

near the inner or superior surface, have disappeared, and we have these bundles placed so as to be in relation to both sides of the leaf, and stretching right across the mesophyll. The small bundles are arranged so as to be close to the inferior epidermis, while a few incomplete bundles are placed close to the upper epidermis. The intercellular spaces, or lacunæ, are largely developed, and divide the large complete bundles one from the other. Cells containing chlorophyll are found on both sides of the leaf, more or less surrounding the intercellular spaces, and placed between the fibro-vascular bundles. These transparent spaces also change in character. Instead of being evident lacunæ they are now composed of numerous cells of large size, with very thin walls, and probably able to carry air in the same manner as the intercellular canals. Another well marked difference in the structure of the leaf is observable, namely, that all the fibro-vascular bundles are partly surrounded by a cellular sheath; a single row of cells, which sharply defines them from the surrounding tissues. This sheath is only very slightly developed in the upper part of the butt, and is altogether wanting in the lower part of the butt. The sheath is, however, not complete, as it is wanting on the side of the bundle next the lower epidermis. Here, as in other parts of the leaf, the fibro-vascular bundles approach very near the epidermis, and are not separated by many cells. It may also be considered as wanting on the other side of the bundles, but the numerous large cells below the epidermis, on the superior side of the leaf, may be looked upon as completing it.

The keel and coloured edge of the leaf is covered by a very thick cuticular layer, this being coloured gives the peculiar appearance to it.

The bundles near the edge become small, and are complete, each bundle being separated from the other by a lacunæ. Near the centre (middle line of the leaf) small bundles are developed between the large ones, but at all parts the same relative position in regard to the upper and lower epidermis is preserved.

B.—Upper portion of Blade or tip of the Leaf.

In the upper part of the leaf the same relations of parts is preserved as in the lower portion of the blade. The bundles, however, diminish very considerably in size, and the quantity of spiral vessels and cambiform cells increases, while the prosenchymatous cells diminish. The bundles, when seen in transverse section, run across the mesophyll, and are placed between the intercellular spaces, several cells separating the bundle from the upper epidermis, while the lower epidermis is in close contact with the bundle. They are also provided with the cellular sheath, like the bundles lower down. The thick coloured cuticle on the keel and margins of the leaf is, in all respects, the same as that described on the blade. The fibro-vascular bundles are best developed on the upper or inner side, few prosenchymatous cells existing on the under side. If the leaf was therefore split at this part, the best fibre would be found on the upper part, and only a small quantity on the under side. Lower down in the leaf this arrangement does not hold, there being as much fibre on one side as on the other; while in some cases more fibres actually exist on the under than on the upper side. The epidermis cuticle cells, containing chlorophyll, &c., resemble those of the other parts of the leaf, and already described.

Large fibro-vascular bundles exist close to the keel and edge of the leaf. These contain much prosenchyma, but are not surrounded by a sheath of cells like the other bundles in the leaf.

§ 4.—GLOSSY OR SUPERIOR SURFACE.

The glossy, or superior surface, is covered with a well developed epidermis. The cells are narrow, and not greatly elongated. A very thick cuticle exists on the free, or outer surface. This cuticle is best developed on the blade, while on the sheath it is very thin when the gum has been formed. The thickened cuticle seems to furnish the material out of which the flax gum is formed. No *stomata* exist in the epidermis of the upper side of the leaf.

§ 5.—BLOOM OR INFERIOR SURFACE.

The epidermal cells on the bloom or inferior surface of the leaf are small, but more elongated than those on the upper surface; the elongation being in the direction of the long axis of the leaf. A well marked alternation of structure of the lower epidermis is seen, an alternation of a band with stomata, and a band without stomata. The band without stomata is found over the prosenchymatous bundles; while the band with stomata exists only over the cells containing chlorophyll. This gives the peculiar banded appearance to the lower surface. The stomata are well developed, and are quadrangular, resembling very much the stomata of the *Agave*. They are very closely packed on the portion of the epidermis on which they exist, while none are to be met with on the epidermis covering the prosenchymatous fibres.

§ 6.—MICROSCOPICAL CHARACTER OF PREPARED FIBRES OF PHORMIUM TENAX.

The fibres of the New Zealand flax plant, which are used for manufacturing purposes, consist of the *prosenchymatous wood-cells*, which form part of the fibro-vascular bundles existing in the plant. In this way the New Zealand flax is perfectly distinct in its anatomical and physiological character from Irish flax and Russian hemp. In the plant the prosenchymatous wood-cells exist in bundles, composed entirely of these cells, but much more frequently mixed up with a number of other cells or vessels. The bundles are thus of very different value, some containing much valuable fibre, while others contain comparatively little. When examined with the microscope, the ultimate prosenchymatous wood-cells appear as elongated, more or less cylindrical fibres, tapering towards each end, the tapering ends of the cells over-lapping. The length of these cells is very difficult to determine, and all attempts to isolate a single perfect cell have as yet failed. They must, however, be of considerable length, as several cells have been traced for $2\frac{1}{2}$ inches. The cell, when isolated and viewed from the side, appears as a transparent cylinder, with a cavity. The relative sizes of the cell, and of the cavity, vary very much, and measurements of many fibres are given in this Report. The measurements were obtained by using