equinum) belonging to the family of *Strongylidæ*, and that in many, perhaps in a majority of cases, the existence of such an aneurism must be considered, if not the sole, at any rate the principal, cause of colic.

Although not much that is really new can be added to what was said in the annual report of 1886, and although no important discoveries have since been made, the simple fact that since that report was published such an aneurism has been found in every one of the sixteen horses that have been killed for anatomical purposes in the Veterinary College, or Veterinary Department of the Ohio State University, and that said aneurism was found not only in old horses, but also in young horses and in mules, will more than corroborate what was said two years ago, and be of interest to science, and of practical value to the farmer and horse-owner. As to the occurrence of the aneurism in young horses, Dr. Detmers states, that, among the sixteen horses and mules killed for anatomical purposes since the publication of the fifth annual report, were two young horses (one last year, and one this winter) which were each less than two years old, consequently mere colts, and that both had big aneurisms containing quite a large number of worms.

As colic is one of the most frequent diseases of horses, which, notwithstanding its frequent occurrence, is but little understood even by the majority of veterinarians, and consequently a disease which is seldom rationally treated, and perhaps oftener than any other a subject of quackery of the grossest kind; further, as it causes every year great losses, partially due to its often dangerous character, and partially to irrational treatment, — this brief treatise on colic, showing the causal connection between the aneurism and the morbid process, explaining its true causes, describing the symptoms, etc., giving a rational treatment, and pointing out the means of prevention, will be appreciated by farmers and horse-owners.

As to colic, it will, on the whole, be easier to ward off or to prevent the exciting than the predisposing causes. A prevention of the principal and most frequent exciting causes will be effected if the horse is always regularly fed; if the food is sound, wholesome, and digestible; if feeding a heavy meal immediately before and immediately after severe exercise is avoided; if no food that has a tendency to ferment, or that is rich in alkalies, is given; if the feeding of new grain and of new hay that has not yet passed through the so-called "sweating process" is avoided, or, where that cannot be done, if such new hay and new grain are fed only in small quantities, and then with a small pinch of salt added to each meal; if no icy food, or food covered with hoar-frost, is allowed to be eaten; if no ice-cold water is given to drink, or, when it cannot be avoided, only in small quantities, and never when the horse is perspiring or has an empty stomach; and, finally, if meal or bran that may be used as food is never given until it has been thoroughly moistened.

The principal predisposing cause, according to Dr. Detmers,— the aneurism in the anterior mesenteric artery, — can be warded off by preventing the worm-brood of *Sclerostomum equinum* from entering the digestive canal of the horse; but this, it seems, can only be accomplished if the horse is never allowed to drink any water but what is positively free from the worm-brood. That this will be difficult, will not need any explanation.

This bulletin will be sent free to any resident of Ohio on application to the Ohio Agricultural Experiment Station, Columbus, O.

QUARTZ FIBRES.

IN almost all investigations which the physicist carries out in the laboratory, he has to deal with, and to measure with accuracy, those subtle and to our senses inappreciable forces to which the so-called laws of nature give rise. Whether he is observing by an electrometer the behavior of electricity at rest, or by a galvanometer the action of electricity in motion; whether in the tube of Crookes he is investigating the power of radiant matter, or with the famous experiment of Cavendish he is finding the mass of the earth, — in these and in a host of other cases he is bound to measure with certainty and accuracy forces so small that in no ordinary way could their existence be detected; while disturbing causes which might seem to be of no particular consequence must be eliminated, if his experiments are to have any value. It is not too much to say that the very existence of the physicist depends upon the power which he possesses of producing at will and by artificial means forces against which he balances those that he wishes to measure.

The weight of a single grain is not to our senses appreciable, while the weight of a ton is sufficient to crush the life out of any one in a moment. A ton is about 15,000,000 grains. It is quite possible to measure with unfailing accuracy forces which bear the same relation to the weight of a grain that a grain bears to a ton.

To show how the torsion of wires or threads is made use of in measuring forces, simply hang a straw horizontally by a piece of wire. Rest on the straw a fragment of sheet-iron. A magnet so weak that it cannot lift the iron is able to pull the straw round through an angle so great that the existence of the feeble attraction is plainly evident.

Ordinary spun glass, a most beautiful material, is about one-thousandth of an inch in diameter, and this would appear to be an ideal torsion-thread. Owing to its fineness, its torsion would be extremely small, and the more so because glass is more easily deformed than metals. Owing to its very great strength, it can carry heavier loads than would be expected of it. It has every good quality but one, and that is its imperfect elasticity. For instance: if a mirror is hung by a piece of spun glass, and if you turn the mirror twice to the right, and then turn it back again, a ray of light reflected from the mirror does not come back to its old point of rest, but oscillates about a point on one side, which, however, is slowly changing, so that it is impossible to say what the point of rest really is. Further, if the glass is twisted one way first, and then the other way, the point of rest moves in a manner which shows that it is not influenced by the last deflection alone: the glass remembers what was done to it previously. For this reason spun glass is quite unsuitable as a torsion-thread. It is impossible to say what the twist is at any time, and therefore what is the force developed.

So great has the difficulty been in finding a fine torsion-thread, that the attempt has been given up, and in all the most exact instruments silk has been used. The natural cocoon fibres consist of two irregular lines gummed together, each about one two-thousandth of an inch in diameter. These fibres must be separated from one another and washed. Then each component will, according to the experiment of Gray, carry nearly 60 grains before breaking, and can be safely loaded with 15 grains. Silk is therefore very strong, carrying at the rate of from 10 to 20 tons to the square inch. It is further valuable in that its torsion is far less than that of a fibre of the same size of metal, or even of glass, if such could be produced. The torsion of silk, though exceedingly small, is quite sufficient to upset the working of any delicate instrument, because it is never constant. At one time the fibre twists one way, and another time in another, and the evil effect can only be mitigated by using large apparatus in which strong forces are developed. Any attempt that may be made to increase the delicacy of apparatus by reducing their dimensions is at once prevented by the relatively great importance of the vagaries of the silk suspension.

The result, then, is this: the smallness, the length of period, and therefore delicacy, of the instruments at the physicist's disposal, have until lately been simply limited by the behavior of silk. A more perfect suspension means still more perfect instruments, and therefore advance in knowledge.

As nothing that Mr. C. V. Boys, F.R.S., knew of could be obtained that would be of use to him, he was driven to the necessity of trying by experiment to find some new material. The result of these experiments was the development of a process of almost ridiculous simplicity.

The apparatus consists of a small cross-bow, and an arrow made of straw with a needle-point. To the tail of the arrow is attached a fine rod of quartz which has been melted and drawn out in the oxyhydrogen jet. The operator holds a piece of the same material in his hand, and, after melting their ends and joining them together, — an operation which produces a beautiful and dazzling light, — all he has to do is to liberate the string of the bow by pulling the trigger with one foot; and then, if all is well, a fibre will be drawn by the arrow, the existence of which can be made evident by fastening to it a piece of stamp-paper.

In this way threads can be produced of great length, of almost any degree of fineness, of extraordinary uniformity, and of enormous strength. A quartz fibre one five-thousandth of an inch in diameter Mr. Boys had in constant use in an instrument loaded with about 30 grains. It has a section only one-sixth of that of a single line of silk, and it is just as strong. Not being organic, it is in no way affected by changes of moisture and temperature, and so it is free from the vagaries of silk which give so much trouble. The piece used in the instrument was about 16 inches long. Had it been necessary to employ spun glass, which hitherto was the finest torsion material, then, instead of 16 inches, he would have required a piece 1,000 feet long, and an instrument as high as the Eiffel Tower to put it in.

There is no difficulty in obtaining pieces as fine as this, yards long if required, or in spinning it very much finer. Dr. Royston Piggott has estimated some of them at less than one-millionth of an inch; but, whatever they are, they supply for the first time objects of extreme smallness the form of which is certainly known, and therefore one cannot help looking upon them as more satisfactory tests for the microscope than diatoms and other things of the real shape of which we know nothing whatever.

Since figures as large as a million cannot be realized properly, it may be worth while to give an illustration of what is meant by a fibre one-millionth of an inch in diameter. A piece of quartz an inch long and an inch in diameter would, if drawn out to this degree of fineness, be sufficient to go all the way round the world 658 times; or a grain of sand just visible — that is, one-hundredth of an inch long and one-hundredth of an inch in diameter — would make 1,000 miles of such thread. Mr. Boys has made use of fibres one ten-thousandth of an inch in diameter, and in these the torsion is 10,000 times less than that of spun glass.

As these fibres are made finer, their strength increases in proportion to their size, and surpasses that of ordinary bar steel, reaching, to use the language of engineers, as high a figure as 80 tons to the inch. While these fibres give us the means of producing an exceedingly small torsion, and one that is not affected by weather, it is also true that they do not show the same fatigue that makes spun glass useless. A peculiar property of melted quartz makes threads such as these a possibility. A liquid cylinder, as Plateau has so beautifully shown, is an unstable form. It can no more exist than can a pencil stand on its point. It immediately breaks up into a series of spheres. This is well illustrated in that very ancient experiment of shooting threads of resin electrically. When the resin is hot, the liquid cylinders which are projected in all directions break up into spheres. As the resin cools, they begin to develop tails; and when it is cool enough, i.e., sufficiently viscous, the tails thicken and the beads become less, and at last uniform threads are the result.

Now, in the case of the melted quartz, it is evident, that, if it ever became perfectly liquid, it could not exist as a fibre for an instant. It is the extreme viscosity of quartz, at the heat even of an electric arc, that makes these fibres possible. The only difference between quartz in the oxyhydrogen jet, and quartz in the arc, is that in the first you make threads, and in the second are blown bubbles.

CULTIVATION OF SUGAR IN PERSIA.

THE sugar-cane was introduced into Persia from its original home in Bengal at a very remote period. The first indisputable mention, says the United States consul at Teheran, of sugar by a Western writer, is that by Moses Chorencrisis, in the fifth century, who describes the sugar-cane as he saw it growing on the banks of the Karun River, which joins the Shott-et-Arab at the head of the Persian Gulf. In the olden times, and as late as the fourteenth century, the sugar-cane was much cultivated in Susiana, the country intersected by the Karun River, and principally near Ahwaz and Jundi Shapur. Susiana was then one of the principal intermediate commercial stations between the present towns of Dizful and Shushter, and had its water from the Karun River by means of canals cut from the right bank some distance above Shushter, and from the Diz River by canals cut from the left bank, near the town of Dizful. With the decline of Jundi Shapur, in the thirteenth century, the canals were neglected, and the cultivation of sugar-cane necessarily ceased. The present Ahwaz is a small village of about fifty houses, on a mound which covers the ruins of a part of the former town. Hundreds of millstones or wheels, formerly used for squeezing the juice out of the cane, are lying about in all directions. Persian historians do not ascribe the ruin of Ahwaz to the failure of the water-supply, but to scorpions. They say that an Indian merchant, with the view of raising the price, bought up all the sugar he could, and stored it for a year or two. When he opened his stores, all the sugar had turned into scorpions. Millions of scorpions came out of the sugar-store, all the inhabitants of Ahwaz fled, and the city has remained a desert from that day. There is still current in Persia a proverb which says, "At Ahwaz sugar-cane produces scorpions;" and one of the Persian poets, referring to the ringlets of his mistress, says, "They are as deadly as the scorpions of Ahwaz." The only district in Persia where sugar-cane is now cultivated is Mazanderan, which is the principal rice-producing district, and it was probably introduced during the last century. The sugar-cane in Mazanderan requires twelve months to ripen; but the canes are small and poor, few being ever found thicker than a man's finger, and the produce is of very inferior quality, being dark and moist. Both of these defects in all probability arose from want of skill in the cultivation and preparation of this valuable plant. The sugar is mostly consumed in the province; a considerable portion, however, is exported to Gilan, and some to Russia. The canes are planted in slips with two or three joints, in February or March, and ripen about eight or nine months after, having then a height of about five feet. One mill turns out per day about 200,000 pounds of juice, and about 60 to 70 pounds of sugar. The juice, therefore, yields 30 to 35 per cent of sugar. Only raw sugar is manufactured in Mazanderan. There are no sugar-refineries. The raw sugar is sold at the place of manufacture in the villages at from three farthings to a penny a pound, and in the markets of Sari and Barfunish at from a penny to twopence a pound, according to quality. In some towns of Persia, principally Yezd and Ispahan, Jaru raw sugar was, up to a few years ago, refined, and made into loaf-sugar. The loaf-sugar made in Persia was seldom perfectly crystallized, and was on that account very soft; it was also more or less impure and dirty, the loaves not having been properly washed, and the green sirup not having been completely removed. The imported loaf-sugar becoming very cheap, sugar-refining in Persia ceased to be profitable. The general Persian word for "sugar" is *shakar*, "the sugar-cane" is *udi-i-shakar*, while "refined sugar" is *kand*, "a loaf of sugar" is *kelleh-i-kand*, "sugar-candy" is *nabat*. Persia is famous for its sugar-candy. This is made in the ordinary way, but is left to crystallize on strings in a bowl of earthenware or china. The strings are kept at the bottom of the bowl by a piece of lead, and at the top by strips of wood. When taken out of the bowl, it retains its shape, and is called *kasch-i-nabat*; i.e., a bowl of candy. Consul Schindler is of opinion that sugar-cane would thrive well in some districts of Persia and southern Persia, at altitudes of from 1,000 to 3,000 feet above the level of the sea. The plain of Bugh-i-Mailik, east of Shushter, at an elevation of 2,600 feet; that of Shapur, west of Shiraz, elevation 2,500 feet; those of Fihift and Rudbar, south of Kerman, elevation 2,500 feet, — appear to him to be eminently suited to the cultivation of the sugar-cane.

FRUIT-CANDYING INDUSTRY OF LEGHORN.

THE English consul at Leghorn says that that city occupies the first place in Italy, and perhaps throughout the Mediterranean, for the preparation of the candied citron and orange peel so largely used in all branches of confectionery — citron being brought for this purpose from Corsica, from Sicily, from Calabria and other southern provinces of Italy, from Tunis and Tripoli, and even from Morocco; while the candied peel of the fruit is exported to North America, to the United Kingdom, and to Hamburg for distribution throughout Germany. Sugar also is imported for the purpose of the manufacture from Egypt. The wood of the boxes in which the candied peel is packed comes from Trieste, and the immense earthenware vessels necessary for the saturation of the fruit in