appears to me absolutely groundless. The only velocity that can possibly remain constant, or approximately constant, during wheeling, is the velocity with reference to the supporting medium; and as that velocity is, according to his previous assumption, not only small, but negative, there is no energy available to enable the bird to rise. Indeed, the bird, in passing from a negative velocity relative to the air, to a positive velocity relative to the air, must pass through the phase of no velocity relative to the air, in which he is practically helpless, being compelled to fall vertically in order to acquire sufficient speed to steer. Like Mr. Pickering, Professor MacGregor treats the subject as though the earth influenced the motions of a bird on the wing by some other means than gravitational attraction. He apparently fails to perceive, that, if the body of air in which the bird moves has no internal motion, its relation to his flight is precisely that of a calm.

Let me illustrate. A steamer propelled with uniform force on a calm ocean has its rudder turned constantly, and by the same amount, to the right, and consequently describes a circle. This circle is described *on the ocean:* it expresses a relation between the moving body and that by which it is supported. It has no reference to the bottom of the ocean. It makes no difference whether that part of the ocean is at rest or is part of a swift current. The relation of the boat to the water is not affected by the relative motion of water and bottom. Or consider a skater. Having acquired momentum, he is able to describe circles without propulsive effort until the stored-up energy is consumed by friction and by the resistance of the air. The ice on which he circles may be frozen to the shores of a pond, or it may float with uniform speed on a rapid river; but his relation to the ice is the same in either case, and his circles have the same pattern *as engraved on the ice.* The case of the soaring bird is closely analogous. His horizontal motions are related only to the air in which he moves, and by which he is supported, and they are not affected by the uniform horizontal motion of that air with reference to the ground.

A slight correction, and I have done. I assume, as Professor MacGregor says, that after wheeling, the bird's velocity relative to the medium in which he turns will be the same as before (discounting friction); but I do not admit the implication "that during the turn his velocity relative to the earth will change by an amount equal to twice the velocity, relative to the earth, of the medium in which the turn is made." His velocity relative to the earth will change by an amount equal to twice his velocity relative to the medium.

G. K. GILBERT.

Washington, D.C., Feb. 25.

IN two communications published in the last number of *Science* (p. 151) under the above title, Professor Pickering and Professor MacGregor have developed with considerable ingenuity a theory of the possibility of a bird soaring in a uniform horizontal wind; but it is certainly true that a bird cannot soar — that is, permanently sustain or elevate itself without expending energy — in such a wind, and it has therefore seemed to me to be important, in the interests of clear thinking, to show on dynamical grounds why soaring is impossible in this case.

Evidently the velocity of the wind relative to the earth has nothing to do with the question, as it is the relative movement of wind and bird that causes the re-actions between them, and therefore can alone come into consideration. Let the air, therefore, be supposed to be at rest relative to the earth, and it becomes at once obvious that the bird cannot soar: for, suppose the bird to have any imaginable initial velocity, and to wheel in the most artful manner, it is still a mass falling under the influence of gravity, and only resisted more or less by the fluid friction of the medium in which it is placed. This fluid friction of the air against its wings can only delay its fall, but can never prevent it, just as it delays the fall of a feather.

A theory of soaring must explain how energy is given to the bird by the wind; but it is clear, that, instead of the bird receiving energy, it is expending either its kinetic energy, as when in one of its whirls it sweeps upwards, or potential energy when it sweeps downwards. But the temporary increase of potential energy in a rise can never equal the corresponding loss of kinetic energy, because energy is being continually expended in frictional heating. There is thus a steady expenditure of energy, and none received from the medium, and the bird is therefore bound to come to the ground. The only effect of the medium is to resist the motion, in whatever direction it may take place, whether up or down.

As soon as it is clearly seen that the only thing we are concerned with is the relative motion of air and bird, and that the air may be at rest relative to the earth without affecting the question in the slightest, the futility of any attempts to explain soaring in a uniform horizontal wind is apparent.

If any one wishes to discover the particular fallacies in the theories above mentioned, let him attempt to follow out the reasoning as given in the communications referred to; assuming, however, that there is no wind, that the air is at rest relative to the earth; remembering that the mere fact of the earth's moving relative to the wind has no connection with the relation between the bird and the air.

The theory that soaring can be kept up by taking advantage of differentially moving layers of air is not open to the above criticism, and may be the true explanation: it is certainly not unreasonable on its face.

ARTHUR L. KIMBALL.

Johns Hopkins University, Baltimore, Feb. 23.

### To keep Water-Mounts Moist.

IN biological work with the microscope it is frequently desirable to preserve water-mounts for several days, that growth, development, etc., may be observed from time to time. Water lost by evaporation can be very successfully replaced to the glass slips from a beaker beneath by means of capillary tubes. To make these, hard-glass tubing of about three millimetres bore is softened in a Bunsen flame, and then drawn out to a diameter of from two-tenths to three-tenths of a millimetre. This is then divided up into lengths of five centimetres, and each piece bent at an angle of about 80° one centimetre from an end by holding it over a very small flame for an instant, when, of its own weight, the end falls to the proper angle. One tube is sufficient for a slip, and is applied by first touching the longer limb in water, when instantly the liquid will rise and fill the tube, which may now be suspended by the shorter portion from the glass slip, allowing one end to just touch the edge of the cover-glass, and the other to dip beneath the surface of the water in the beaker. A thin film of water will run along the shorter limb, and hold it securely in place. The whole is then covered with a suitable bell-jar. In this way mountings in water or nourishing solutions may be kept an indefinite time, and are always ready for examination without disturbing them in the least. Should it be desired to supply more fresh water or nourishing solution to the mount than would ordinarily arise, a bit of filter-paper applied to the side of the cover-glass opposite the capillary tube will accomplish this.

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Parsons College, Fairfield, Io., Feb. 18.

### Color-Blindness a Product of Civilization.

THE following is a summary of a paper read before the Kansas Academy of Science at Leavenworth, Nov. 1, 1888: —

The fact that blindness to certain colors exists among civilized people is well established; also the percentage of cases to be found among males has been determined with considerable probability for the races of Europe and America. There has been much diversity in methods of testing, and the results of many reported determinations might well be called into question. Still it is probably not far from the truth that about four out of every hundred males are more or less deficient in color-sense. Of females there have been reported (B. J. JEFFRIES, M.D., *Color-Blindness*, p. 74) as examined in Europe and America 39,828; and of these, only 60 were color-blind, or 2 per cent. Of both males and females, 156,732 have been tested; and of these, 6,721, or 4.27 per cent, are color-blind. These statistical facts have naturally excited interest and discussion. If so large a number as four out of every hundred are unable to distinguish colors, there arises, of course, a practical question important to the railroads, marine, etc.

The gravity of this fact is already recognized more or less in all countries by the test examinations for color-blindness among employees. But there is in these statistics also much of interest to scientists.