varieties of auroræ are confined to these two; for General Sabine has informed me that he himself, along with the late Sir Edward Parry, observed at Lerwick in the Shetland Isles in 1818, at the same instant, two auroral arches crossing one another at an angle. But, be this as it may, when we reflect that there are many kinds of particles in our earth, some of which may be affected more rapidly than others by a primary magnetic force, we shall cease to wonder that the phenomena presented are of a complicated description.

All these considerations have induced me to think that it is lost labour to attempt a quantitative comparison when our observation of the magnetic disturbances and their corresponding earth-currents is confined to one locality; and it will be seen from this paper, that while endeavouring to uphold the hypothesis of induced action, I have done so by a comparison of a general and qualitative rather than by one of a quantitative nature.

XV. "Further Observations in favour of the View that Nerve-fibres never end in Voluntary Muscle." By Lionel S. Beale, M.B., F.R.S., Fellow of the Royal College of Physicians, Professor of Physiology and of General and Morbid Anatomy in King's College, London; Physician to King's College Hospital, &c. Received June 5, 1863.

Few anatomical inquiries of late years have excited more interest than the present one. Since my paper published in the 'Philosophical Transactions' for the year 1860, several memoirs have appeared in Germany. In my paper just published in the last volume of the 'Transactions,' I have replied to the statements of Kühne and Kölliker, but I had not succeeded in actually tracing the very fine nucleated fibres I had demonstrated from one undoubted nerve-trunk to another. As a *demonstration*, therefore, my conclusions *were defective*, though the only explanation to be offered of facts I had observed was that included in the view I propounded in my first paper. The question between my opponents and myself upon this matter is not one of interpretation, but a question of simple fact. I assert that the fine nerve-fibres can be followed much further than the point where Kühne and Kölliker maintain the ends or *termina-*

tions are situated, if the specimen be so prepared as to prevent destruction of these most delicate fibres, and the refractive power of the medium be such as to enable us to see them.

I propose to present to the Royal Society next session a paper in which I shall *demonstrate* the truth of the conclusions I have arrived at; but as my specimens are already prepared, and during the last few months several drawings have been made, I hasten to give a short statement of facts, in order that those who have been led to conclusions opposed to my own may have an opportunity of studying the very same muscle.

The great width and refractive power of the large elementary fibres of the pectoral of the common frog render it impossible to follow for any great distance amongst them nerve-fibres of the $\frac{1}{60,000}$th of an inch = ·000187‴ in diameter; and I have therefore long been searching for a very thin voluntary muscle, with fine fibres, which, like the bladder of the frog, could be examined without the necessity of making thin sections, and thereby deranging the relation of all the finest and most delicate structures. Such a muscle I have found in the *extensive mylo-hyoid of the little green tree-frog* (Hyla arborea). The elementary fibres of this muscle are scarcely more than the $\frac{1}{3000}$th of an inch = ·0036‴ in diameter; and as there are but two layers, the fibres of which are at right angles to each other, all the structures in the muscle can be demonstrated most beautifully. The very long thin muscular fibres are not too close for exact observation. The vessels can be readily injected.*

These specimens have been prepared upon the same plan as others, and are preserved in glycerine, which enables me to press the thin muscle and separate the fibres further from each other, while the finest fibres of the nerves are prevented, by the viscid medium, from breaking or from being so compressed amongst the other tissues as to be destroyed or rendered invisible. The muscle

* The very thin and wide intercostal muscles of the Chameleon, after having been soaked in glycerine, may be separated into two layers, *external* and *internal intercostals*, in each of which the finest ramifications of the nerve-fibres may be followed, and their relation to the sarcolemma demonstrated. The long elementary fibres of the thin tubular part of the tongue of the same animal are also favourable for this investigation; but the Chameleon is only to be obtained occasionally, and the muscle of the green tree-frog, above referred to, possesses many advantages.

must be prepared when quite fresh, otherwise the fine nucleated fibres are completely disintegrated. The capillaries were injected as in the other cases*.

In this thin muscle, networks formed by bundles of dark-bordered fibres, consisting of from two to five or six, may be very easily shown, and with high powers (700 to 3000 diameters) the very fine nucleated fibres resulting from the division and subdivision of these in a dichotomous † manner, can be readily demonstrated.

In this thin muscle I have often followed individual fine nucleated nerve-fibres, now over, now under muscular fibres, sometimes crossing transversely, sometimes obliquely, and sometimes running for a certain distance parallel to the fine muscular fibre. The drawing accompanying this paper renders further description unnecessary. I shall enter into full detail in my communication next session; but as the summer is the period to obtain specimens of the *Hyla*, I am anxious my fellow-labourers in Germany should at once be acquainted with the advantages of the thin muscle alluded to; and I cannot too strongly recommend this beautiful little frog, which they have the advantage of procuring more readily than Englishmen, for microscopical investigation. All the tissues are beautifully distinct, and I challenge those who are interested in these questions to discuss them with me, selecting the tissues of this animal for special study.

Explanation of the Plate.

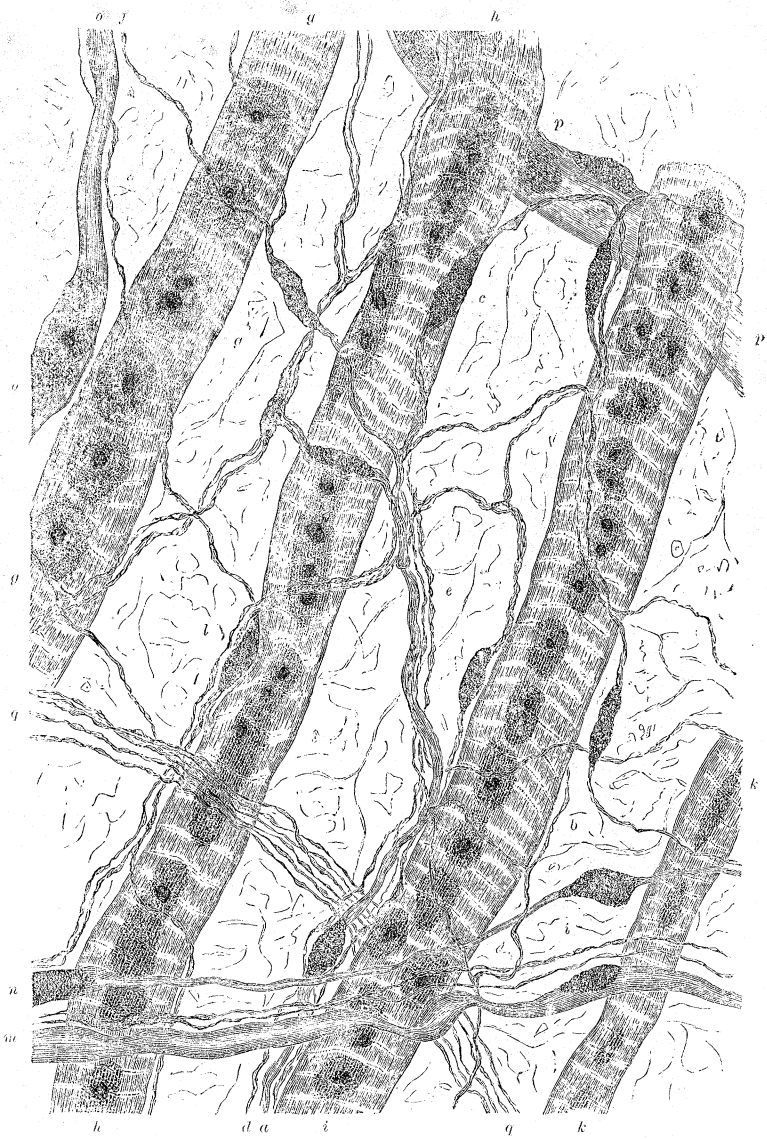
Distribution of finest nucleated nerve-fibres to the very narrow elementary muscular fibres of the mylo-hyoid of the little green tree-frog (Hyla arborea), *magnified* 1700 *diameters. Drawn on the block by the author.*

The elementary muscular fibres are marked *g*, *h*, *i*, *k*. *k* is a very young one, slightly stretched; *i* is a fully-formed muscular fibre; *h*, another stretched in its central part. The nuclei of these fibres exhibit some differences in size and form. Nucleoli are distinct in all, and in the fibre marked *g* the nuclei, which were coloured by carmine, exhibit three different intensities of colour,—the dark central spot, "nucleolus," being most intensely coloured, as indicated by the shading in the drawing.

---

* As the details of the mode of preparing these specimens would occupy many pages, I must defer entering into this part of the question; and it is useless to give the outline, as success depends entirely on minutiæ.

† The dichotomous division is most common; but sometimes three, four, or even five branches result from the division of one fibre, as is well known to be the case in the common frog.



Distribution of finest nucleated-Nerve Fibres to the Elementary Muscular Fibres of the Mylo-hyoid Muscle of the little Green Tree Frog (Hyla Arborea). Drawn on the block by the Author, from a specimen magnified 1700 diameters (the first twenty-fifth made by Messrs. Powell & Lealand). The diameter of each muscular fibre corresponds to that of a human red blood-corpuscle.

SCALE. $\frac{1}{10,000}$ of an English Inch $\frac{1}{500\,000}$ × 1,700 diameters.

a is a nerve-fibre which was followed over more than twenty elementary muscular fibres from a dark-bordered fibre. One of the subdivisions of this fibre is seen at *f*, where it again runs with a very fine dark-bordered fibre (*o*). The dark-bordered fibre (*o*) was some distance higher up in the specimen, but its place has been altered in order to avoid the necessity for a still larger drawing. Above *b* a nucleus of a very fine nerve-fibre is seen. Such nuclei lie upon the surface of the muscular fibres, external to the sarcolemma. The nucleus often *appears* as if it were within the sarcolemma (*c*), but the fibres proceeding from each extremity render such a position impossible. The relation of these nerve-nuclei to the sarcolemma is seen at *l* in profile. The nuclei, as well as the fibres for a certain distance, often adhere to the sarcolemma very firmly; but in the thin mylo-hyoid muscle the course of the fibres over or under, but always *external* to the muscular fibres, may be readily traced if the muscular fibres be separated slightly from each other, as represented in the drawing.

At *d* fine nerve-fibres accompanying the fine fibre continued from the dark-bordered fibre, as described in the 'Philosophical Transactions' for 1862, are represented. Such fibres are also seen at *e* and *f*.

m, *n*, and *o* dark-bordered fibres, with nuclei near their distribution. *m* would probably pass over sixty or seventy muscular fibres, and *n* over perhaps twenty, before it divided into fibres as fine as those seen at *b*, *e*, *f*, *l*.

p a very fine capillary vessel with a nerve-fibre running close to it.

q a bundle composed of six very fine nerve-fibres near their distribution. These fibres exhibit a very distinctly beaded appearance, which is also observed in many other fine fibres in different parts of the specimen.

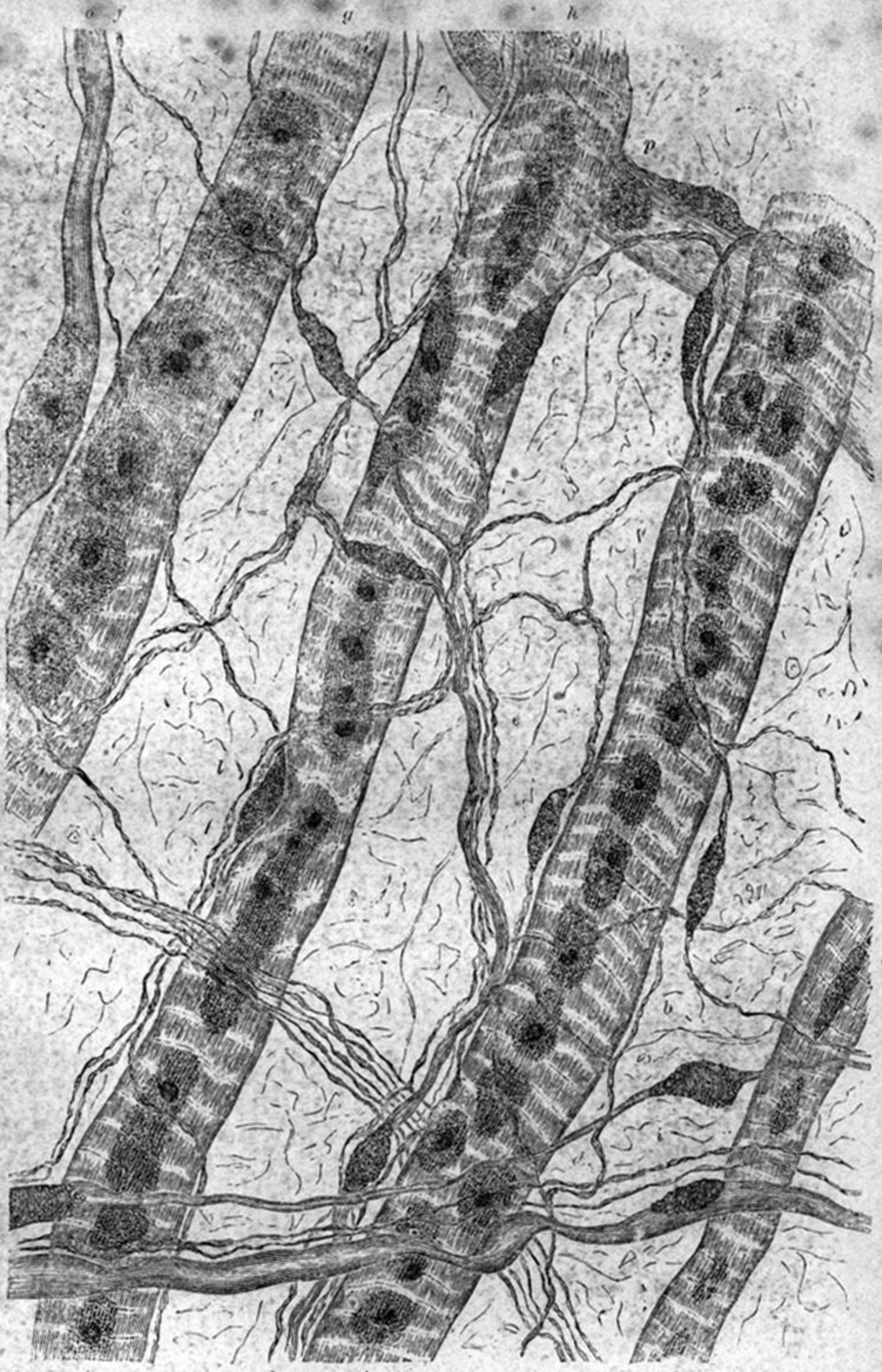
Traces of connective tissue are seen in all parts near the fine nerve-fibres and around the muscular fibres. Here and there some very fine connective tissue-fibres, which were not altered by acetic acid, are represented. These represent the remains of fine nerve-fibres, which existed in a state of functional activity at an earlier period.

The drawing, with the exception of the position of the nerve-fibre (*o*) above mentioned, is an actual copy from nature. The relative position of the muscular fibres, the form and general characters of the so-called nuclei, and the position and size of the nerve-fibres and their nuclei have been carefully preserved.

I have traced the very fine nerve-fibres in so many instances from one trunk to another ramifying at a very considerable distance, that I cannot believe any true terminations or ends exist.

XVI. "Note on the Minute Structure of the Grey Matter of the Convolutions of the Brain of Man, the Sheep, Cat, and Dog." By Lionel S. Beale, M.B., F.R.S., &c. Received June 18, 1863.

By a new process of investigation, I have succeeded in demonstrating the connexion between the nerve-cells and fibres in the grey matter of the convolutions and in other parts of the mammalian brain, and have followed individual fibres for a much greater distance



Distribution of finest nucleated Nerve Fibres to the Elementary Muscular Fibres of the Mylo-hyoid Muscle of the little Green Tree Frog (Hyla Arborea). Drawn on the block by the Author, from a specimen magnified 1700 diameters (the first twenty-fifth made by Messrs. Powell & Lealand). The diameter of each muscular fibre corresponds to that of a human red blood-corpuscle.

SCALE. $\frac{1}{10,000}$ of an English Inch $\frac{1}{10,000}$ × 1,700 diameters.