may not his aſſertion be after Mr. de Courtivron's calculation, ſince they give a difference of time conſiderably greater?

I am, with the greateſt regard,

Reverend Sir,

Your moſt humble

and obedient ſervant,

Clairaut.

Hampton-Court in Middleſex. June 30, 1754.

XCIII. *A Letter to the Right Honourable the Earl of* Macclesfield, *Preſident of the Royal Society, concerning ſome new electrical Experiments, by* John Canton, *M. A. and F. R. S.*

My Lord,

Read Nov. 14, 1754.

AS electricity, ſince the diſcovery of it in the clouds and atmoſphere, is become an intereſting ſubject to mankind; your lordſhip will not be diſpleaſed with any new expeperiments or obſervations, that lead to a farther acquaintance with its nature and properties.

The reſinous and vitreous electricity of Mr. Du Fay, which aroſe from his obſerving bodies of the one claſs to attract, what thoſe of the other would repel, when each were excited by attrition; received no light till the publication of the ſecond part of Mr. Franklin's experiments; wherein it appears, that the one

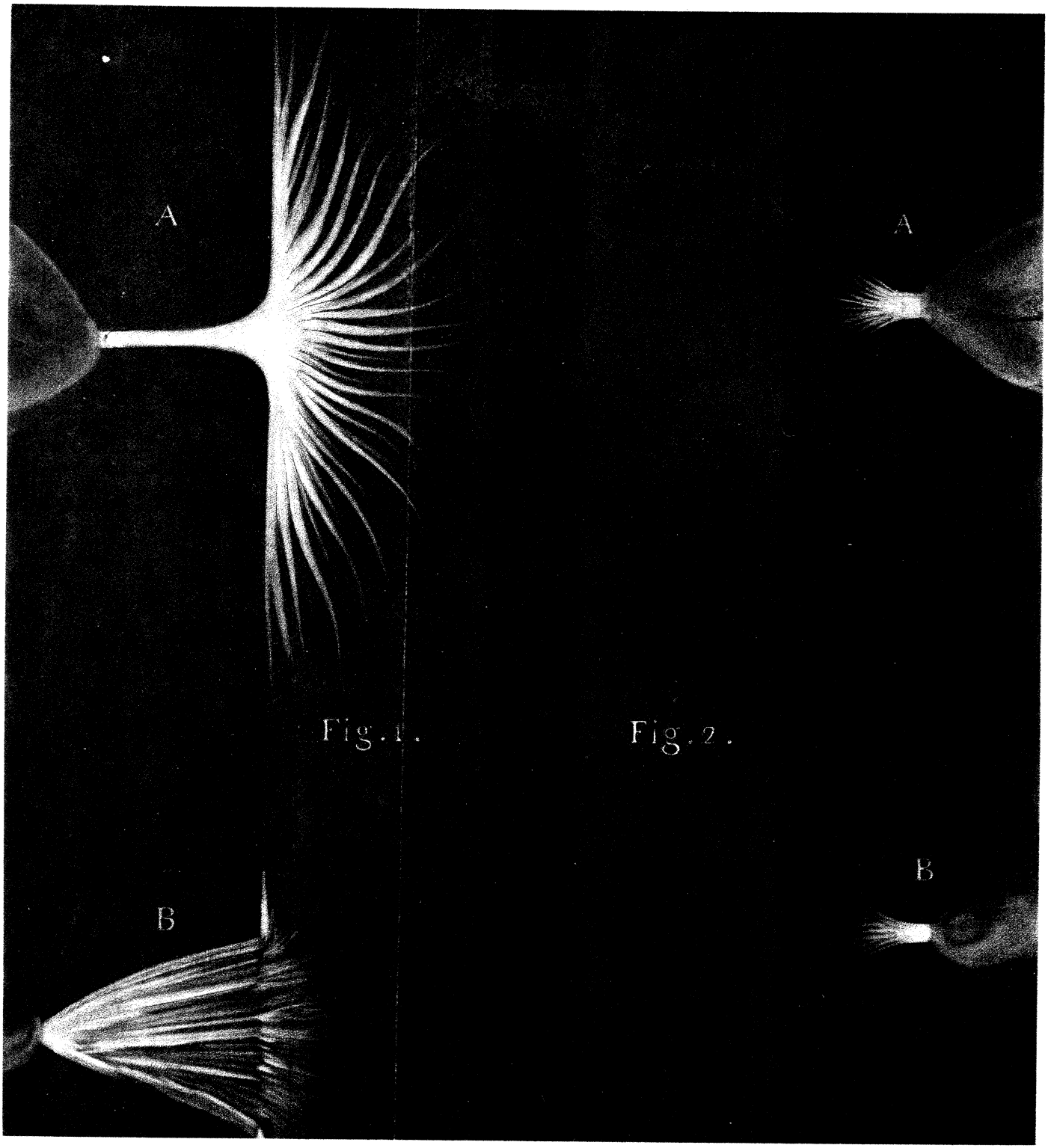

Fig. 1.

Fig. 2.

one kind of bodies electrify poſitively, and the other negatively; that excited glaſs throws out the electric fire, and excited ſulphur drinks it in. But no reaſon has yet been aſſigned, why vitreous bodies ſhould receive, and reſinous bodies part with this fire, by rubbing them. Some perſons indeed, of conſiderable knowlege in theſe matters, have ſuppoſed the expanſion of glaſs, when heated by friction, to be the cauſe of its receiving more of the electric fluid than its natural ſhare; but this ſuppoſition cannot be made with regard to bodies of the other ſort, ſuch as ſulphur, ſealing-wax, *&c.* which part with it when treated in the ſame manner. The following experiments, firſt made at the latter end of December 1753, and often repeated ſince, may perhaps caſt new light on this difficult ſubject.

Having rubbed a glaſs tube with a piece of thin ſheet-lead and flower of emery mixt with water, till its tranſparency was entirely deſtroyed; after making it perfectly clean and dry, I excited it with new flannel, and found it act in all reſpects like excited ſulphur or ſealing-wax. The electric fire ſeems to iſſue from the knuckle, or end of the finger, and to ſpread itſelf on the ſurface of this tube, in the beautiful manner repreſented at *A* and *B* in *Fig.* 1. *Plate* 32.

If this rough or unpoliſhed tube, be excited by a piece of dry oiled ſilk (eſpecially when rubbed over with a little chalk or whiting), it will act like a glaſs tube with its natural poliſh. And in this caſe, the fire appears only at the knuckle, or end of the finger; where it is very much condenſed before it enters; as at *A* and *B* in *Fig.* 2.

But if the rough tube be greaſed all over with tallow from a candle, and as much as poſſible of it wiped off with a napkin, then the oiled ſilk will receive a kind of poliſh by rubbing it, and after a few ſtrokes, will make the tube act in the ſame manner as when excited at firſt by flannel.

The oiled ſilk, when covered with chalk, or whiting, will make the greaſed rough tube act again like a poliſhed one: but if the friction be continued till the rubber is become very ſmooth, the electric power will be changed to that of ſulphur, ſealing-wax, *&c.*

Thus may the poſitive and negative powers of electricity be produced at pleaſure, by altering the ſurfaces of the tube and rubber; according as the one or the other is moſt affected by the friction between them: For if the poliſh be taken off one-half of a tube, the different powers may be excited with the ſame rubber at a ſingle ſtroke. And the rubber is found to move much eaſier over the rough, than over the poliſhed part of it.

That poliſhed glaſs electriſes poſitively, and rough glaſs rubbed with flannel negatively, ſeems plain, from the appearance of the light between the knuckle, or end of the finger, and the reſpective tubes; but yet may be farther confirmed by obſerving, that a poliſhed glaſs tube, when excited by ſmooth oiled ſilk, if the hand be kept at leaſt three inches from the top of the rubber, will at every ſtroke appear to throw out a great number of diverging pencils of electric fire, as in *Fig.* 3. *Plate* 33; but not one was ever ſeen to accompany the rubbing of ſulphur, ſealing-wax, *&c.* nor was I ever able to make any ſenſible alteration in the air of a room, merely by the friction of thoſe

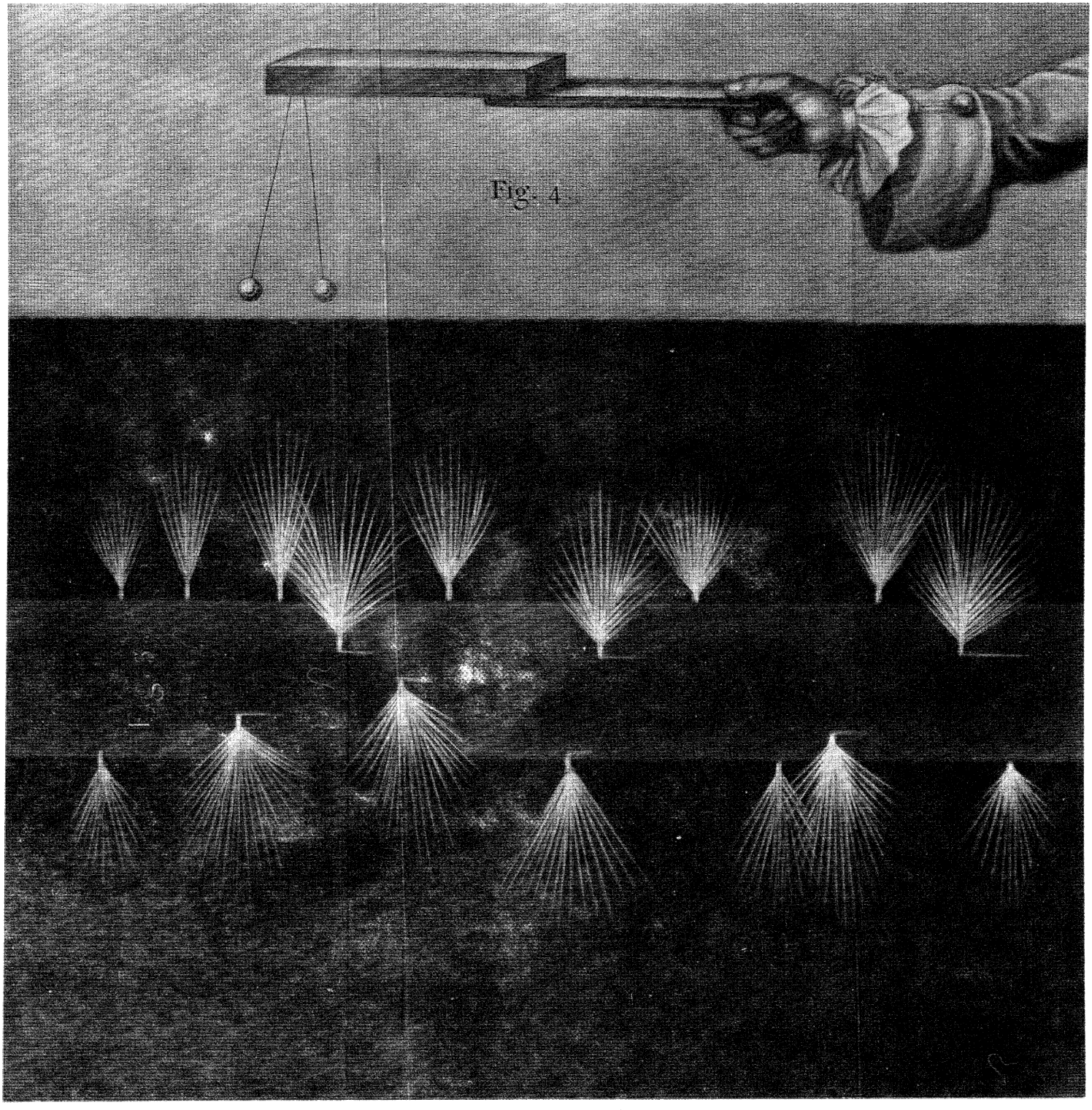
Fig. 4.

thoſe bodies: whereas the glaſs tube, when excited ſo as to emit pencils, will, in a few minutes, electrify the air to ſuch a degree, that (after the tube is carried away), a pair of balls, about the ſize of the ſmalleſt peas, turn'd out of cork, or the pith of elder, and hung to a wire by linen threads of ſix inches long, will repel each other to the diſtance of an inch and an half, when held at arm's-length in the middle of the room. But their repulſion will decreaſe as they are moved toward the floor, wainſcot, or any of the furniture; and they will touch each other when brought within a ſmall diſtance of any conductor. Some degree of this electric power I have known to continue in the air above an hour after the rubbing of the tube, when the weather has been very dry.

The electricity from the clouds, in the open air, may be diſcovered in the ſame manner, if the balls are held at a ſufficient diſtance from buildings, trees, *&c.* as I have ſeveral times experienced, by a pair which I carry in a ſmall narrow box with a ſliding cover, (*Fig.* 4.) ſo contrived as to keep their threads ſtraight, and that they may be properly ſuſpended, when let fall out of it: and theſe balls will eaſily determine whether the electricity of the clouds or air be poſitive, by the decreaſe; or negative, by the increaſe of their repulſion, at the approach of excited amber or ſealing-wax.

To electrify the air, or moiſture contained in it, negatively; I ſupport by ſilk, between two chairs placed back to back, at the diſtance of about three feet, a tin tube with a fine ſewing-needle at one end of it; and rub ſulphur, ſealing-wax, or the rough glaſs tube, as near as I can to the other end, for three or four

four minutes. Then will the air be found to be negatively electrical; and will continue ſo a conſiderable time after the apparatus is removed into another room.

The air without-doors I have ſometimes known to be electrical in clear weather; but never at night, except when there has appeared an aurora borealis, and then but to a ſmall degree, which I have had ſeveral opportunities of obſerving this year. How far poſitive and negative electricity in the air, with a proper quantity of moiſture between, to ſerve as a conductor, will account for this, and other meteors ſometimes ſeen in a ſerene ſky, I ſhall leave to the curious in this part of natural philoſophy to determine. That dry air at a great diſtance from the earth, if in an electric ſtate, will continue ſo till it meets with ſuch a conductor, ſeems probable from this experiment: An excited glaſs tube with its natural poliſh, being placed upright in the middle of a room, by putting one end of it in a hole made for that purpoſe in a block of wood, will generally loſe its electricity in leſs than five minutes, by attracting to it a ſufficient quantity of moiſture, to conduct the electric fluid from all parts of its ſurface to the floor. But if, immediately after it is excited, it be placed in the ſame manner before a good fire, at the diſtance of about two feet, where no moiſture will adhere to its ſurface, it will continue electrical a whole day; and how much longer I know not. It may not be improper to mention here, that if a ſolid cylinder of glaſs be ſet before the fire till quite dry, it may as eaſily be excited as a glaſs tube, and will act like one in every

every reſpect: the firſt ſtroke will make it ſtrongly electrical.

In a paper I laid before the Royal Society, on the 6th of December laſt, I conjectured, that the electricity of the atmoſphere might be obſerved even in the winter; which I have ſince found to be true: for in the ſucceeding months of January, February, and March, my apparatus was electrified no leſs than twenty-five times, both poſitively and negatively, by ſnow, as well as by hail and rain; and to almoſt as great a degree, when Fahrenheit's thermometer was between 28 and 34, as I ever knew it in the ſummer, except in a thunder-ſtorm.

I ſhall be glad, if theſe obſervations and experiments may engage perſons of more leiſure and ſuperior abilities to purſue this inquiry; as it is highly probable their reſearches would be rewarded by many uſeful diſcoveries. I have the honour to be,

My Lord,

Your Lordſhip's moſt obedient,

and obliged humble ſervant,

John Canton.

Spital-Square,
Nov. 11, 1754.

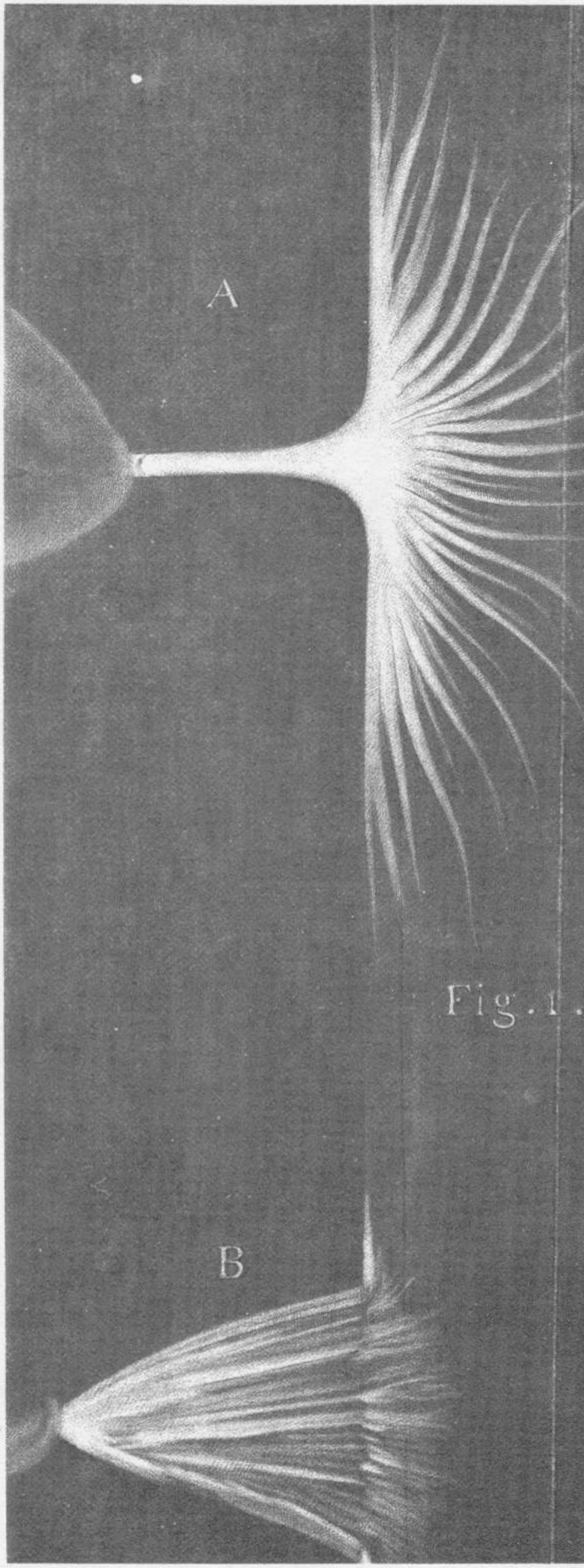

Fig. 1.

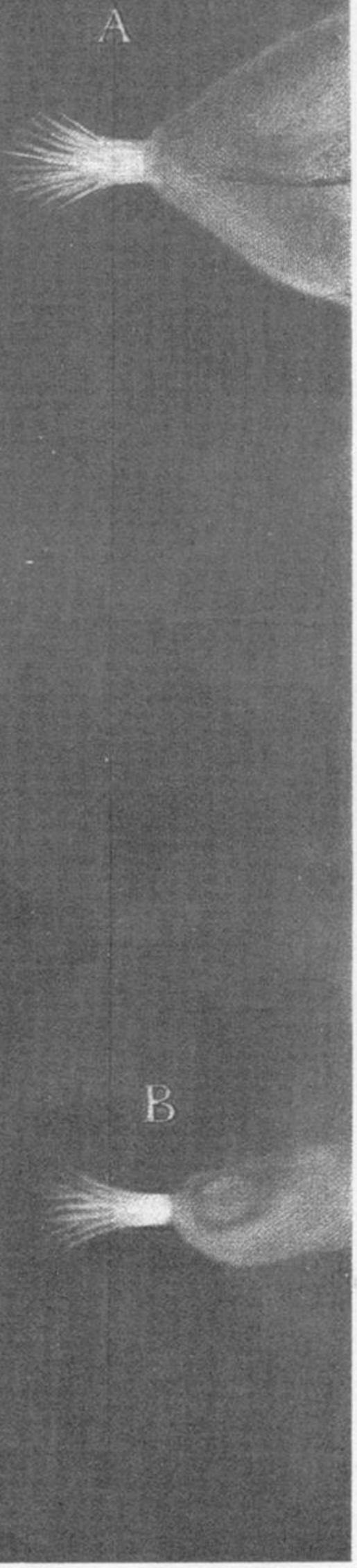

Fig. 2.

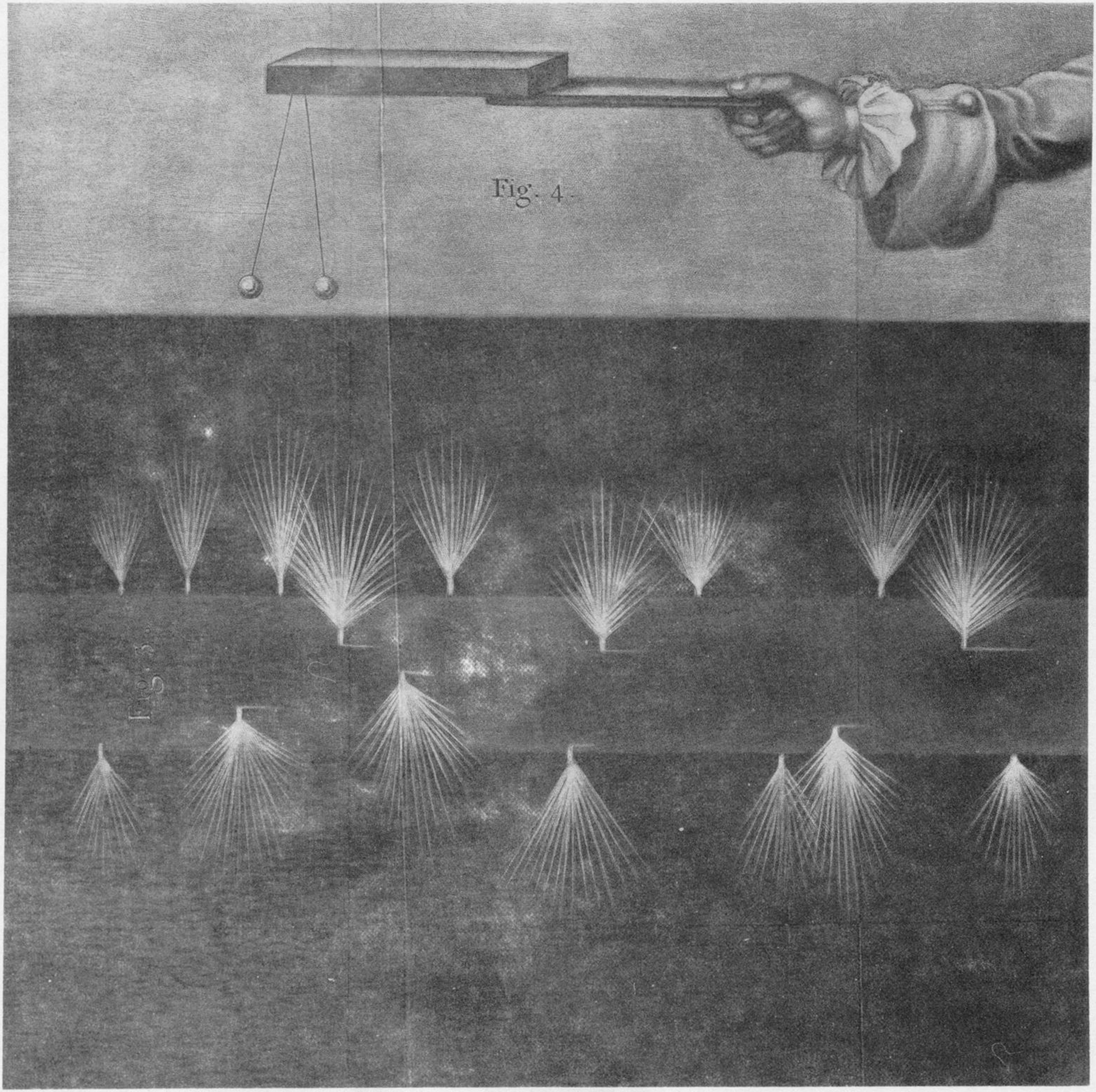

Fig. 4.

Fig. 5.