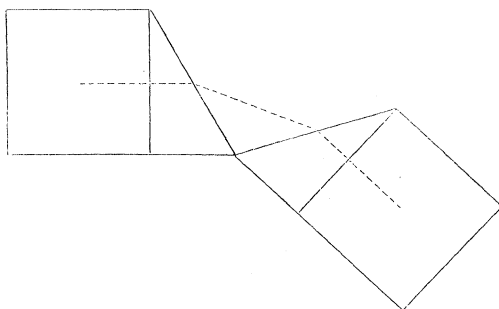


prism and transmits it in a plane at right angles to the axis of the collimator to the second prism.

This second prism is moveable about an axis parallel to its edge and to the axis of the telescope, and has a right angled reflecting prism attached to it, so that the light after traversing this prism twice passes the second time through the fixed prism and so by reflection into the telescope. The lever carrying the second prism with its reflecting prism is moved by a micrometer screw, by the head of which the movement of the prism is read.

We placed the design in the hands of Mr. Hilger, some time since, and we now exhibit the instrument to the Society.

In the last number of the "*Journal de Physique*," M. Thollon describes some modification of his instrument, but it does not seem that his modified plan is so well adapted to the ordinary use of a chemical laboratory as ours.



The accompanying diagram represents a section through the prisms at right angles to the axis of the collimator and telescope.

*April 24, 1879.*

THE PRESIDENT in the Chair.

The Presents received were laid on the table and thanks ordered for them.

The Right Hon. Richard Assheton Cross, Secretary of State for the Home Department, was admitted into the Society.

The following Papers were read:—

- I. "On the Nature of the Fur on the Tongue." By HENRY TRENTHAM BUTLIN, F.R.C.S. Communicated by J. BURDON SANDERSON, F.R.S., Professor of Physiology in University College, London. Received March 26, 1879.

[PLATES 10—13.]

The fur on the tongue is generally stated to consist chiefly of epithelial cells, usually sodden and granular. But several observers have described fungi as existing in it, or in the buccal mucus. Robin, for instance, describes a form of *Leptothrix* (*L. Buccalis*) in the mouth, and particularly in and between the teeth. Kölliker mentions, as of constant occurrence, masses or dark-brown bodies (which had previously been described by Miquel and Neidhardt, as occasionally present) having a granular aspect, which he believed to be of the nature of a fungus, similar if not identical with the fungus affecting the teeth. Billroth speaks of finding in the white fur of himself and of several patients, exquisite palmelloidal forms of *Ascococcus* and *Glacococcus* colonies.

The object of this paper is to show that schizomycetes form the essential constituent of the fur, and to explain, as far as possible, some of the laws which govern the formation of fur.

The tongue is kept clean by free movement and by being rubbed against the interior of the mouth, the gums, and the teeth; but fur almost always exists upon its surface, both in health and in disease. The fur is generally thickest in the morning before food is taken, and during illness, when the necessary cleansing is not properly performed. It occurs, too, most abundantly in the centre and back part of the tongue, covering a triangular area immediately in front of the circumvallate papillæ, for this part of the tongue is most difficult to keep clean. It occupies the papillary surface of the tongue, scarcely ever extending beyond it, and is, therefore, not found posterior to the circumvallate papillæ. It does not form a continuous layer unless it is exceedingly thick, but lies upon the tops of the filiform and some of the fungiform papillæ. In children the fungiform papillæ are usually quite free from fur, but in adults the difference between the fungiform and filiform papillæ is not nearly so well marked, and, with the exception of those situated near the apex of the tongue, the fungiform papillæ are frequently coated. Fur forms upon the filiform papillæ, because these papillæ are rough and possessed of longer or shorter epithelial processes, to which foreign matters cling readily, and from which it is very difficult to dislodge them. The fungiform papillæ, on the contrary, are usually smooth and rounded on the summit, and even when large are easily kept clean.

The accompanying tables refer to the constancy of the presence of fur, to its thickness in health, and to its relation to the papillæ.

*Analysis of Cases examined.*

On 68 healthy tongues—fur on all except one.

On 178 tongues of persons suffering from disease or accident—fur on all except two.

Table showing relation of fur to papillæ on 62 healthy tongues, with remarks on the age of the persons and the characters of the papillæ.

Position of Fur.	No. of cases.	Age of Patients.	Remarks on Papillæ.
On filiform papillæ only.	41	22 under 20 years of age.	In all cases fungiform papillæ small—in 14 cases difficult to distinguish.
On filiform and some fungiform papillæ.	18	17 over 20 years of age—1 æt. 15.	
Equally on filiform and fungiform papillæ.	3	All over 20 years....	Fungiform papillæ small or indistinguishable.
	62		

Table of thickness of the fur on 68 healthy tongues, with remarks on the papillæ and the nature of the tongue.

Quantity of Fur.	No. of cases.	Papillæ.	Condition of Tongue.
None.....	1	Scarcely any.....	Tongue very smooth and supple.
Very thin.....	17	Scarcely any in 12...	Very smooth and supple in 12.
Thin.....	38		
Moderately thin.....	10	Large and distinct in 8.	Infirm old people, æt. 80 and 95.
„ thick.....	2	Large and distinct...	
Thick.....	0		
	68		

When thin the fur can only be scraped off with difficulty, and always brings with it numerous fragments of the hair-like processes which form the terminations of the filiform papillæ. But, when thicker, soft, and moist, it can be removed in considerable quantity with ease.

Microscopical examination of the results of such scraping gives, in nearly every instance, the same results.

1. *Débris* of food and bubbles of mucus and saliva.

2. Epithelium.

3. Masses which appear at first to consist of granular matter, but which are the glœa of certain forms of schizomycetes. When large and closely packed they are of yellow or yellowish-brown colour, but when smaller and more loosely held together are almost colourless. They are generally attached to portions of the hair-like processes which have come away with them, on account of the tenacity with which they adhere to the processes. Vertical sections of hardened tongues show the relation of these masses to the filiform papillæ better than mere scrapings of the surface of the tongue. The filiform papillæ, instead of exhibiting fine, clean, tapering processes, terminate in processes which are uneven, tuberculated, or beaded, and blunted at their ends, owing to the presence of these bodies. Around the masses float free fungi, often exhibiting very active movement. The relative proportion of the three constituents of fur varies under certain conditions. The quantity of *débris* of food and bubbles is much greater during or immediately after eating than during fasting, although there is no corresponding increase of the fur at such times. The epithelium is much more abundant in thin fur than in thick fur, its quantity depending rather upon the vigour with which the tongue is scraped than upon the amount of fur present. It can be obtained in just as great quantity where no fur is present, provided the tongue be closely scraped. The schizomycetes are found in every case in which there is fur upon the surface of the tongue, and I have even found a little of the glœa where no fur was perceptible to the naked eye. The quantity of glœa depends roughly upon the quantity of fur. The position of the glœa corresponds with the position of the fur. The fur dots the tops of the filiform papillæ, and the glœa is attached to the processes of these papillæ. Fresh scrapings of fur show this relation of the glœa to the filiform papillæ, but vertical sections of hardened tongues show more than this. They show that the filiform papillæ are the sole seat of the glœa, which does not exist between the papillæ, and seldom upon the fungiform papillæ. Again, the colour and appearance of the thin grey fur corresponds with the colour and appearance of the thin grey pellicle which forms upon the surface of Bacterium-producing fluids, and as the latter becomes whiter and more opaque as it becomes thicker, so does the fur become whiter and more opaque with increased thickness. A modification of colour is, however, frequently produced by the yellow or brownish-yellow tint of the glœa.

In order to ascertain the true nature of the glœa, and to obtain it in a much purer form than that in which it exists naturally upon the

surface of the tongue, I cultivated it upon a warm stage. Minute portions of fur from different tongues were placed in a drop of aqueous humour, and kept at a temperature of 30° to 33° C. Free growth and development took place, but instead of the single fungus I had expected several fungi were found. Only two forms, however, were present in every instance, namely, *Micrococcus* and *Bacillus*, and, from a comparison of the natural fur with results obtained by artificial cultivation, I think there can be little doubt that the fur consists chiefly or essentially of these two fungi.

*Micrococcus* existed in every case examined, small spherical bodies generally in pairs or groups of four, but often forming chains. Upon the warm stage rapid multiplication took place with the production of pairs, fours, long and short chains often twisted and looped, and small and large colonies. When these colonies reached a large size (which happened in the course of a few hours) they presented a granular appearance and assumed a yellow or brownish-yellow colour, and all movement ceased in them.\* The development of *Micrococcus* occurred abundantly and rapidly in all the experiments made with the exception of one, in which so rapid a formation of *Bacterium termo* took place, that in the course of a few hours the whole of the fluid was clouded and obscured by its presence. Usually the development of other fungi did not interfere with that of *Micrococcus*. Comparing the masses or colonies produced by cultivation with the granular masses of which the fur chiefly consists, the chief constituent of each appears to be the *Micrococcus* sphere. The natural colonies are, of course, not often so pure as those produced artificially, but still not uncommonly these natural colonies present the same regularity of structure as the colonies figured in sketch 5.

The other form, *Bacillus*, was also present in every case examined, but unfortunately development seldom or never occurred, being apparently prevented by the presence of other fungi. It consisted of slender rods, having a well-marked double contour and a light interior. Their length varied much, but was always many times their breadth. There were no defined contents within the rods, except in some of the longer and broader of them, which contained highly refractive spherical bodies which appeared to be spores. The shorter rods moved actively about the field of the microscope, and even some of the longer rods (looking when magnified 450 times from  $\frac{1}{2}$  inch to 1 inch long) moved slowly from place to place. The rods were generally straight, but some of the longer ones were curved or bent. They often formed short chains or occurred in pairs, but did not form colonies, although they sometimes occurred in great number and of large size in the *Micrococcus* colonies. They showed very little

\* I never observed any lengthening into rods, or the development of any other form from these *Micrococci*.

change in appearance for many hours, sometimes for two or more days, after which they usually became granular and degenerated. These bodies are apparently identical with the *Leptothrix buccalis* of Robin. But I think they would be more rightly called *Bacillus subtilis*. Their length, their slender form, the conditions in which they occur, and the fact of their non-development in the presence of other fungi point to this conclusion. I made many attempts to separate them in order to produce the fungus in a purer form by cultivation, but did not succeed in doing so. Although this fungus did not develop under artificial conditions in the presence of *Micrococcus* and other fungi it is highly, probable that its development takes place freely upon the surface of the tongue. Its habitual presence there, generally in tolerable abundance, and the occurrence of spore-bearing filaments may be adduced as evidence in favour of this view.

Besides these fungi *Bacterium termo* existed in some of the furs examined, and twice developed with such rapidity that the whole of the fluid was crowded with these organisms to the exclusion of every other form. Pairs, chains, and colonies were formed.

*Sarcina ventriculi* was frequently present and generally developed quickly. It usually occurred in pairs or fours, and was easily recognisable by its large size, compared with the other organisms present, by the square or oblong form of its nuclei, by their faint yellow or red tint, and by the area of protoplasm surrounding the nuclei. The groups of two or four moved slowly about the field of the microscope, but the large masses which were formed remained quite motionless. The masses attained so large a size as seriously to interfere with the growth of some of the other organisms, and when large showed a decided yellow, or brownish-yellow colour.

In two or three of the specimens there occurred rapid and very abundant development of a form of *Spirillum*, which appeared from the double twist which it exhibited, and from its extreme tenuity, to be *Spirochaeta plicatilis*. Its growth took place from exceedingly small portions of the organism, and continued only at one end, which was in constant motion, whilst the other end remained stationary; and as the growth progressed, large masses were formed which soon became so dense that it was impossible to discern the nature of the organism of which they were composed. This *Spirochaeta* did not occur in most of the specimens examined.

A larger form of *Spirillum* was also occasionally present, but was not seen in the act of developing.

Although I believe the fur consists chiefly of *Micrococcus* and *Bacillus subtilis*, I think it is probable from the results obtained in the experiments upon which the foregoing observations are founded, that the development of these other forms (*Bacterium termo*, *Sarcina ventri-*

Fig. 1.

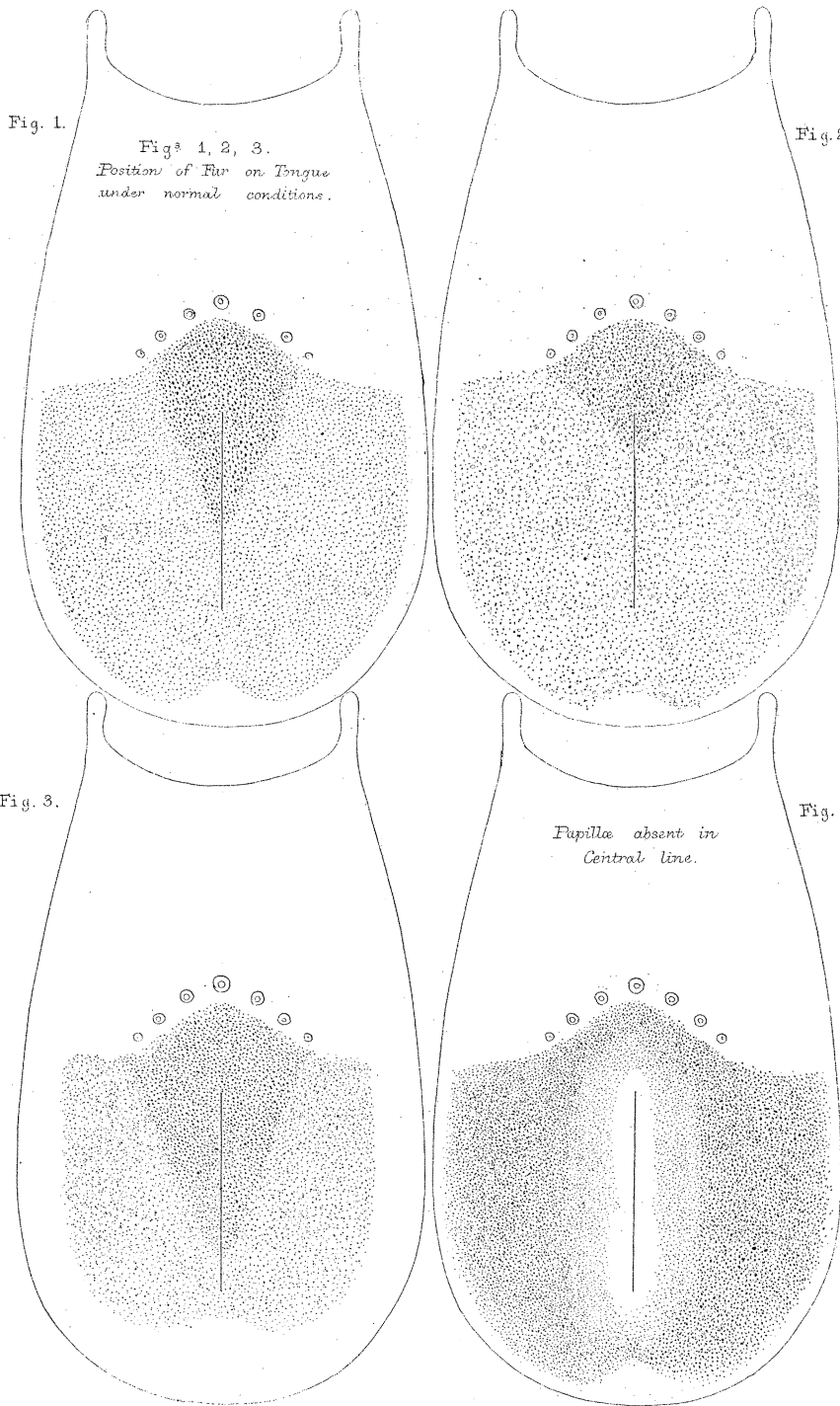
Figs 1, 2, 3.  
Position of Fur on Tongue  
under normal conditions.

Fig. 2.

Fig. 3.

Fig. 4.

Fapillae absent in  
Central line.



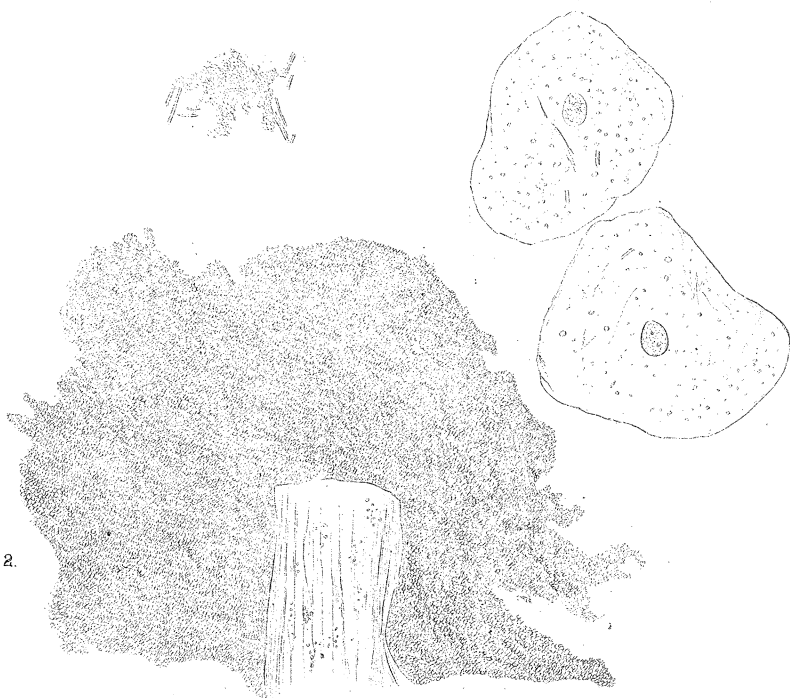


Fig. 2.

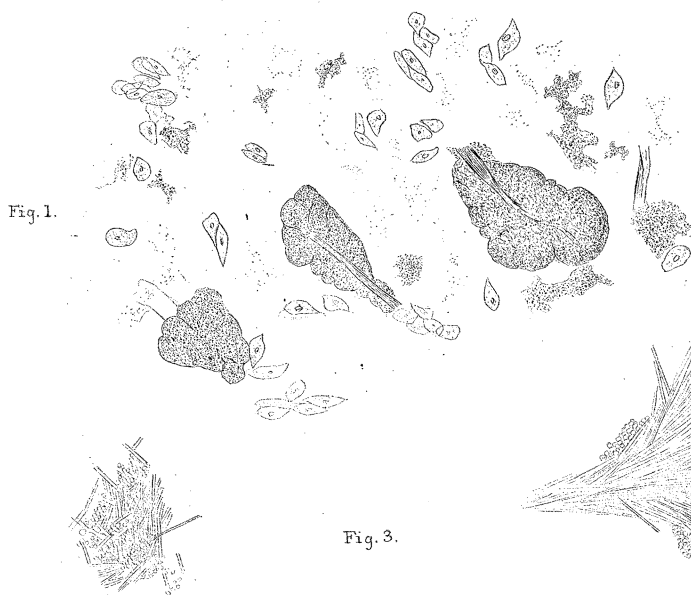


Fig. 1.

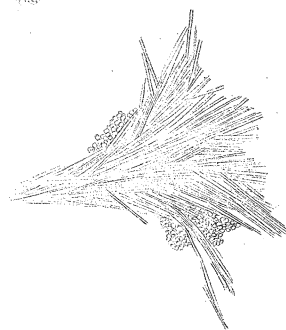


Fig. 3.



Fig. 1.



Fig. 3.



Fig. 2.



Fig. 4.



Sketch 5.

*Micrococcus.*

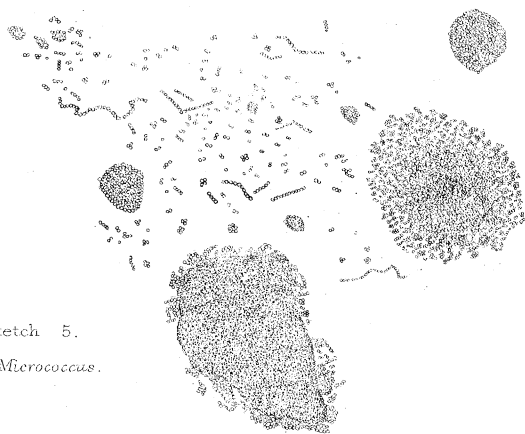


Fig. 1.

*Sarcina.*

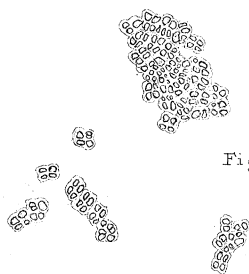


Fig. 4.

*Bacillus subtilis.*

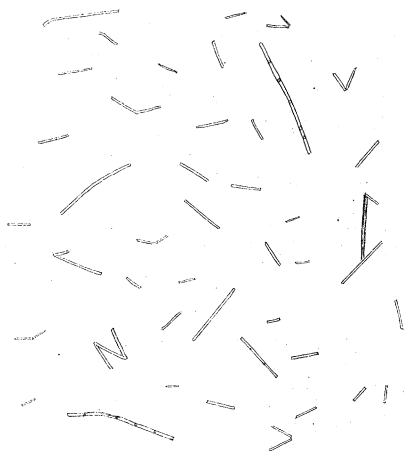


Fig. 2.

*Bacterium termo.*

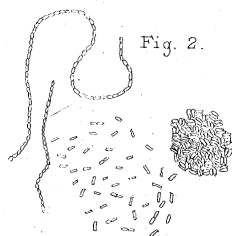


Fig. 3.

*Spirochaeta spicillata.*



Fig. 6.

*Vibrio.*



Some results of cultivation (x450)

*culi*, *Spirochaeta plicatilis*) may often add considerably to its bulk, and may, perhaps, modify its characters under certain conditions.

The slime which exists around and between the teeth is composed of the same constituents as the fur on the tongue; all the organisms which are found in the one are found also in the other. *Bacillus subtilis* exists, however, in greater quantity in this tooth-slime than in the fur, and the rods and filaments are usually much longer in the tooth-slime, probably because they are not subjected to so much disturbance.

In conclusion I have to thank Dr. Burdon Sanderson and Dr. Lauder Brunton, for valuable suggestions, and for the kindly interest they have shown in this work.

*A List of the principal Works relating to the Nature and Character of  
Tongue Fur.*

- 1831. Piorry. "Du Procédé Opératoire." Paris, 1831.
- 1845. Remak. "Diagnostische und Pathologische Untersuchungen." Berlin, 1845, s. 221.
- 1849. Pfeufer. "Der Mundhöhlenkatarrh." Henle u. Pfeufer. Ztschft. f. Rat. Med., Bd. 7, 1849, s. 180.
- 1850. Miquel. "Untersuchungen über der Zungenbeleg." Prager Viertel Jahrschft., 1850, Bd. 28, s. 44.
- 1853. Robin. "Végétaux Parasites." Paris, 1853, p. 345.
- 1861. Neidhardt. "Mittheilungen über die Veränderungen der Zunge in Krankheiten." Arch. d. Wissensch. Heilkunde, Bd. v, 1861, s. 294.
- „ Hyde Salter. Todd's "Cyclopædia of Anatomy and Physiology." Art. "Tongue." Vol. iv, pt. 2, p. 1161.
- 1866. Hallier. "Die Pflanzlichen Parasiten." Leipsig, 1866.
- 1867. Kölliker. "Handbuch der Gewebelehre." 5th Auflage. 1867. Ss. 348—349.
- 1873. Fairlie Clarke. "Diseases of the Tongue." London, 1873, p. 93.
- 1874. Billroth. "Coccobacteria septica." Berlin, 1874, s. 94.
- „ Robin. "Leçons sur les Humeurs." Paris, 1874, p. 550.
- 1877. Koch. "Untersuchungen über Bacterien." Cohn's Beiträge zur Biologie der Pflanzen, Bd. II, Hft. 3, s. 399.

II. "Note on the Supplementary Forces concerned in the Abdominal Circulation in Man." By J. BRAXTON HICKS, M.D., F.R.S. Received March 26, 1879.

During the ordinary inspiratory effort, the descent of the diaphragm, most noticeable in the male, necessarily produces pressure on the abdominal viscera in contact with its lower surface; these in their turn press down the intestines, which, acting as fluid enclosed in closed elastic sacs, press equally in all directions. Thus during each descent the abdominal walls are projected forwards, as may be readily seen by adapting an instrument similar to a cardiograph resting on three feet,

Fig. 1.

Fig<sup>s</sup> 1, 2, 3.  
*Position of Fur on Tongue*  
*under normal conditions.*

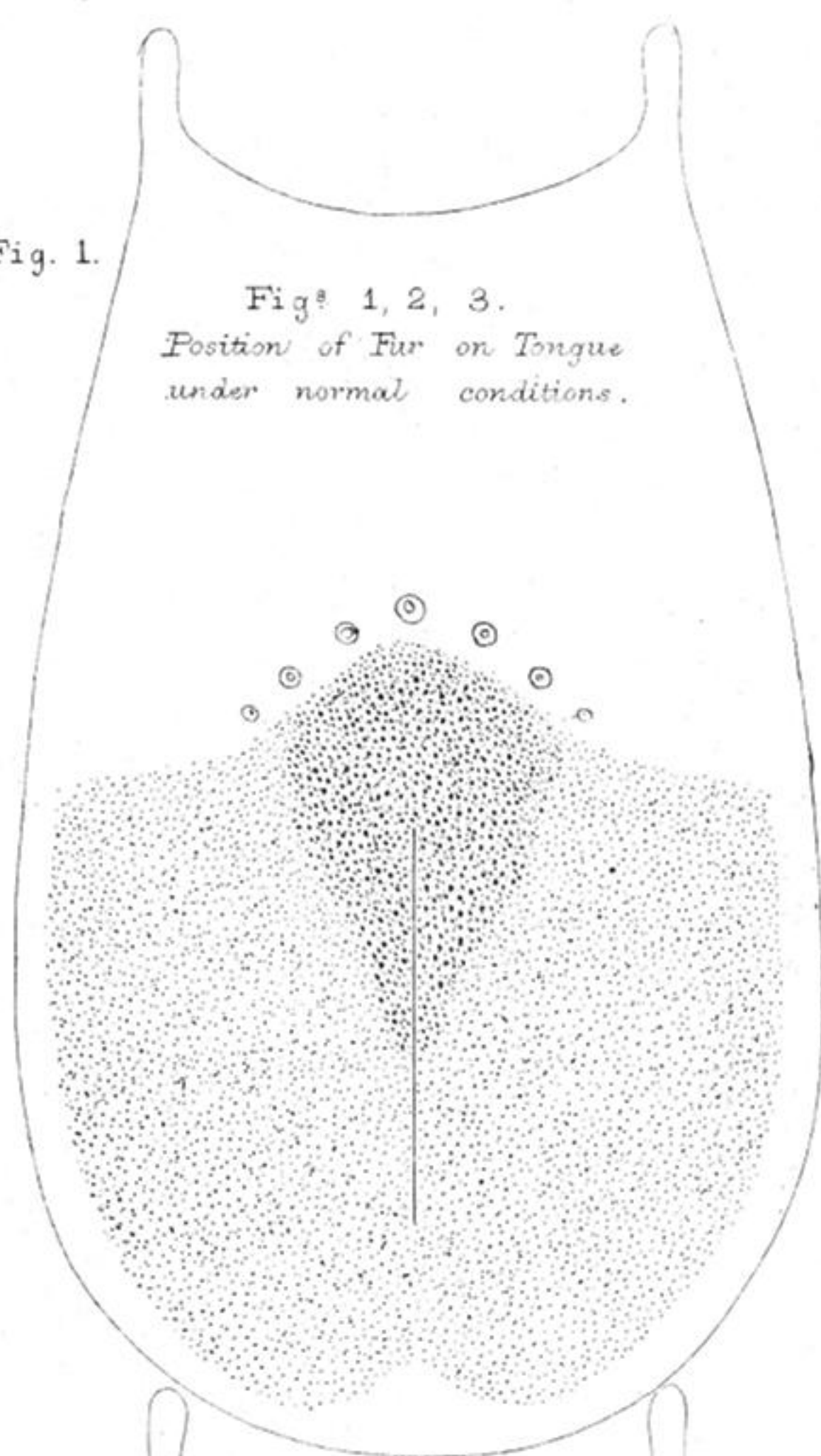


Fig. 2.

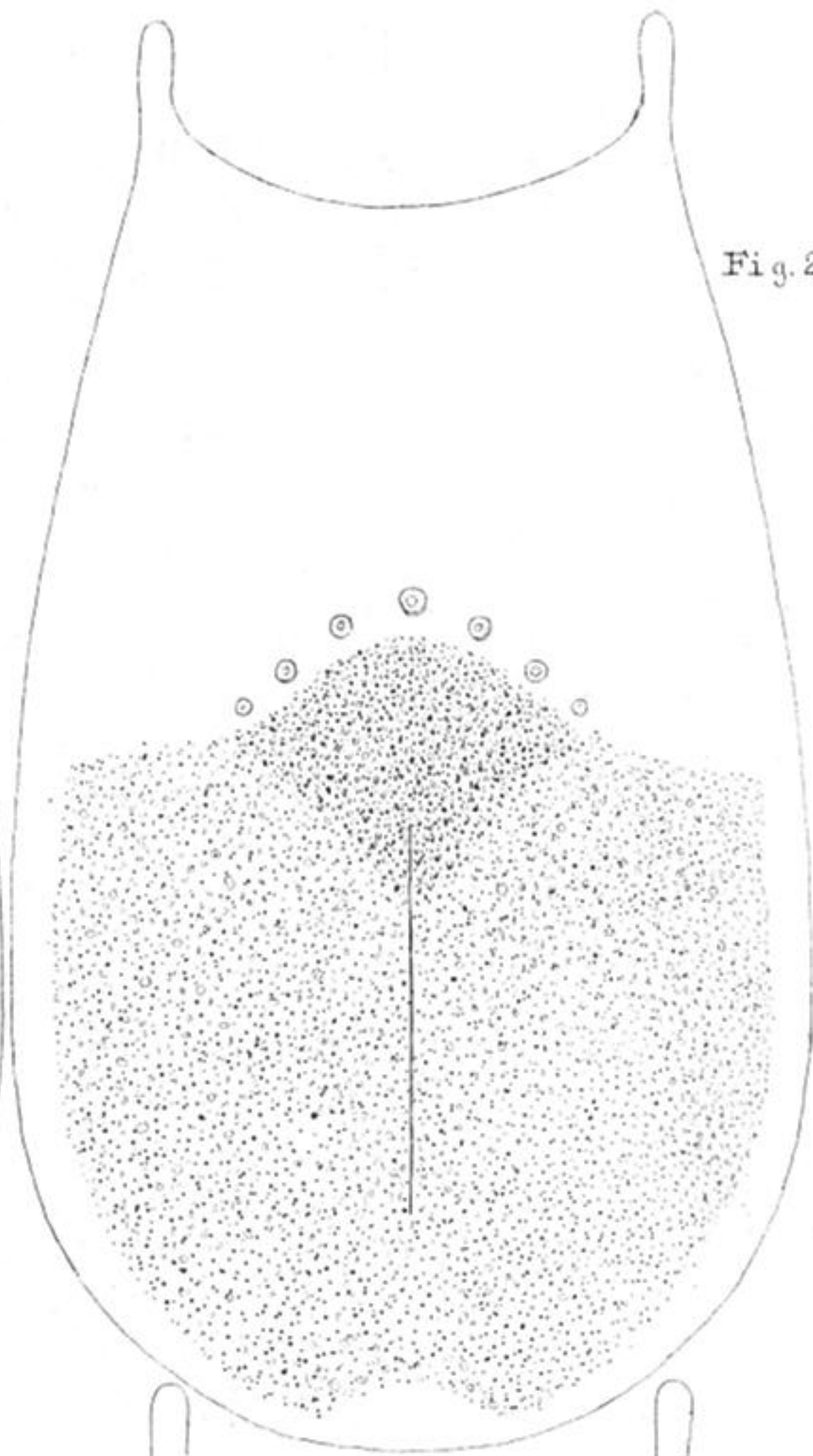


Fig. 3.

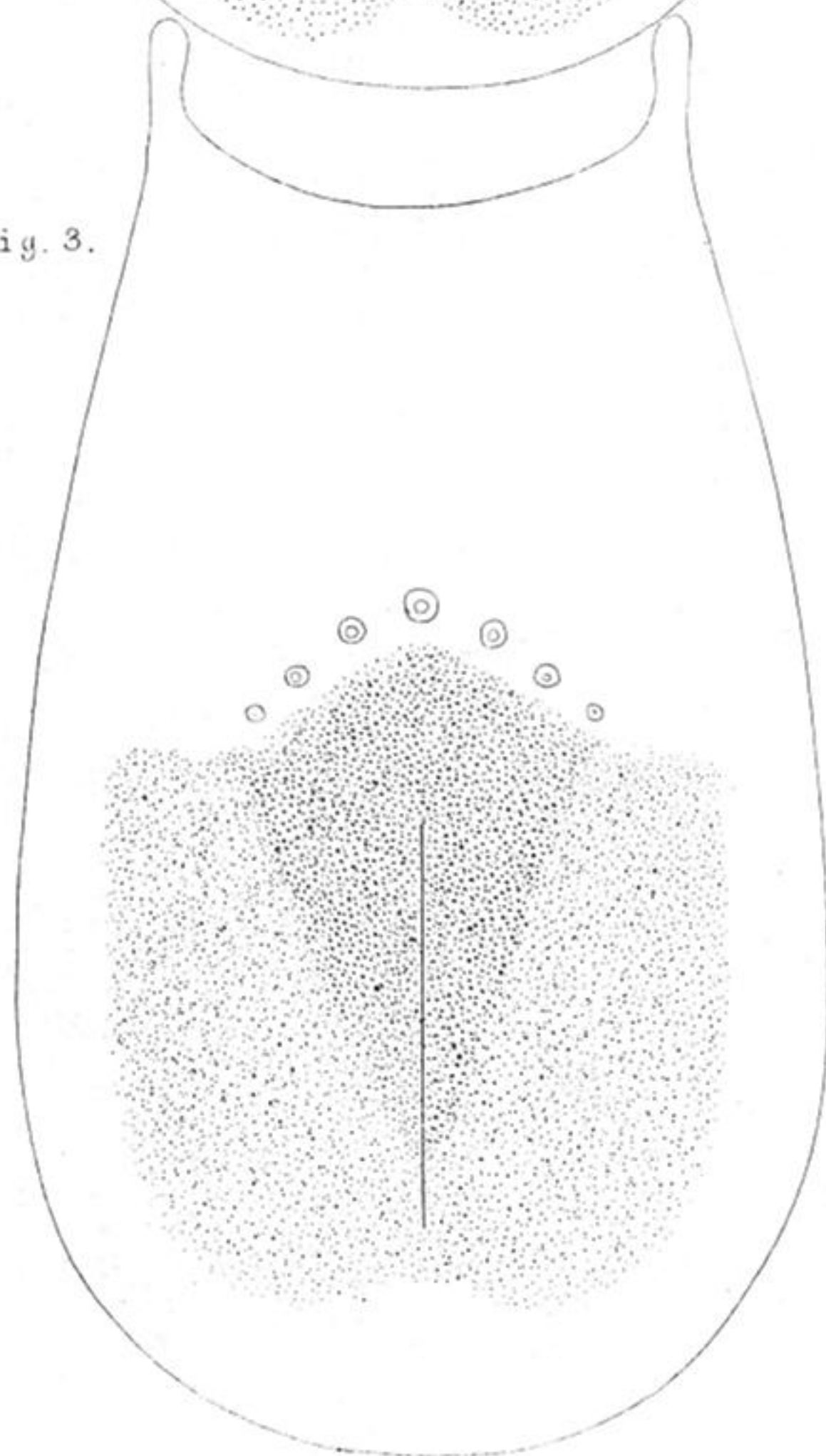


Fig. 4.

*Papillae absent in*  
*Central line.*

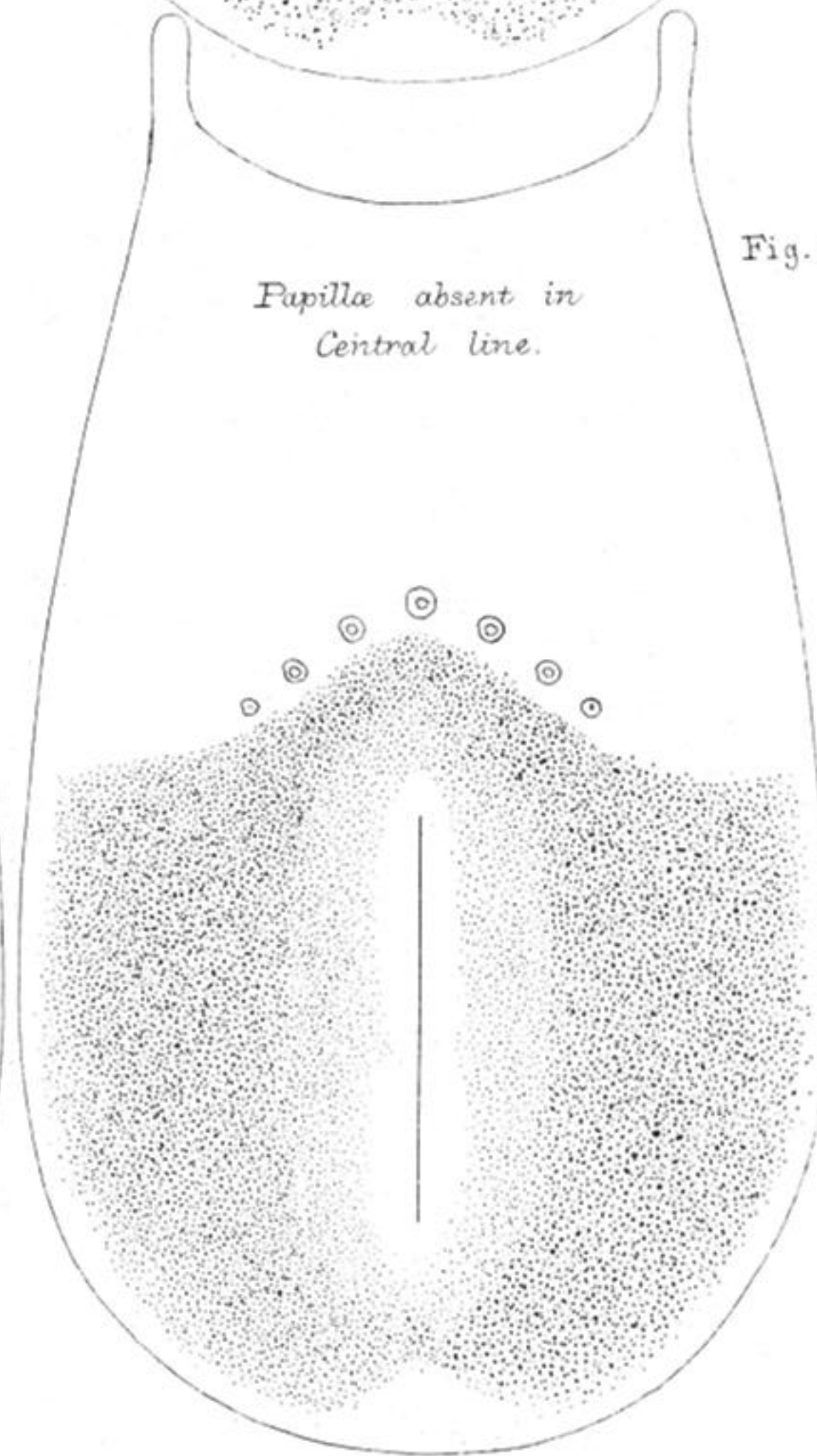






Fig. 2.

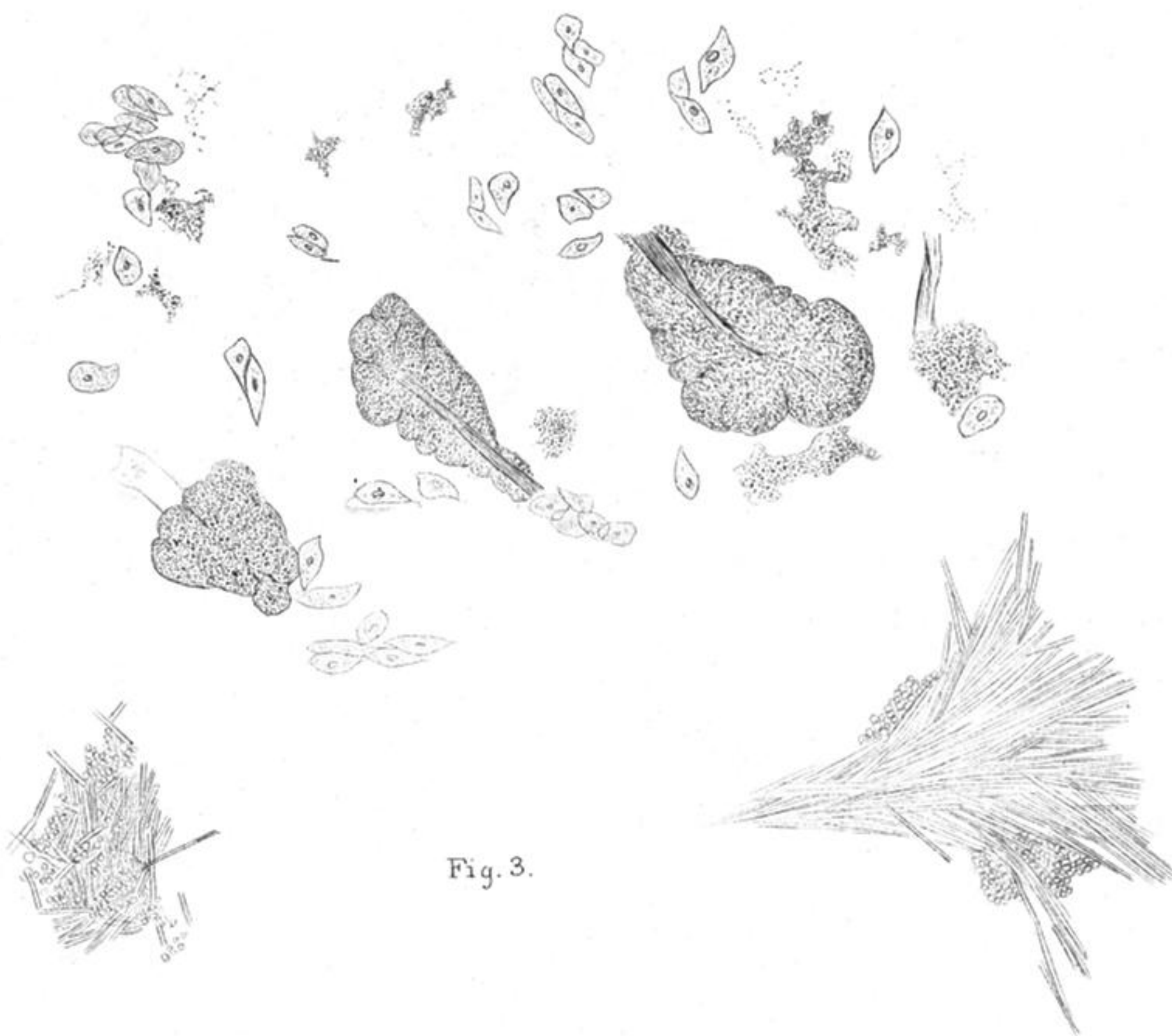


Fig. 1.

Fig. 3.

Fig. 1. Constituents of healthy fur. (low power)  
 Fig. 2, 3. d° d° highly magnified. (×450)

Fig. 1.



Fig. 3.

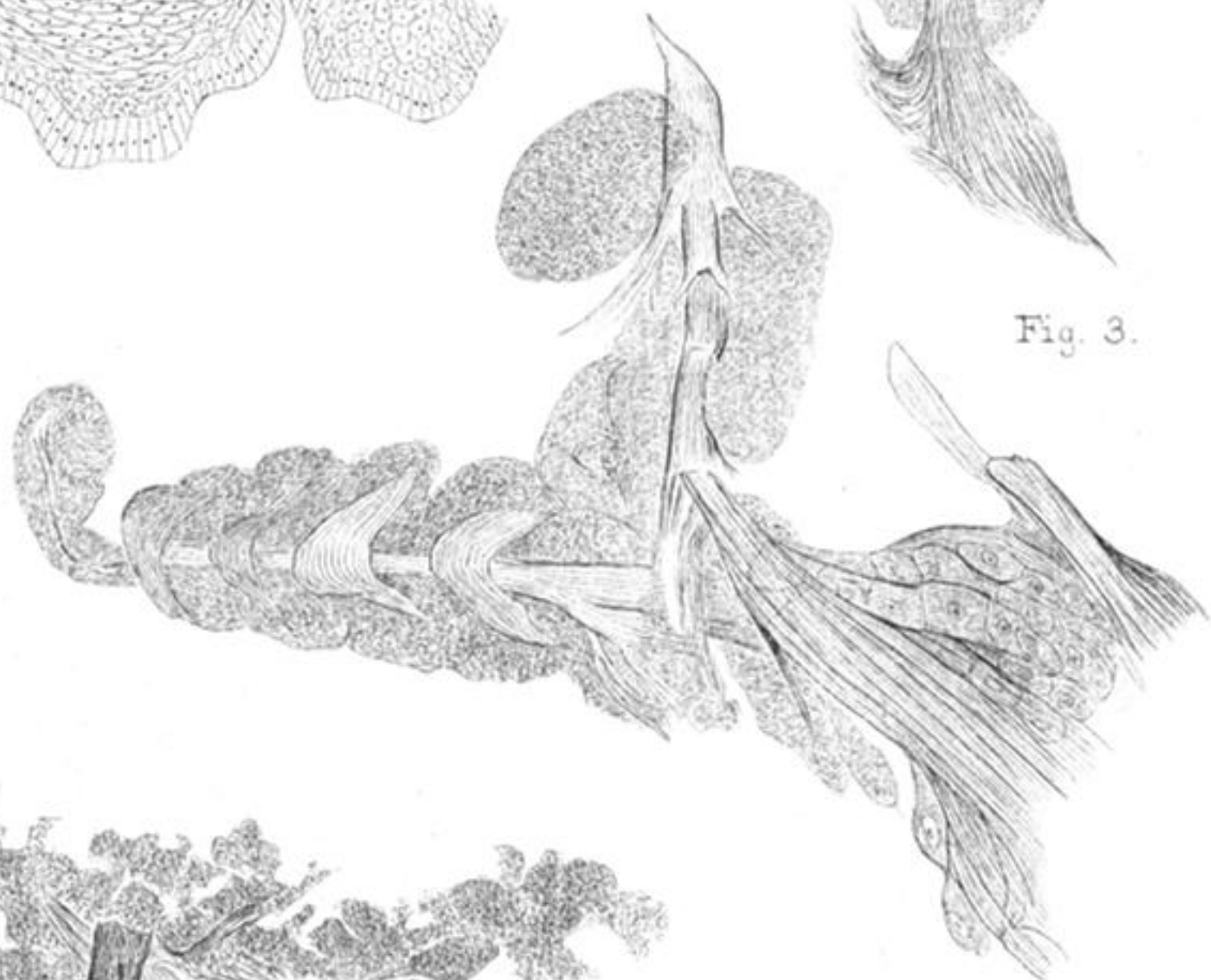
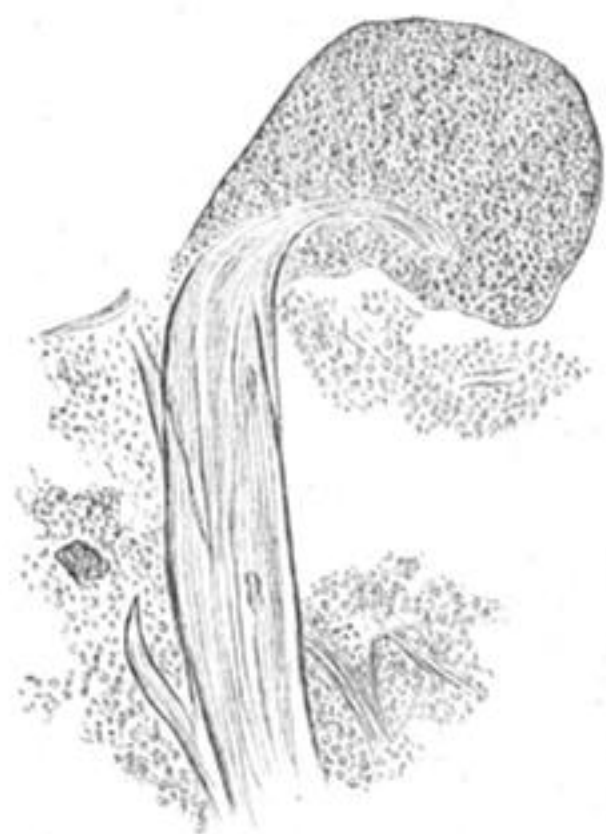


Fig. 2.



Fig. 4.



Fig<sup>s</sup> 1, 2. Sections of Epidermis-fur on filiform papillæ (oc. 3, obj. 4)  
Fig<sup>s</sup> 3, 4. Portions of Papillæ with fur upon them. ( $\times 240$ .)



Sketch 5.  
*Micrococcus.*

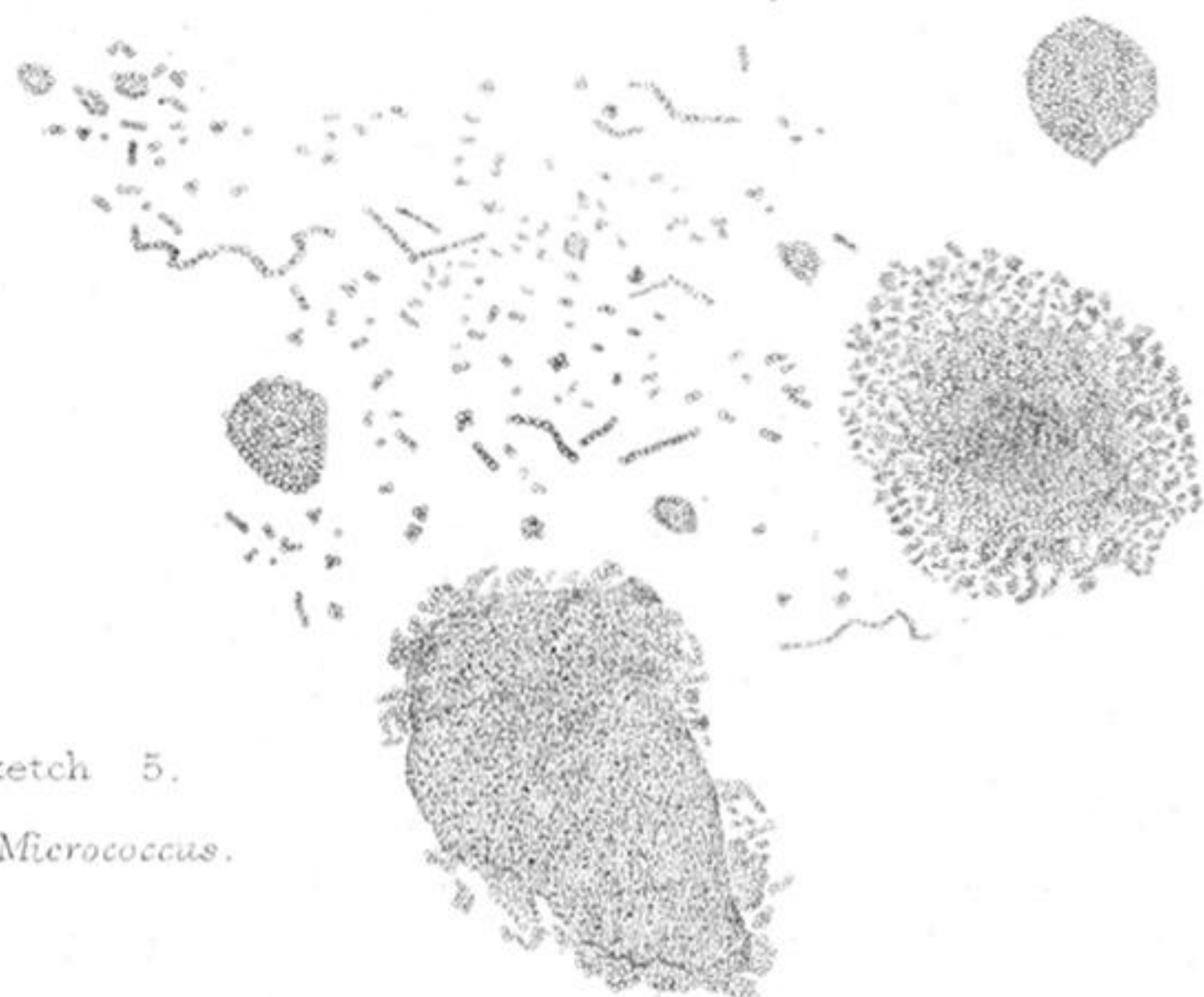


Fig. 1.



*Sarcina.*

Fig. 2.



*Bacterium termo.*

Fig. 6.  
*Vibrio.*



Fig. 4.

*Bacillus subtilis.*

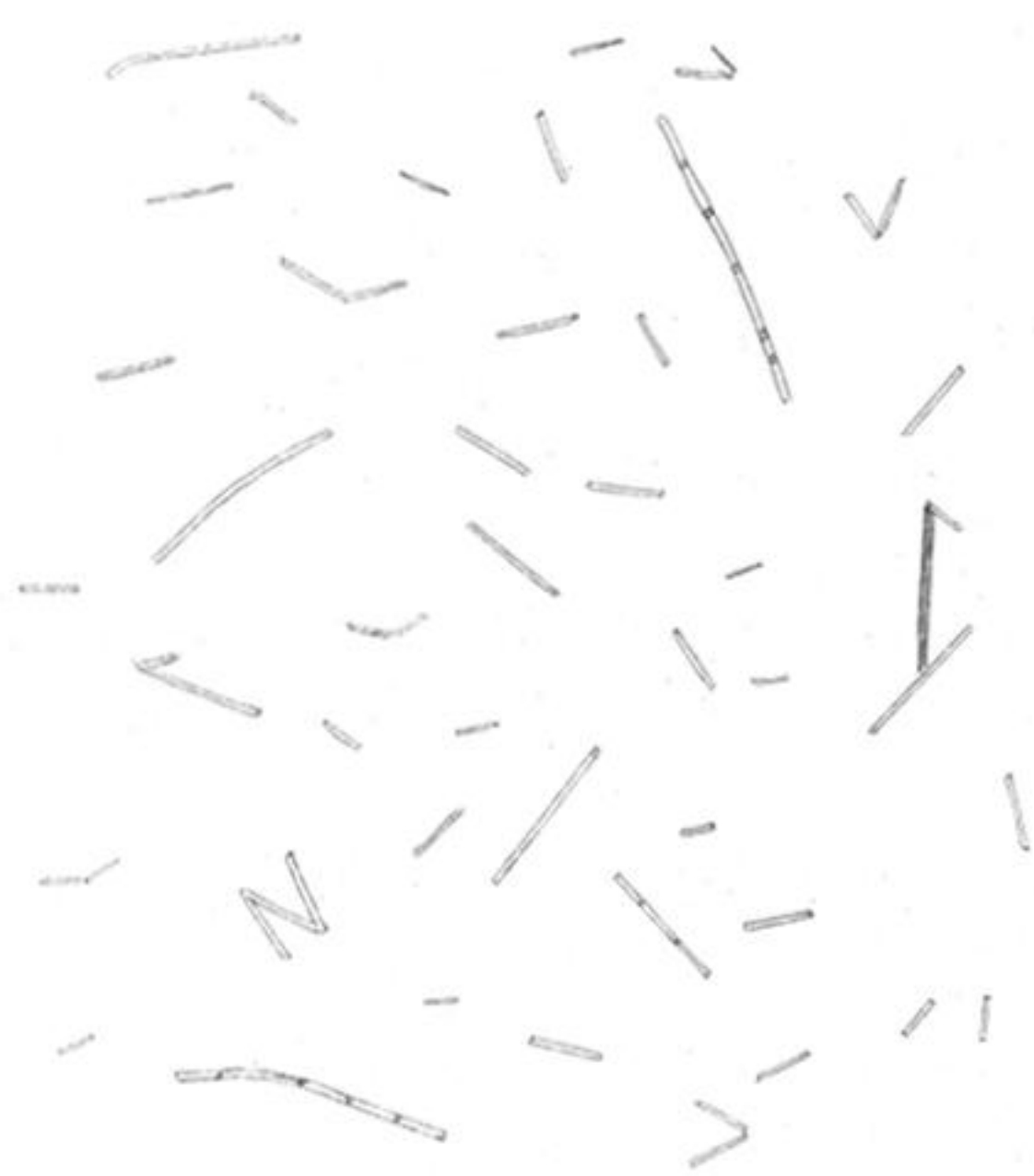


Fig. 3.

*Spirochaeta splicatilis.*

