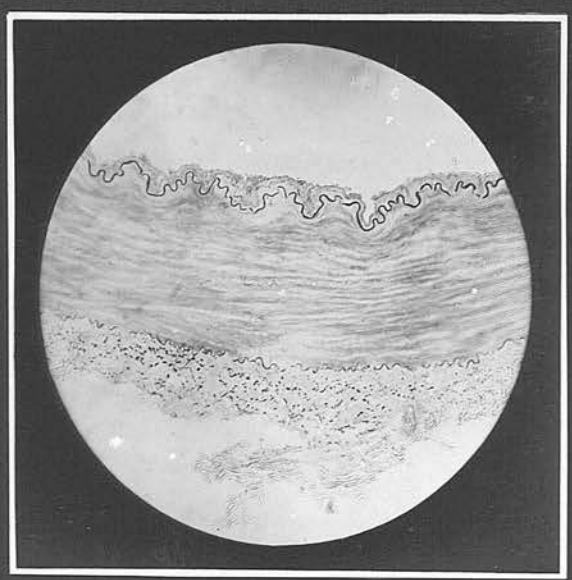

Fig. 18.

Figs. 19, 20 & 21.

Sections of the brachial artery from a subject aged 42 years.

Fig. 19. x 100.

Upper portion of brachial artery.

The intima is clearly defined. The media contains a number of elastic tissue fibres chiefly in the inner portion of the vessel wall. The external coat is composed largely of a network of elastic tissue fibres.

Fig. 20. x 100.

Middle portion of brachial artery.

The media contains fewer elastic tissue fibres. The external coat is still well defined.

Fig. 21. x 100.

Lower portion of brachial artery.

A few elastic tissue fibres only are present in the media. The external coat appears to be thicker, and the elastic tissue fibres present seem to be stronger than in the previous two sections.

Fig. 19.

Fig. 20.

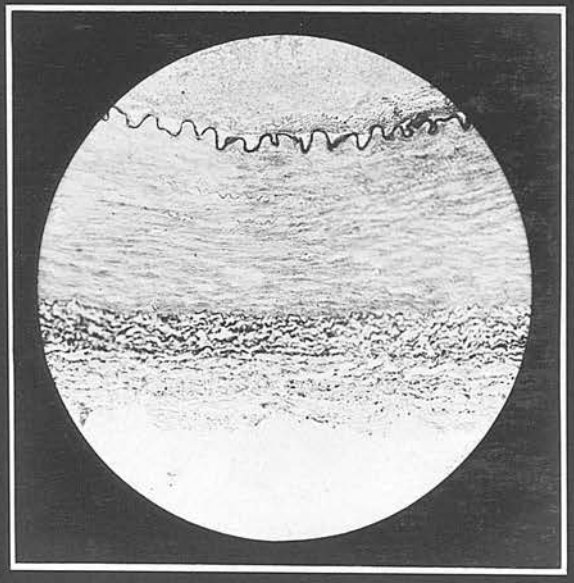

Fig. 21.

Figs. 22 & 23.

Sections of brachial and radial arteries from a subject of 42 years (same case as previous section).

Fig. 22. x 100.

Lower brachial artery immediately above bifurcation.

A few elastic fibres are present in the media. The external coat is well marked and contains a dense network of elastic tissue fibres.

Fig. 23. x 100.

Middle portion of radial artery.

The middle coat is largely muscular, and little or no elastic tissue is present. The external coat is thick but contains few elastic tissue fibres.

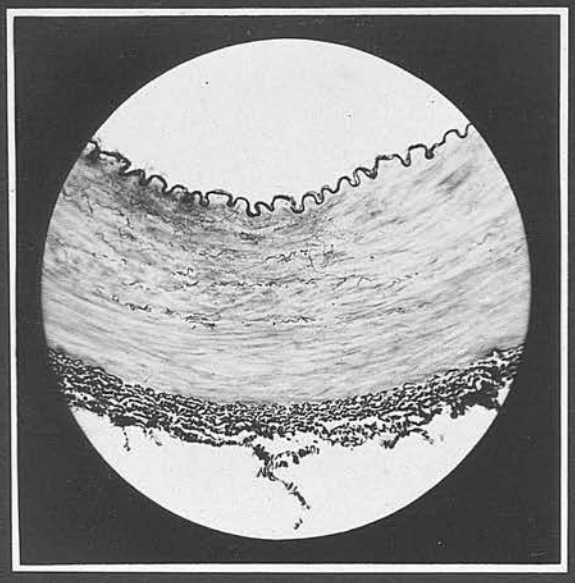

Fig. 22.

Fig. 23.

Figs. 24, 25, 26 & 27.

Sections of the axillary, brachial and radial artery from a subject aged 36 years.

Fig. 24. x 100.

Axillary artery.

The media contains many elastic tissue fibres circularly arranged. The thin external coat merges into the media.

Fig. 25. x 100.

Lower portion of brachial artery.

The media contains a number of elastic tissue fibres. The external coat is composed of a layer of longitudinally disposed elastic tissue fibres.

Fig. 26. x 100.

Upper portion of radial artery.

The media is largely muscular but contains a few scattered elastic tissue fibres. The external coat is well defined and contains a number of strong elastic tissue fibres.

Fig. 27. x 100.

Lower portion of radial artery.

Practically no elastic tissue is to be seen in the media which is composed mainly of muscular tissue. The adventitia contains relatively few elastic tissue fibres.

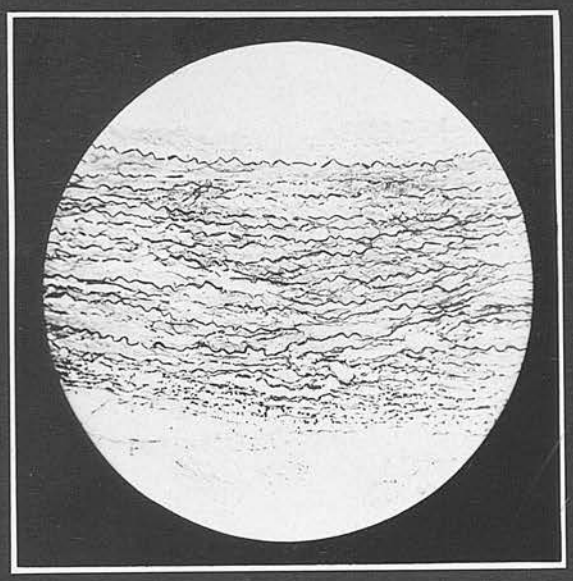

Fig. 24.

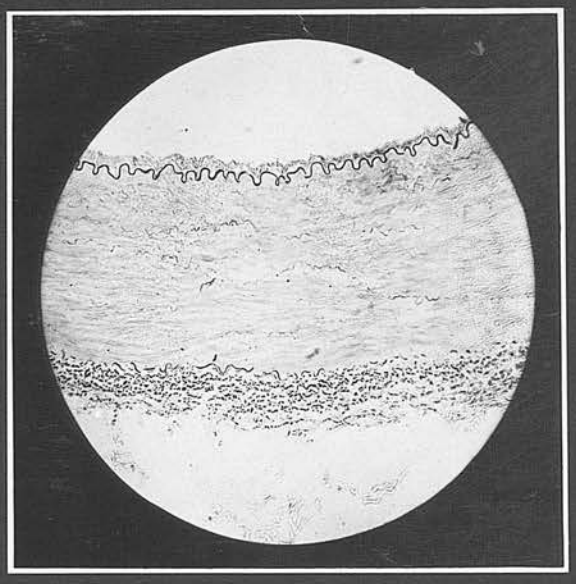

Fig. 25.

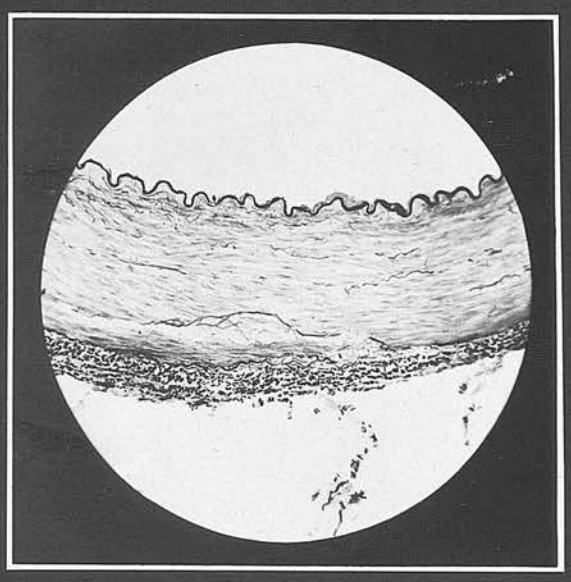

Fig. 26.

Fig. 27.

Figs. 28, 29 & 30.

Sections of the brachial artery from a subject aged 23 years.

Fig. 28. x 100.

Upper portion of brachial artery.

The media contains a number of elastic tissue fibres which are arranged mainly in the inner portion of the vessel wall. The external coat is well marked and contains a dense network of elastic tissue fibres.

Fig. 29. x 100.

Middle portion of brachial artery.

A few elastic tissue fibres are scattered throughout the media. The external coat appears to be composed of a layer of closely interwoven fibres of elastic tissue.

Fig. 30. x 100.

Lower portion of brachial artery.

One or two faintly outlined elastic tissue fibres only are to be seen in the media. The adventitia contains a considerable number of dense elastic tissue fibres.

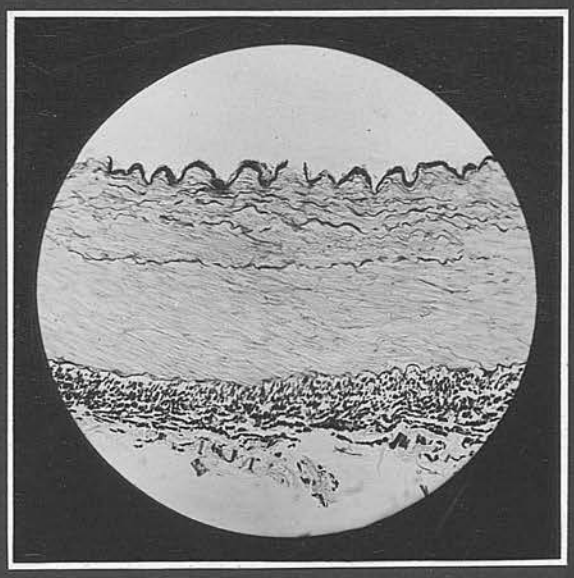

Fig. 28.

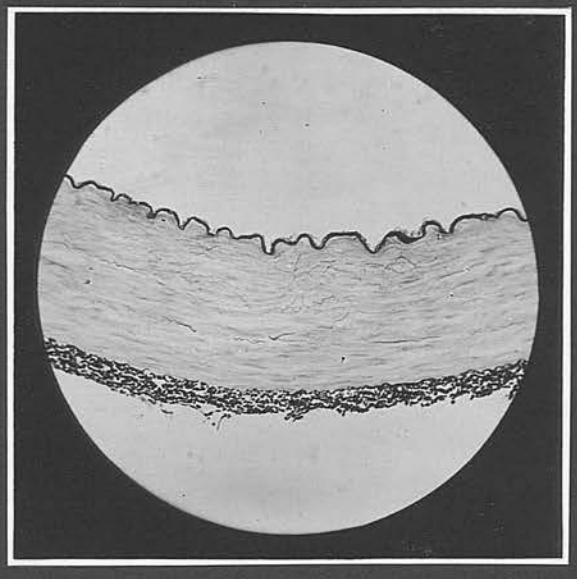

Fig. 29.

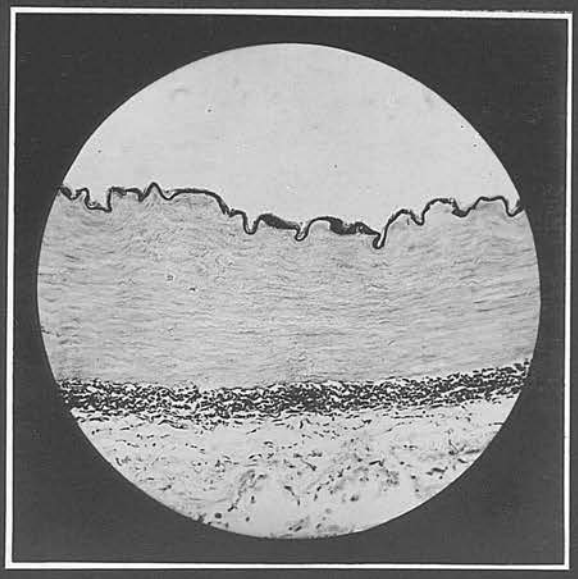

Fig. 30.

Figs. 31, 32 & 33.

Sections of the radial artery from a subject aged 23 years (same subject as immediately preceding sections).

Fig. 31. x 100.

Upper portion of radial artery.

The media is composed almost entirely of muscular tissue. The elastic tissue fibres in the external coat are mainly disposed longitudinally.

Fig. 32. x 100.

Middle portion of radial artery.

The media is muscular in structure. The elastic tissue fibres in the adventitia are fewer in number than in the previous section.

Fig. 33. x 100.

Lower portion of radial artery.

No elastic tissue fibres are to be seen in the media. The elastic tissue fibres in the external coat are mainly arranged longitudinally.

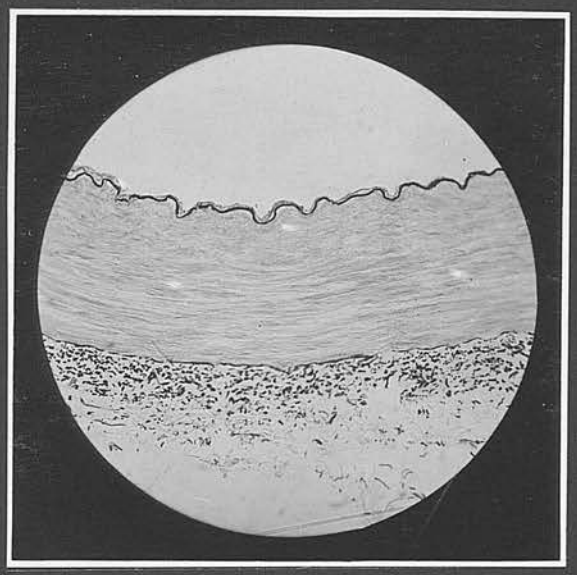

Fig. 31.

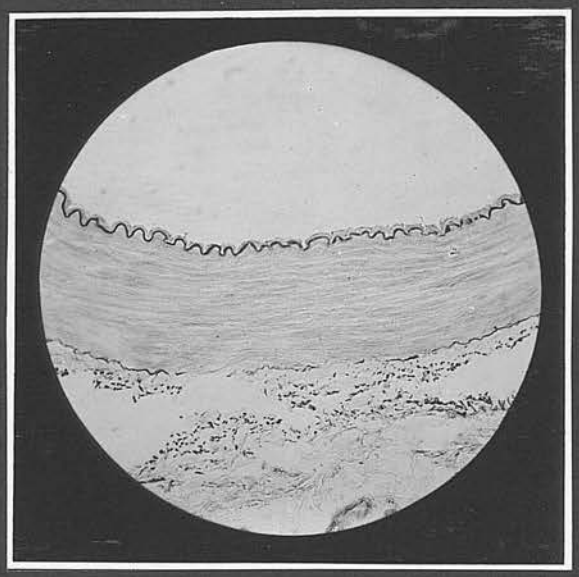

Fig. 32.

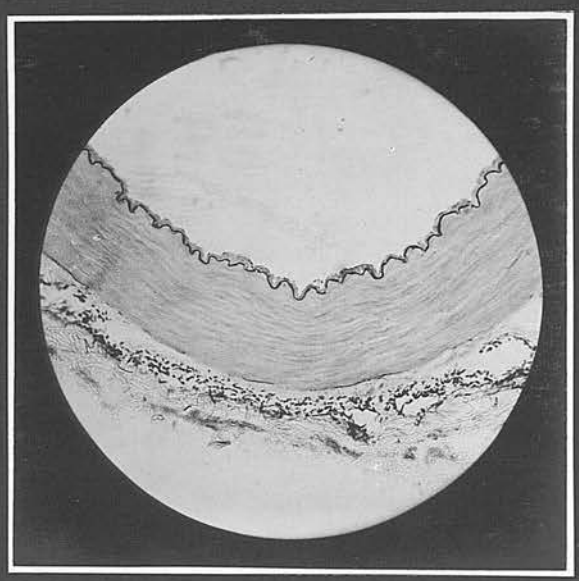

Fig. 33,

Figs. 34 & 35.

Sections of femoral and popliteal arteries from a subject aged 23 years (same subject as preceding sections).

Fig. 34. x 100.

Femoral artery at inguinal ligament.

The vessel wall is composed mainly of the thick muscular tissue of the media. A few isolated fibres of elastic tissue are present. The external coat contains a thick network of elastic tissue fibres.

Fig. 35. x 100.

Popliteal artery.

The media is largely muscular in structure but contains a few scattered elastic tissue fibres. The external coat is composed of a dense network of strong elastic tissue fibres.

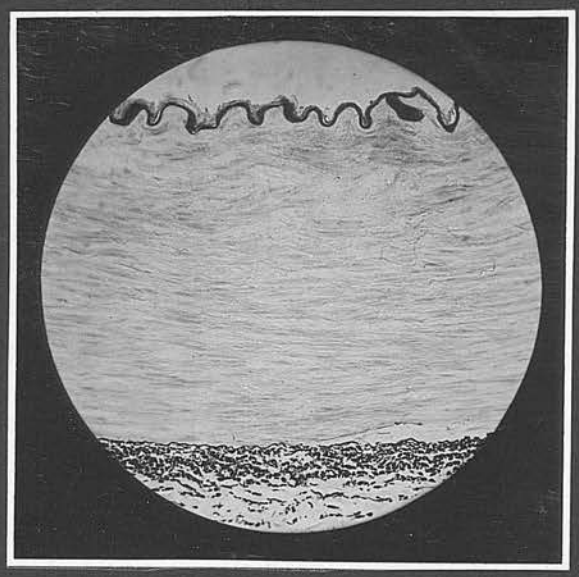

Fig. 34.

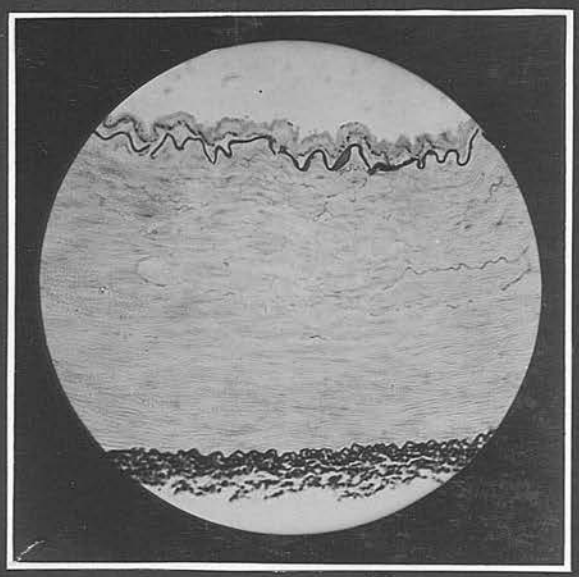

Fig. 35.

Figs. 36, 37 & 38.

Sections of axillary, brachial and radial artery from a child aged 3 years.

Fig. 36. x 100.

Axillary artery.

The media contains a large amount of elastic tissue. The external coat is not well marked, and with the exception of a few scattered longitudinal fibres is practically non existent. The intima as in the large arteries of adults is composed of a thin layer of elastica, lined by a comparatively thick layer of endothelial cells.

Fig. 37. x 100.

Lower portion of brachial artery.

The internal elastic layer is well defined. While there is a distinct decrease in amount of elastic tissue present, the vessel wall still presents a relatively elastic appearance. The external coat is well defined and contains a thick mesh of closely interwoven elastic fibres, mainly arranged longitudinally.

Fig. 38. x 100.

Lower portion of radial artery.

The internal coat is again well defined, but the media shows a distinct decrease in the amount of elastic tissue present, although a few well defined fibres of elastic tissue are to be seen. The external coat is well marked, but the elastic fibres do not appear to be as thick as in the previous section.

Fig. 36.

Fig. 37.

Fig. 38.

Figs. 39 & 40.

Sections of femoral and popliteal arteries from a child aged 3 years.

Fig. 39. x 100.

Femoral artery at the inguinal ligament.

The internal coat is well marked and the media contains a few scattered fibres of elastic tissue. The external coat is particularly well developed and consists of a dense network of elastic tissue fibres mainly arranged longitudinally.

Fig. 40. x 100.

Popliteal artery.

The internal coat is quite well marked, but the media presents a relatively inelastic structure. As in the previous section, the elastic tissue of the external coat is dense, and the fibres are arranged chiefly in the long axis of the vessel.

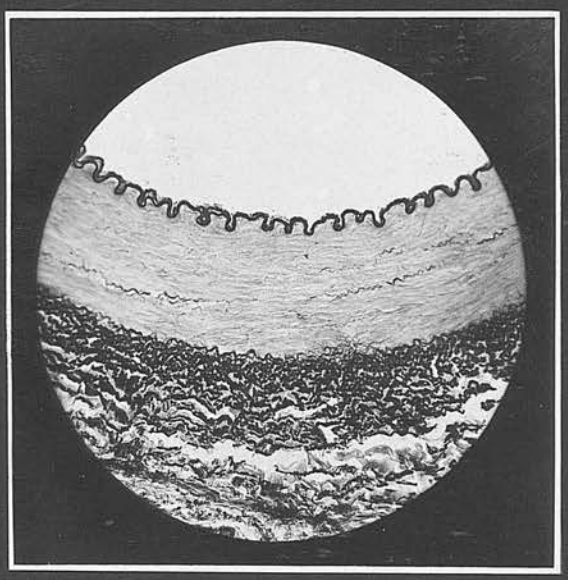

Fig. 39.

Fig. 40.

Figs. 41 & 42.

Sections of femoral and popliteal artery from a subject aged 60 years.

Fig. 41. x 100.

Femoral artery at the inguinal ligament.

The media is largely muscular but contains a few scattered elastic tissue fibres circularly disposed. A few longitudinally arranged fibres of elastic tissue belonging to the external coat are seen at the lower extremity of the section.

Fig. 42. x 100.

Popliteal artery.

The media presents a similar appearance to the foregoing section. The external layer contains a dense network of strong elastic tissue fibres.

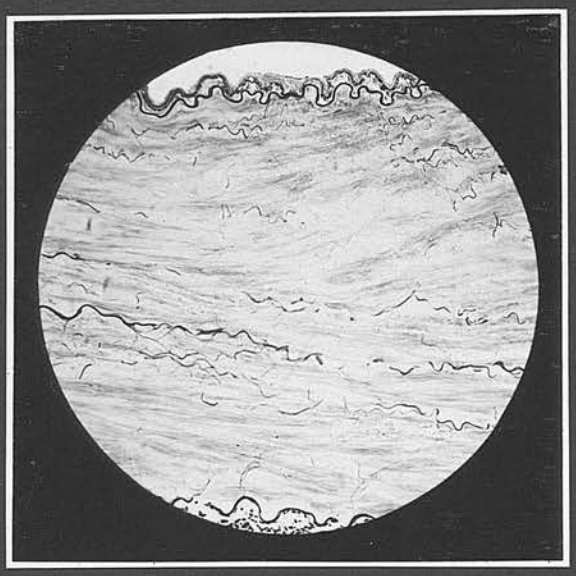

Fig. 41.

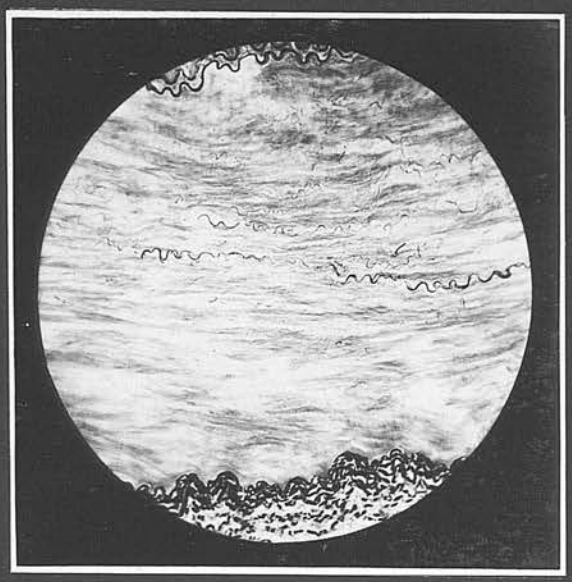

Fig. 42.

Figs. 43 & 44.

Sections of femoral and anterior tibial artery from a subject aged 42 years.

Fig. 43. x 100.

Femoral artery at the inguinal ligament.

The media consists of a thick muscular layer with a few scattered elastic tissue fibres. The external layer is detached, but the portion remaining may be seen to contain strong elastic tissue fibres.

Fig. 44. x 100.

Upper portion of anterior tibial artery.

The media is largely muscular in structure, a few strands of elastic tissue only being visible. The external coat is well formed, and consists of a dense network of elastic tissue fibres.

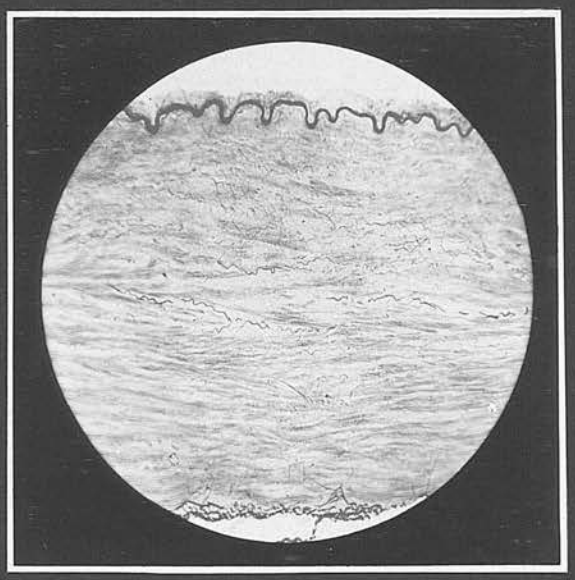

Fig. 43.

Fig. 44.

Figs. 45, 46 & 47.

Sections of femoral, popliteal, and anterior tibial artery from a subject aged 36 years.

Fig. 45. x 100.

Femoral artery at the inguinal ligament.

A number of elastic tissue fibres are seen in the middle coat. The external coat is partially separated, but can be seen to contain many thick elastic tissue fibres.

Fig. 46. x 100.

Popliteal artery.

The internal elastic coat is sharply outlined. The media is largely muscular, but contains a few scattered fibres of elastic tissue. The external coat is well marked, and in its inner portion appears to consist of a dense network of strong elastic fibres.

Fig. 47. x 100.

Upper portion of anterior tibial artery.

The media is again largely muscular, very few elastic tissue fibres being present. The elastic fibres of the external coat are not so closely arranged as in the previous section; they appear to be thinner and are mainly arranged longitudinally.

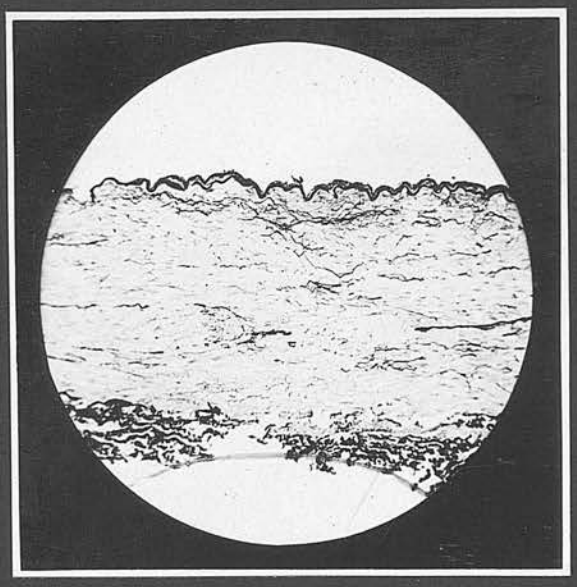

Fig. 45.

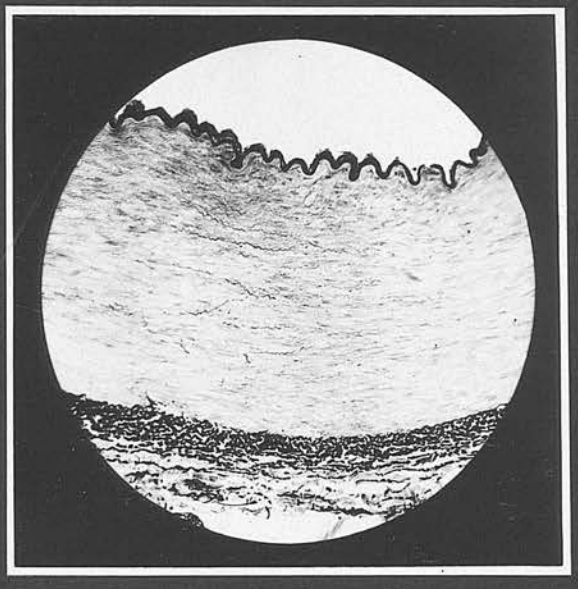

Fig. 46.

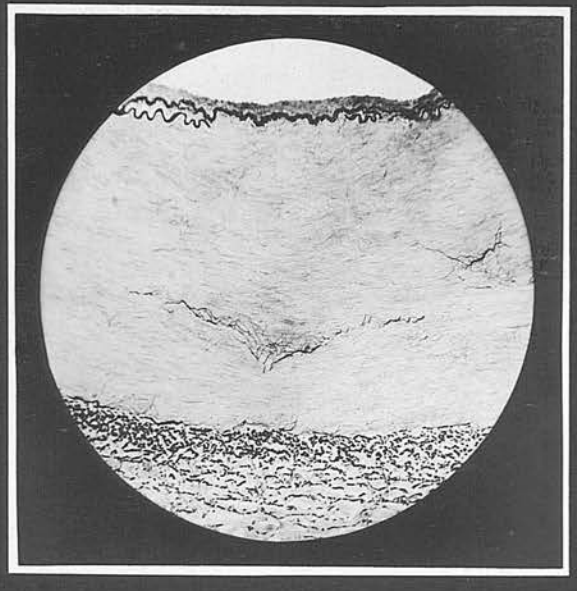

Fig. 47.

Figs. 48, 49 & 50.

Sections of the axillary and brachial artery from a subject aged 59 years.

Fig. 48. x 100.

Axillary artery.

There is a fairly thick endothelial and sub-endothelial layer, and the internal elastic lamina is not sharply differentiated from the media. The media contains numerous circularly arranged elastic tissue fibres. A few longitudinally arranged elastic fibres are present in the external coat which merges gradually into the media.

Fig. 49. x 100.

Middle portion of brachial artery.

The internal elastic coat is sharply defined. The media contains numerous elastic tissue fibres arranged circularly. The external coat which is well marked contains many elastic tissue fibres longitudinally disposed.

Fig. 50. x 100.

Lower portion of brachial artery.

The media contains a relatively smaller number of elastic tissue fibres. The elastic fibres of the external coat are again arranged mainly in the long axis of the vessel.

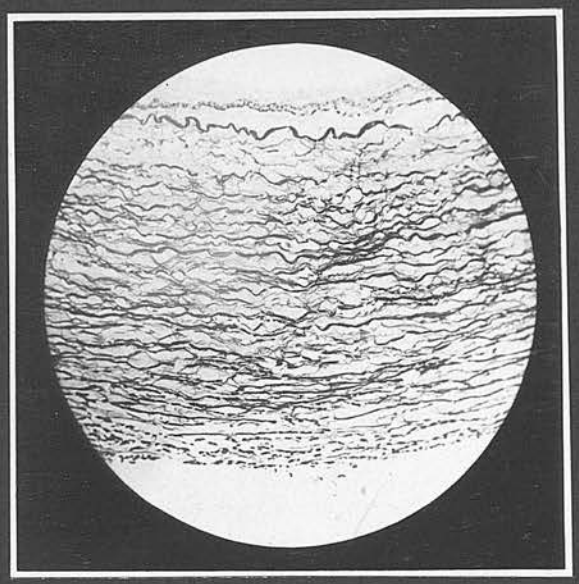

Fig. 48.

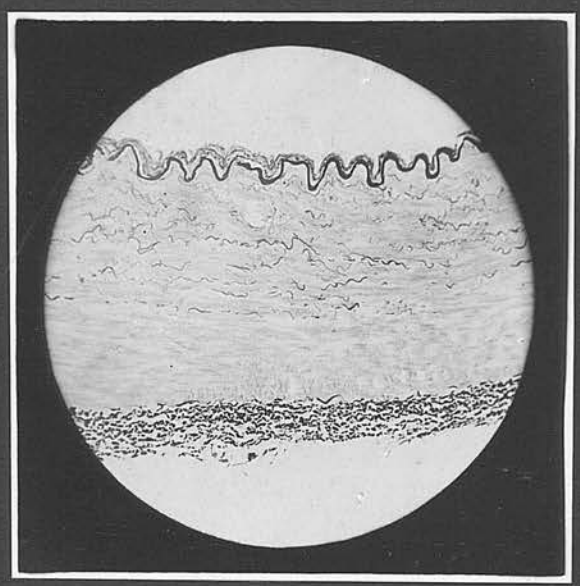

Fig. 49.

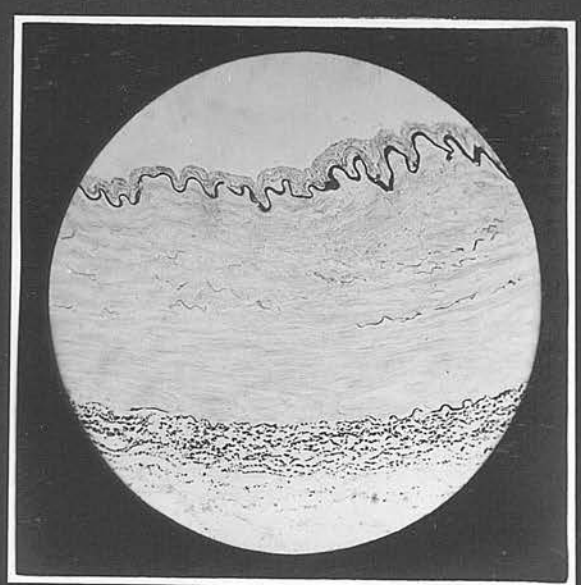

Fig. 50.

Figs. 51, 52 & 53.

Sections of the radial artery from a subject aged 59 years (same subject as preceding sections).

Fig. 51. x 100.

Upper portion of radial artery.

Fig. 52. x 100.

Middle portion of radial artery.

Fig. 53. x 100.

Lower portion of radial artery.

In all sections the internal elastic coat is sharply outlined, and is covered by a proliferation of endothelium. The media is in all cases largely muscular in structure, containing relatively few elastic tissue fibres. The external coat appears to be relatively loose in structure, and the longitudinally arranged elastic tissue fibres are more scattered.

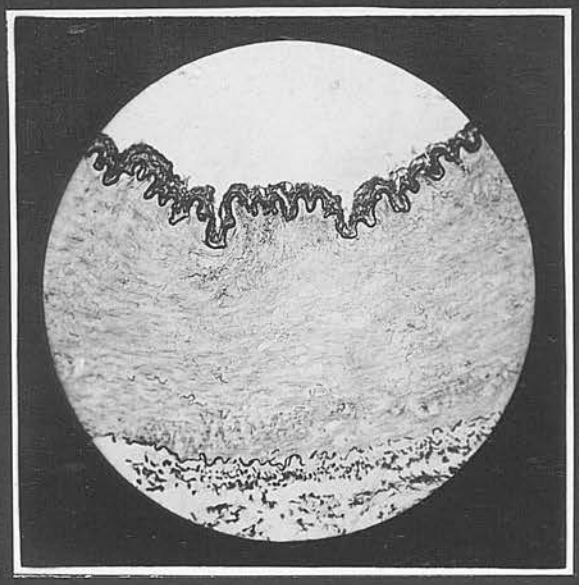

Fig. 51.

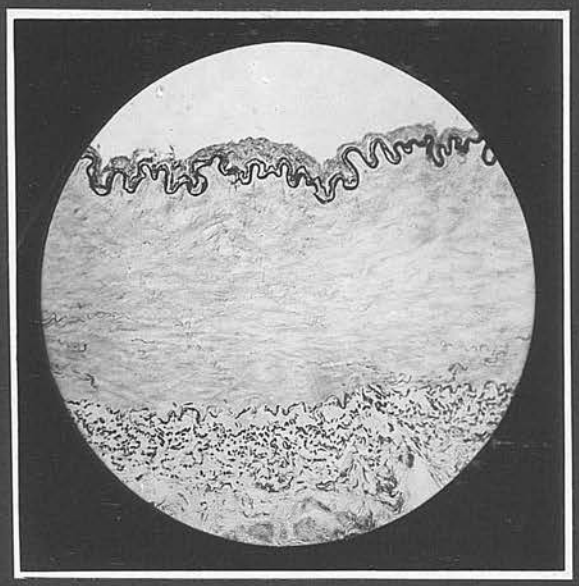

Fig. 52.

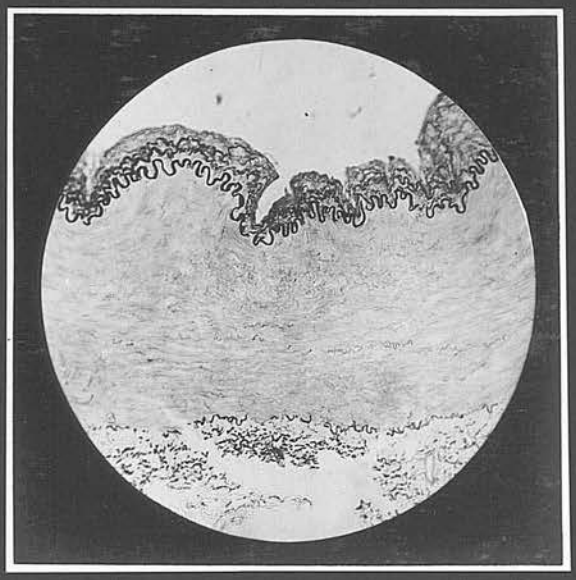

Fig. 53.

Fig. 54. x 100.

Upper portion of femoral artery, from a subject aged 59 years (same case as preceding sections).

The internal elastic coat is thick and covered by proliferated endothelium. The media is largely muscular in structure and contains few elastic tissue fibres. The external coat is well marked and contains a network of thick elastic fibres.

Fig. 55. x 100.

Popliteal artery from the same case.

The proliferation of the internal coat is again seen. The middle coat is muscular and contains a few scattered elastic tissue fibres only. The external coat contains numerous thick elastic tissue fibres closely interwoven.

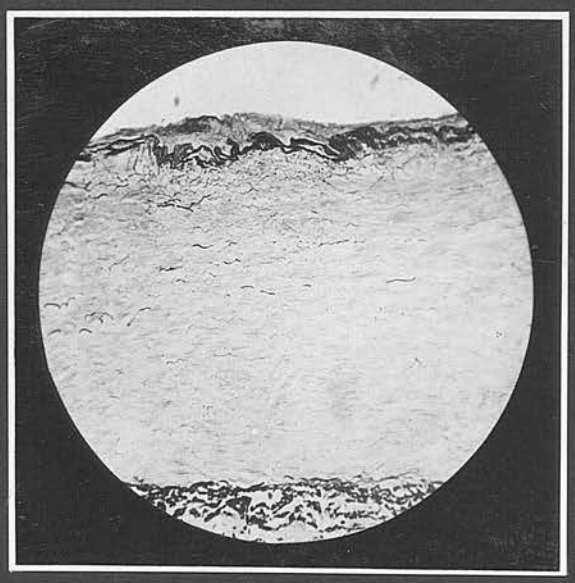

Fig. 54.

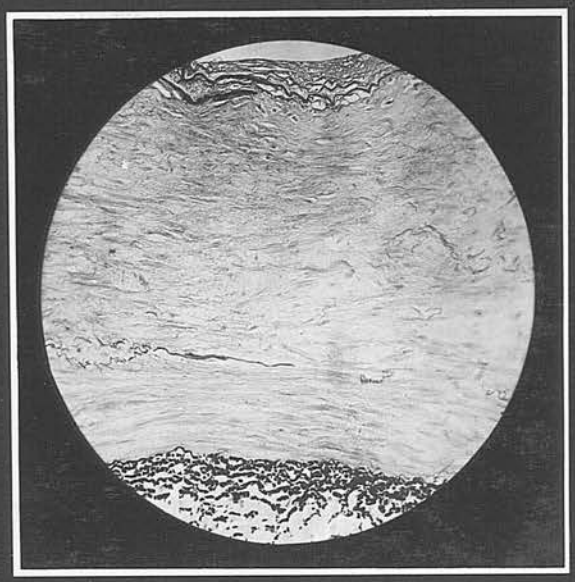

Fig. 55.

Fig. 56. x 100.

Section of the axillary artery from a full term foetus.

The internal coat merges into the media, which is composed largely of a mass of circularly arranged elastic tissue fibres. This coat gradually merges into the adventitia, which contains a few scattered elastic fibres arranged longitudinally.

Fig. 57. x 200.

Different portion of the same section under higher magnification.

The highly elastic structure of the media is clearly seen, this coat forming the greater portion of the wall of the vessel.

Fig. 56.

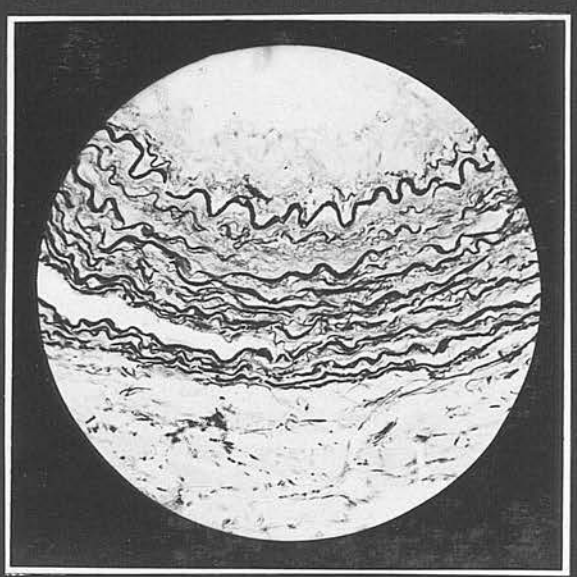

Fig. 57.

Figs. 58, 59, 60 & 61.

Sections of the brachial and radial artery from a full term foetus (same case as preceding sections).

Fig. 58. x 200.

Middle portion of brachial artery.

The internal elastic layer is sharply outlined. The media contains numerous elastic tissue fibres arranged circularly. The external coat is well developed, and contains many elastic tissue fibres.

Fig. 59. x 200.

Lower portion of brachial artery.

The media contains relatively fewer elastic fibres. The external coat contains many elastic tissue fibres, mainly arranged in the long axis of the vessel.

Fig. 60. x 200.

Upper portion of radial artery.

The media still contains a number of elastic tissue fibres, but there is a decrease in the relative number of elastic fibres present in the external coat.

Fig. 61. x 200.

Lower portion of radial artery.

Still further decrease in the elasticity of the media, and in the number of elastic tissue fibres present in the outer coat.

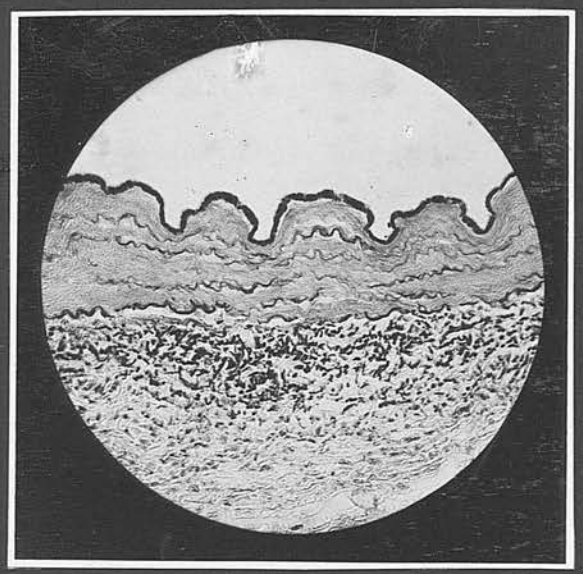

Fig. 58.

Fig. 59.

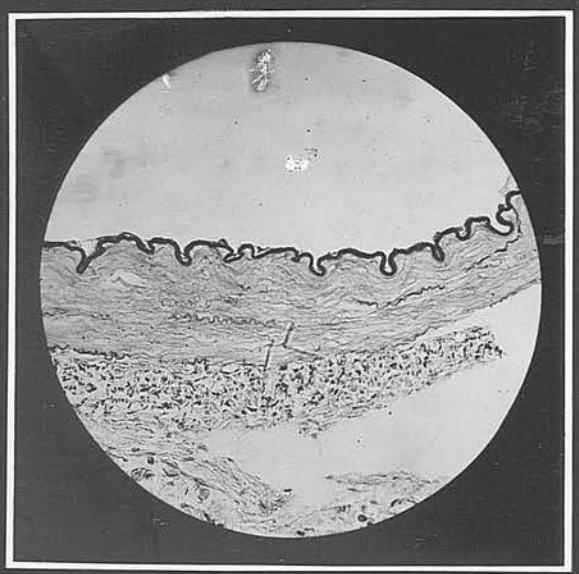

Fig. 60.

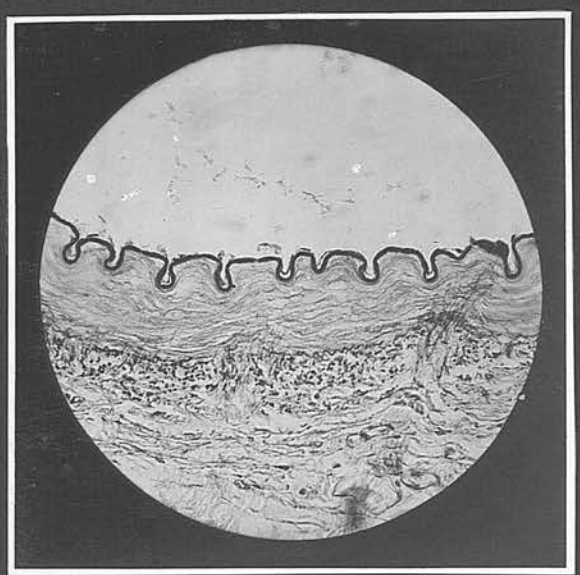

Fig. 61.

Fig. 62. x 200.

Section of the femoral artery from a full term foetus (same case as preceding sections).

The internal elastic layer is well marked. The media contains a number of elastic tissue fibres circularly disposed. The external coat is loosely arranged, and contains numerous elastic tissue fibres cut transversely.

Fig. 63. x 200.

Section of the anterior tibial artery from the same case.

This section presents a rather similar appearance to the previous one, elastic tissue fibres still being present in the media. The elastic fibres of the external coat are loosely arranged and irregularly interwoven.

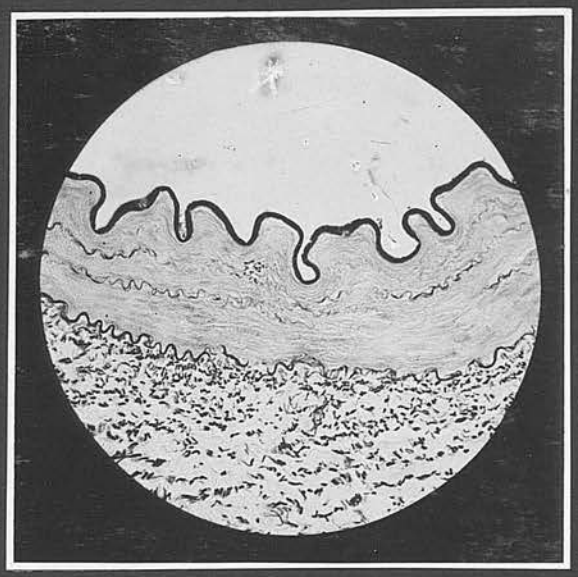

Fig. 62.

Fig. 63.