which the Manilla fibre is obtained; and it is from the uncoiled spiral threads of this vascular tissue that textile fabrics are manufactured, not from the true fibre known as Manilla, and used for rope. I mention this, because from ignorance of this fact it has been suggested that the process, by which fibre from the *Musa textilis* is prepared for fine textile fabrics, might be applicable to the fibre of the *Phormium tenax*.

My principal object in writing this paper was to give publicity to my views. Even if my theory is shown to be erroneous, I hope that it may lead to further experiments, and provoke discussions tending to the improvement of the manufacture of New Zealand flax.

No. VIII.

On the Structure of the Leaf of Phormium Tenax. By Captain F. W. Hutton, F.G.S.

[Read before the Auckland Institute, 18th October, 1869.]

In the present paper an attempt has been made to describe the structure of the leaf of our native flax, so as to form a basis for the examination and comparison of the manufactured fibre, as dressed by different machines, and prepared by different processes, on which subject I hope we shall receive communications from many of our members. I have also added some observations on the gum secreted by the leaf, and which is generally looked upon as the *bête noire* of the manufacturer, but which I believe not to be so black as it is painted. While it was in progress, I saw in the newspapers a short abstract of a paper on the same subject, read by Mr. Nottidge, to the Philosophical Institute of Canterbury. Not having as yet had the pleasure of reading this paper, I am not able to refer further to it; but judging from the very short abstract that appeared in the papers, we seem to be pretty well agreed upon all points, except as to the existence of small canals in the fibro-vascular bundles, formed by the interspaces between the ultimate fibres, which I venture to suggest must have been caused by the knife tearing apart the bundles of fibres, when making transverse sections.

Development of leaf.—The young leaf of the flax plant (*Phormium tenax*), when about a quarter of an inch in length, is composed of loose parenchymatous tissue, covered both on the inner and outer surfaces, near the centre, by an epidermis of elongated rectangular cells, the edges of the leaf being crenulated by the jutting out of the young growing cells. Imbedded in this cellular tissue lie about twenty-three vascular bundles, eleven on each side of the midrib. These, in this young state, are composed entirely of spiral vessels, which contain a single spiral fibre, easily unrolled with a needle. These bundles are 0·0013 inch broad, and about 0·004 inch apart from one another. They lie longitudinally in the leaf, towards the central part of it, the outer growing edge being composed only of cellular tissue. The upper end of each bundle runs into that lying next to it towards the centre, and they thus get shorter and shorter as they recede from the midrib. When the leaf gets about an inch long, the vascular bundles are still seen to branch and anastomose with one another; but this soon ceases, and at all later stages they are very nearly parallel, converging slightly towards the point of the leaf. A layer of thin elongated tubes now makes its appearance, surrounding the bundles of spiral vessels. This is the first state of the fibres from which the plant has got its celebrity; but as yet they are exceedingly tender, and break with the slightest touch. When, however, the leaf has attained a length of four inches, the fibres in the upper part of it have acquired considerable strength, while those at the base are still quite weak. When the leaf is about nine inches long, it commences to exude gum, and appears then to be fully formed.

Description of full-grown leaf.—When fully grown, the leaf attains a length of from three to ten feet, according to soil and variety. The colour varies from light-yellow green to deep-blue green, with yellow or red margins and midribs, while the lower part of the leaf is usually pink. In shape the leaf is linear lanceolate, and keeled, with an acute point. At a point rather less than half-way down from the tip, the two superior or inner surfaces of the two halves of the blade begin to coalesce at the midrib, and this coalescence gradually increases until one-half of the leaf is joined together. The coalescence then gradually decreases, until it occupies only about a fourth of the breadth of the half-blade, which breadth it keeps to the bottom of the leaf, the two half-blades being closely appressed as far as the base, where the two marginal edges closely overlap one another, and form a sheath through which the younger leaves grow. It is only the inner surfaces of the lower portion of the leaf, below the place where the coalescence of the two half-blades begins to decrease, that exude gum.

For the sake of convenience, I shall, in this paper, call the upper part of the leaf, the blade; that portion where the coalescence of the two half-blades reaches its maximum, and which is about half-way between the two ends of the leaf, the butt; and the lower portion, the base of the leaf.

The full-grown leaf is composed of parenchymatous tissue, in which fibro-vascular bundles lie imbedded, and remain isolated from one another as fibrous cords, some of which run from one end of the leaf to the other. This cellular tissue is covered, on both surfaces of the leaf, by an epidermis composed of elongated, rectangular cells, of considerable consistence, but without chlorophyll or other colouring matter.

No stomata or other openings are found on either surface, and the gum appears to be exuded by exosmosis.

The fibro-vascular bundles, which form what are commonly called the fibres of the plant, are composed of elongated tubular liber-cells, enclosing a centre of spiral vessels, and vary much in shape in different parts of the leaf. They are surrounded by a layer of elongated cells, that at once turn blue with iodine, and are probably cambium cells. The bundles are thickest at the base, and taper gradually to the point of the leaf.

The spiral vessels are about 0·001 inch in diameter, and contain a single, rarely a double, spiral fibre, which can be unrolled with a needle. They are filled with air, and have no strength, but are readily broken across.

The liber-cells, on the contrary, have great strength, and form the true fibre of the leaf. They are very long, probably an inch or more, while their thickness never exceeds 0·0006 inch, and is some-