

them, though the bee may have long been dead.

The bee's wings are proportionately small in comparison to other insects—some butterflies of the same weight having perhaps ten times the area of wing. The lack of wing surface is more than compensated, however, in rapidity of vibration, otherwise such intensity and strength of flight would be impossible.

Having a bee tethered by a strand of fine sewing cotton around his waist (so to speak), that is between his thorax and his abdomen, I was struck with the strength of the little creature, as indicated by the strain upon the thread, whether afoot or on the wing.

With my little captive thus restrained, and contemplating the rapidity of wing movement necessary to produce such appreciable strain, I was impressed with a desire to know exactly the number of vibrations per minute, and following the impulse I am pleased to say I succeeded beyond the possibility of doubt.

While I realize that should I tell you I had counted them and that they sometimes exceed 15,000 per minute, and that I also have the certificate of the bee to the same effect, you would accuse me of treading, at least, on the borders of romance, yet I trust I shall be able to convince you that both assertions are practically true.

To effect this purpose I employed the running gears of a clock; and substituting a longer shaft for that which carries the minute hand, erected thereon a wooden disk surrounded with a two inch band of highly polished tin, thereby forming a short cylinder 18½ inches in circumference, which, controllable by a specially constructed governor, was revolvable at any speed within reasonable requirements.

When thus arranged, the cylinder was revolved slowly above a smoking lamp until so coated as to have the appearance of black velvet. It was found that this coating could not be thrown off by the highest speed obtainable, and yet that it adhered so lightly that a hair passed over it would leave its tracery upon the tin. With the cylinder rapidly revolving, a bee with his six legs held in light forceps, but with wings free and struggling to escape, was brought carefully near the revolving surface. At first contact the track was swept clean, leaving no evidence of the frequency of his strokes, and showing that increased

velocity of the cylinder must be resorted to. After tiring out many bees, re-covering the cylinder many times, and finally increasing its speed to 120 revolutions per minute, I was rewarded with many wing-engraved records, one of which is shown in the accompanying cut (Fig. 8).

In this case the wing tracks seen upon the cylinder were precisely seven to the inch, which number, multiplied by 18½ (the number of inches in circumference) and that by 120 (the number of revolutions per minute), gives the highest result inscribed upon the tablet on the cylinder, the results having been inscribed after the experiments were completed, the lowest number given being the record made by the bee, who having become exhausted, was making but slight efforts to escape.

The certificate of the bee, to which I have

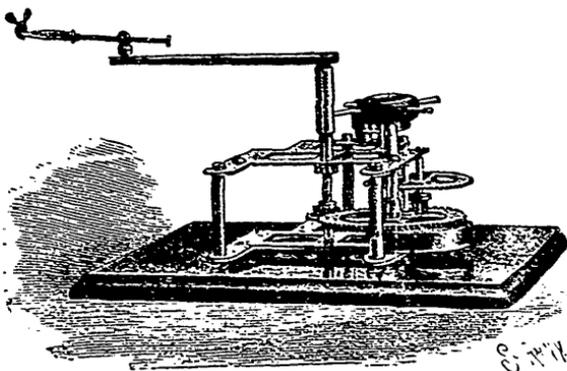


Fig. 4.—BEE MOUNTED ON REVOLVING LEVER

referred, might be interpreted thus:

I hereby certify that when in flight I sometimes vibrate my wings at the rate of 15,510 strokes per minute.

Signed (pointing to the wing tracks)
his
APIS A MELLIFICA
mark.

While these results were entirely satisfactory and conclusive, yet, while pursuing the experiments, foreboding failure, I conceived yet another plan, which, from its very fascination, I was impelled to carry out, and which, though falling very slightly short of the highest record, yet virtually corroborated the results obtained by the former process.

Removing the cylinder, I substituted therefor a wooden lever or "hand" so to speak, which, with the apparatus standing upright, would revolve as the hand of a clock, and fixed the outer end to