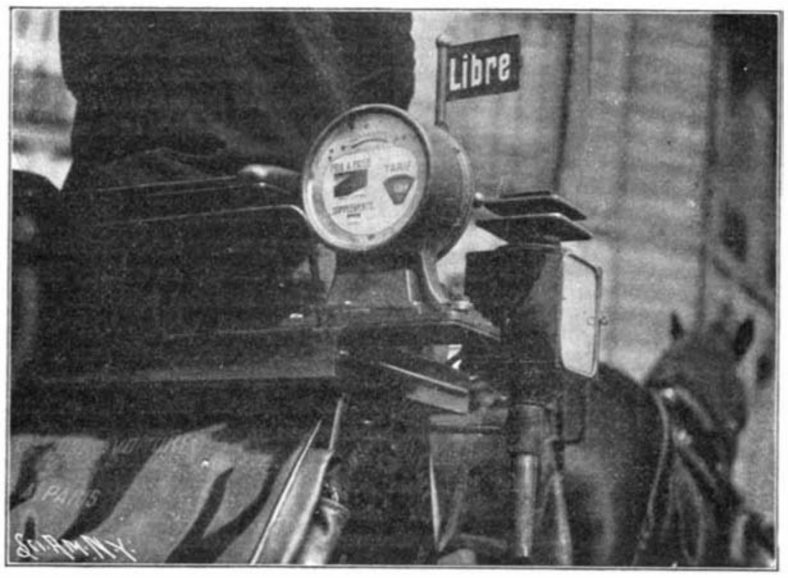
THE TAXOMETER.

The accompanying figure illustrates a new type of counter recently adopted for the public hacks of Paris. The apparatus is actuated by a very simple mechanism that causes it to register, through a measurement of the number of revolutions of one of the wheels, the distance traveled by the vehicle during the period of time indicated by a clock carried by the counter.



THE DISTANCE AND FARE INDICATOR IN USE ON PARISIAN HACKS.

A tappet secured to a collar mounted upon the hub of one of the wheels strikes, once per revolution, the cam of a pump fixed to the axle. Each of these impacts produces a variation in the pressure of a volume of air contained in the pump; and such variation is transmitted, through a rubber tube, to a small bulb of which every inflation causes a ratchet wheel to revolve by one tooth, through the intermedium of a metallic rod. A train of multiplying wheels, analogous to those of a clock, afterward causes the following readings to appear upon the dial: "Fare to be paid," "Distance traveled," "Extra fare," etc. Every 400 meters (about ¼ of a mile), for example, the fare to be paid increases by 10 centimes (2 cents). From the experience of the short time that has elapsed since the appearance of the first hacks with these counters, the following conclusions may be deduced: The new fare is very advantageous for short trips. The first hour costs more than formerly, say 2½ francs (50 cents) instead of 2 (40 cents); but this is largely compensated for by the privilege allowed the passenger of stopping as many times as he desires without being compelled to pay for the complete hour.

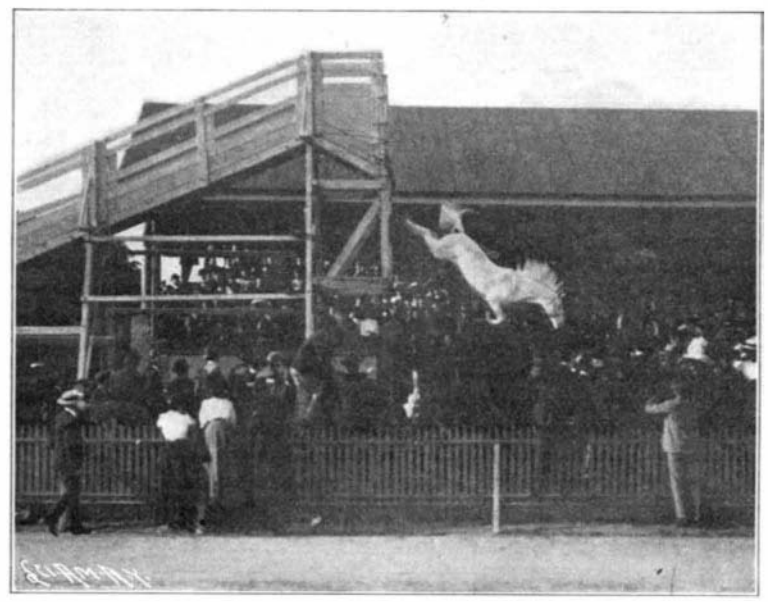
New Carbon Compound.

At a recent meeting of the Academy of Sciences of France, held at Paris, M. Henri Moissan presented a paper concerning the preparation and characteristics of a new carbon compound containing molybdenum. This compound is obtained by heating charcoal with melted molybdenum and aluminium in an electric furnace. The resultant metallic mass is treated with a concentrated solution of potash, and needles of well-defined crystals of the new carbon compound are obtained.

The substance is very hard, is hardly attacked by acids other than nitric, and is not decomposed by water or steam at a temperature below 600 deg. C. It resembles the carburet of tungsten, already known, which is not considered surprising, as the metals tungsten and molybdenum are much alike. It is thought that this new compound may play a rôle in molybdenum steels. The method of preparation shows that even at a rather high temperature (that of boiling aluminium) a molybdenum compound is obtained which contains twice as much carbon as the compounds formed at the highest heat obtainable in the electric furnace.

THE DIVING HORSE.

Our illustration of a horse in midair represents very forcibly the possibilities of animal training. An incline runway about 25 feet above the ground is arranged for the horses to walk or run up, from which they make a plunge and fall into a tank of water below about 12 by 20 feet in area and 12 feet deep. Usually the horses like to make the dive, and the moment they come in sight of the runway they fight to get to it first. The mare goes up first and without hesitation jumps off. The stallion, however, is more diplomatic, for he excites the onlookers by bows right and left, and then after an inspection of the surroundings he goes slowly forward and quite deliberately jumps, successfully rising in the water well pleased as the crowd cheers. It appears to be as much sport to the horses as to the spectators.



THE TRAINED DIVING HORSE.

TRANSPORTABLE WIRELESS TELEGRAPH STATION FOR WAR PURPOSES.

BY OUR BERLIN CORRESPONDENT.

The company which was started some time ago as a consequence of an understanding brought about between the two leading German electrical companies, has since the beginning paid special attention to the use of wireless telegraphy both for naval and military purposes. According to the results so far obtained, communication by two bodies of troops within four days' marching distance of each other is possible with the Morse recording apparatus, while with an acoustic indicator the distance may even be doubled.

In the following, a short description is given of their latest form of portable stations for military purposes.

The stations are arranged for two wave lengths, namely, for a short wave of 350 meters and a long wave of 1,050 meters, the antenna remaining the same for both. With the short wave, the antenna will oscillate in three-quarters, and with the long wave in one-quarter of a wave. The antenna is outbalanced, in the first case, by a counterweight of 6 square meters of copper gauze extended at a height of about 1 meter from the ground, while the amount necessary in the second case is as high as twenty-four square meters. The antenna is supported either by balloons or by linen kites; the former have a volume of 10 cubic meters and a draft of about 3 kilogrammes, while the effective wind surface of the latter is 1.1 square meter, so as to be used even in the case of small wind pressures on account of the saving of gas.

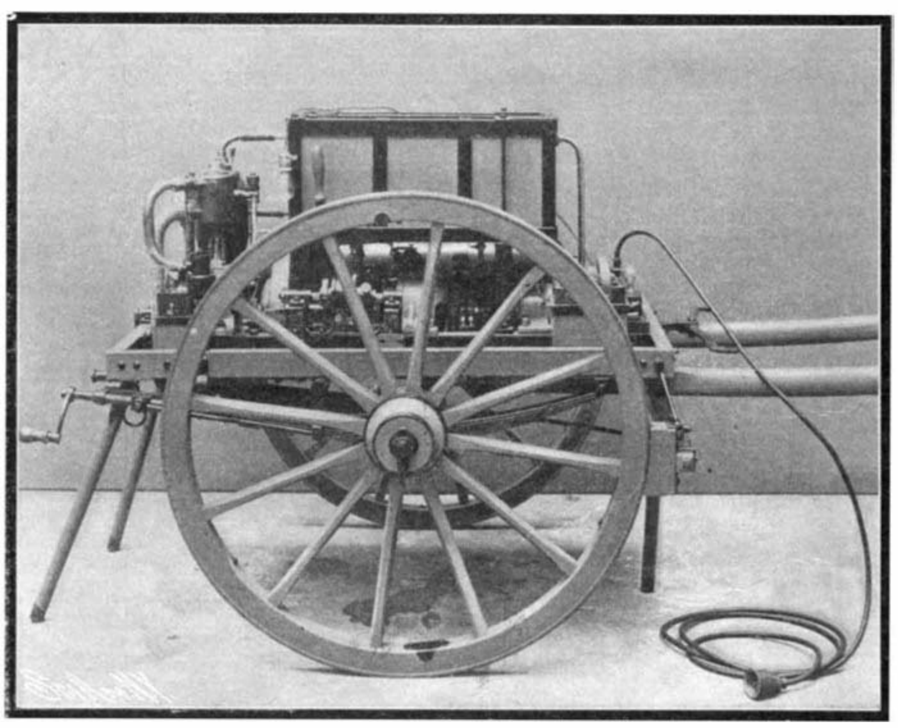
Each station comprises three two-wheel carts, namely, first the power cart; second, the apparatus cart; and third, the tool cart.

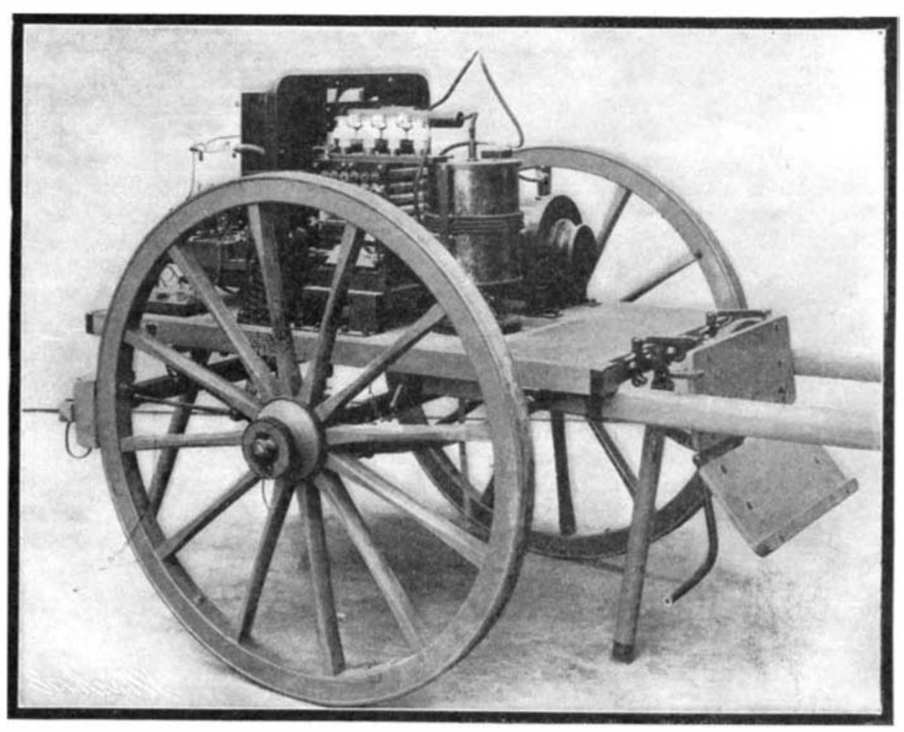
The power cart contains the source of current, consisting of a benzine motor of about 4 horse-power, direct-connected to an alternating current generator of an effective output of about 1 kilowatt, and the exciter. The cooling of the motor is effected by water, carried along in a reservoir located above the benzine dynamo. The circulation of the water is effected automatically by means of a small cog-wheel pump, the water being cooled by a tube system and by a ventilator. The benzine necessary for the operation of the motor is carried in a reservoir about 30 liters in capacity, located adjacent to the water receptacle, this capacity being sufficient for a continuous telegraphic service of about 30 hours.

The igniter of the motor is electrical and operated by accumulators, charged automatically from the exciter of the alternate current generator.

A full supply of accessories and reserve parts is located in the tool box fixed outside of the cart, the side walls of which contain, in addition, the two counterweights as well as bars supporting the latter.

The apparatus cart, separated into two compartments by a frame, contains both the sending and receiving apparatus. In the front part, protected against contacts, are located the high-tension instruments, comprising the induction coil, a battery of Leyden jars with adjustable spark gaps and the high-tension transformer. By means of a door on the side wall easy access is afforded to permit the renewal of the Leyden jars and the regulation of the spark gap. In the rear is arranged the Morse key, and on a board placed on stout springs, two receiving apparatus and a Morse recorder, while on the board of the latter the smaller receiving transformer is located. On the frame separating the car has been arranged the large receiving transformer, the receiving plug as well as a counterweight switch with two levers. On one of the side walls is the acoustic indicator, comprising an electro-



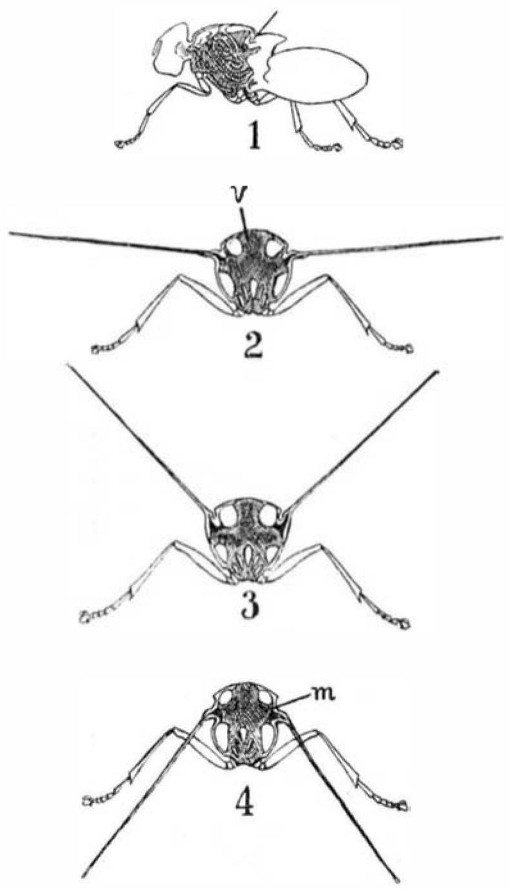


TRANSPORTABLE WIRELESS TELEGRAPH STATION FOR WAR PURPOSES.

lytic detector and a telephone, while on the door a removable alarm bell has been placed. These instruments have been so installed as to permit the removal of the upper part without withdrawing any connection. The accumulator necessary for lighting purposes is placed in a protecting box at the left-hand outer side.

The tool car, finally, contains the gas reservoir and the necessary intrenching tools, as well as the balloon and a reserve benzine reservoir. The gas receptacles are built in the car and have each a capacity of about 5 cubic meters at a pressure of 120 atmospheres, two reservoirs being sufficient for filling the balloon with the aid of a filling hose.

The same outfit has been used in connection with the Gordon Bennett cup for signaling the progress of the race from one point of the race ground to the other.



INSECT WING MECHANISM.

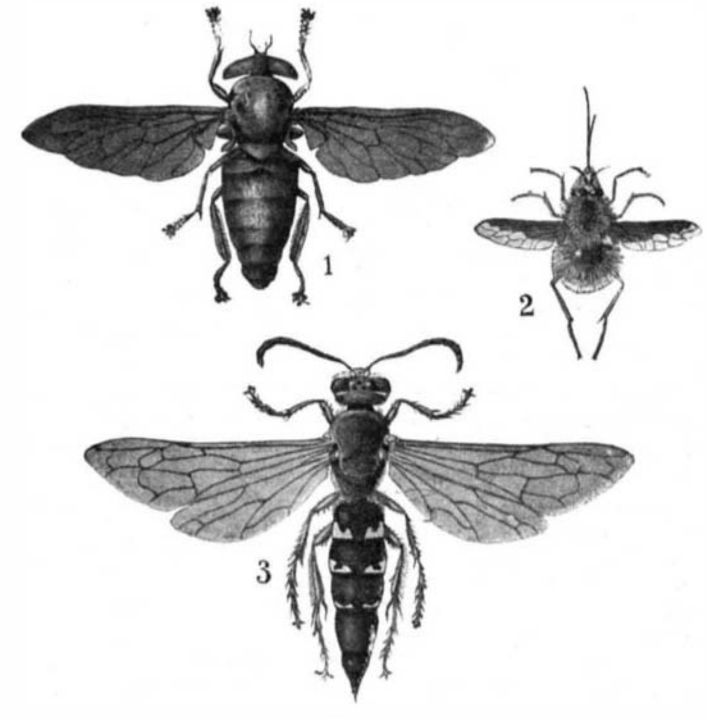
1.—Longitudinal section through thorax of blue-bottle fly (*Calliphora*). Arrow shows position of wing. 2.—Cross section of same, through wings, showing the vertical muscles, *v*, and the lateral arms, *m*, attached to the wings. 3.—Extreme upward position of wings during flight and the lateral muscles in the lower position. 4.—Extreme downward position of the wings in flight and the lateral muscles in the upper position.

INSECT WINGS.

BY S. FRANK AARON.

The method and mechanism of insect flight seem to have been little studied, though perhaps there is no subject relating to insects that will afford more entertainment to the investigator. It is probable that the student of aerial navigation may profit from knowing how insects fly, though the gravity differences between the man and the bug, and the principles evolved and upset thereby, are obvious. We can be more encouraged by observing the flight of the larger birds, but in the construction of wings and aeroplanes and the method of propulsion we can learn more from the insects.

In developing flight nature has adopted the very best and practically the same means for all winged creatures. With the weight-lifting downward stroke of a resisting surface is combined a slight posterior incline of the surface, and propulsion is thus gained by the wedge principle. In the uplift or regaining position of the wing there is an unresisting upper surface. This treble part is taken by the strong primary and secondary feathers of the bird's wings and by the posteriorly pliable wing membrane of the bats and insects.



INSECT WINGS.

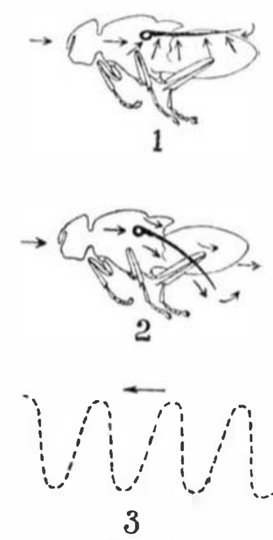
Types of the fastest-flying insects. 1.—The large black horsefly, *Tabanus atrata*. 2.—The little singing bee-fly, *Bombylius major*. 3.—The big digger wasp or sand hornet, *Sphecius speciosus*. All natural size.

The stroke of the wing is vertical and the uplift also, and this can be readily observed in slow-flying insects and birds. The trajectory of the tips of the wings, therefore, may be indicated by a series of waves, the length and breadth of which depend on the height of the stroke and the number of strokes to the speed per distance. The anterior portion of the insect wing is always more strongly braced with stout veins, and in line with the base, is the part directly operated. It is the downward stroke of this rigid part that exerts the lifting force. The posterior portion of the wing, lightly veined, and out of line of the base, is comparatively pliable. If the insect body is held horizontally the posterior portion of the wing will be observed to bend much more easily downward than upward, owing to the construction of the attachment to the body. This explains at once the means of propulsion in the downstroke and the unresisting recovery of the upstroke. In the former the slight upward bend of the posterior portion serves the wedge principle; in the latter the wing is lifted edgeways to the air resistance and has little tendency to check the forward motion of the body.

Insects present very wide differences in their wing structure, more than in any other part. From the rudimentary appendages of certain orthoptera and beetles to the great spreading wings of the swallow-tailed butterflies and giant moths there are many types and variations. The nicely balanced, high-power wings of the flies, bees, and hornets, the over-large yet perfectly controlled wings of the larger lepidoptera and the skimming, short-motion, acrobatic wings of the dragonflies will serve to illustrate modifications of wing outline and muscular control among insects with the highest wing development.

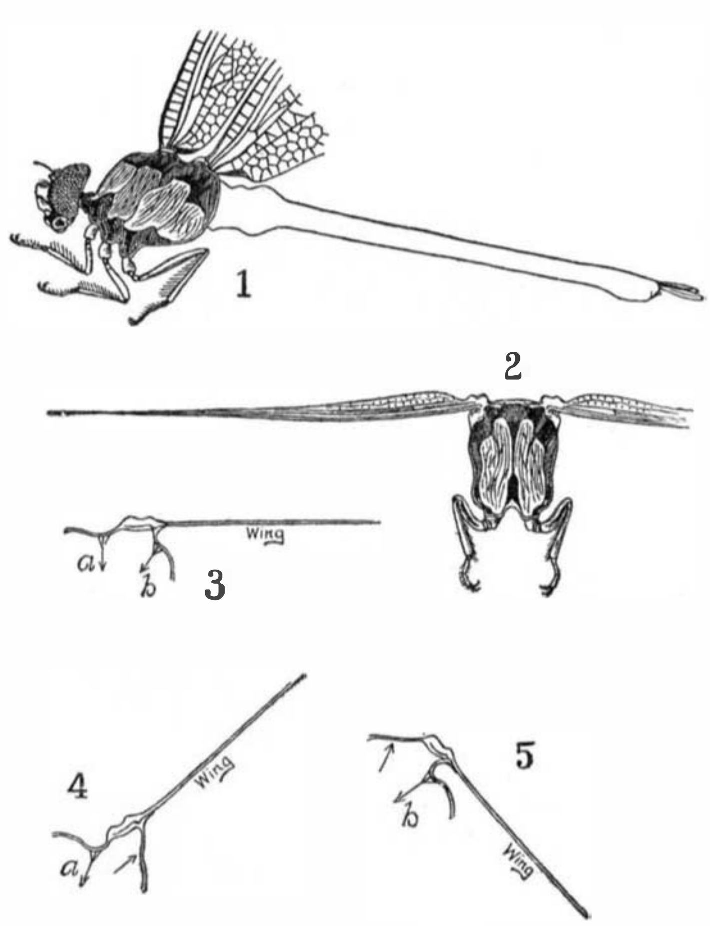
All swift-flying insects have broad wings and stout bodies, the latter to make room for the mass of muscles that is required to drive the wings at a high power. The breadth of wings must depend on the power of the muscles to drive them. In the swiftest insects there is a nice balance of muscle and wing surface. Many stout-bodied, broad-winged insects are weak flyers. Their muscles have not developed toward the control of the wings. They are runners, diggers, jumpers, or swimmers, and use their wings only to rise in air and drift along with the wind. Many species of the two-winged flies of the genera Musca, Tabanis, Tachina, and Bombylius, no doubt rejoice in their less complicated mechanism, for they are the swiftest of all insects. The hornets and bees, little inferior, have the shorter hind wings attached to the fore wings by a row of little marginal hooks and thus, operating with the stouter fore wings, they constitute the broad posterior development necessary for speed. The butterflies, moths, and dragon flies use their fore and hind wings separately and the posterior development of the fore wings is on or beyond the center to make room for the shorter and broader hind wings.

The muscles of insects are pale yellowish or pinkish in color, have a somewhat ropy character, but are very soft and easily separated. The muscles that control the head, wings, and legs are contained in and nearly fill the thorax. The veins of the wings broaden at the base and are attached firmly to the tegument of the thorax which is pliable above and below the base of the wing. This attachment may be called the fulcrum. The muscles operate the pliable portions and by contracting and expanding them pull and force the wings upward and downward. In the flies the wings are attached to the side of the thorax above the center and the muscles stretch from the top to the bottom of the thorax with an arm extending to the wing. This arm works up and down upon the vertical muscles, pulling the wing from the center of its fulcrum and operating the pliable tegument, in the opposite direction from its motion. In the butterflies the wings are hinged on or a little below the center, the legs and abdomen effecting the balance. The muscle, also attached to the base of the wing, acts upon the pliable tegument above and below the fulcrum, and where it expands it appears as a mass of greater density. This apparent density works up and down the muscle; thus it will expand above and



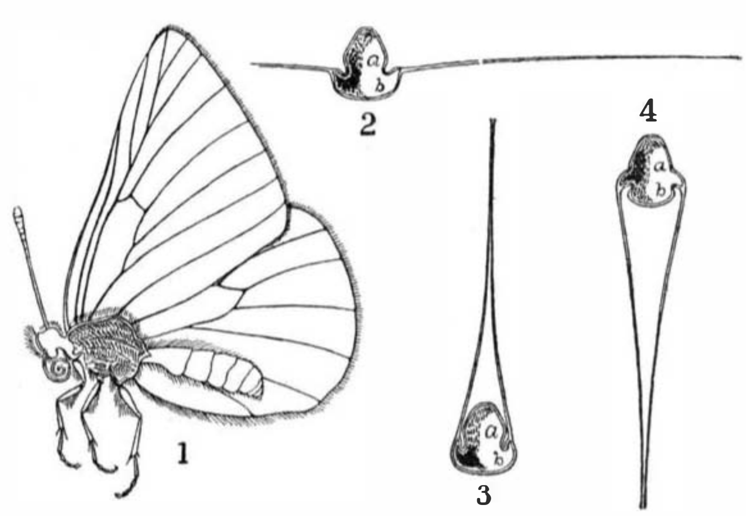
INSECT WINGS.

The middle position of a fly's wing in flying. The arrows shows approximately the resistance of the air. 1.—Downstroke. 2.—Upstroke. 3.—Trajectory of a fly's wing tip when making 300 vibrations and going six feet per second. Arrow shows direction of flight.



INSECT WING MECHANISM.

1.—Longitudinal section through thorax of dragon-fly (*Aeschna*), showing the bundles of muscles. 2.—Cross-section of same between fore and hind wings. 3.—Plan of muscular operation of wing—horizontal position—muscles pull at *a* and *b*. 4.—Same—extreme upward position in flight—muscles pull downward at *a*. 5.—Extreme downward position in flight—muscles pull inward at *b*. At the base of the wing the veins are broadened into rigid plates that are attached firmly to the pliable tegument. This is the fulcrum



INSECT WING MECHANISM.

1.—Longitudinal section of butterfly thorax showing the great number of muscles contained therein. 2.—Cross section of the same through anterior wing bases; the wings held horizontally and the mass of greatest density of the muscles being in a middle position. 3.—The wings held upright, the mass of greatest density below at *b*. 4.—Wings held downward, the mass of greatest density above at *a*. In flying, the wing motion does not reach the extremes of 3 and 4, but an angle from the horizontal of about 70° above and 50° below.