than in adjacent parts of the chromosphere, but not at all in the cloud-cap. The magnesium members of the *b* group showed the cloud faintly in the same way as the sodium-lines; but in b_3 the form was a little more conspicuous.

Between *b* and *F*, *two* lines (λ 5017.6 and 4923.1, both attributed to iron) showed the cloud-cap as beautifully as either of the two below *C*. Numerous other lines were reversed in the chromosphere, but none of them showed the upper parts of the prominence. *F* appeared much the same as D_3.

Between *F* and *G*, *five* lines were noted as showing the cap. The most refrangible of them was Lorenzoni's *f* (λ 4471.2): the other four I did not identify at the moment, being in haste to reach the violet portion of the spectrum, and intending to examine them later, — an intention I was not able to carry out, on account of the intervention of clouds.

The lines $H\gamma$ (λ 4340) and *h* were, of course, conspicuous, each showing the whole of the prominence. I expected that *H* and *K* would do the same, but was disappointed. They both exhibited the cloud-cap finely, but I could not make out in them either the stems of the prominence, or the spikes and knots of the chromosphere; and yet both the lines were well reversed, not only in the chromosphere, but also on the face of the sun itself, over all the faculous region surrounding the spots. The ultra-violet line above *K*, first observed here a few weeks ago, was not visible.

There was no considerable motion-displacement exhibited by any of the lines, — something rather singular in so brilliant a prominence, — nor did its shape change much during the forty-five minutes of observation.

It is perhaps possible that this cloud was indentical with a remarkably brilliant facular *bridge*, which was observed two days before, spanning the largest of the spots which composed the group: still this is by no means certain. The instrument employed was the nine and one-half inch equatorial, with the Clark spectroscope carrying a Rutherfurd grating, of about 17,000 lines to the inch; first-order spectrum.

C. A. YOUNG.

Princeton, N.J., Oct. 22, 1883.

Sternal processes in Gallinae.

Having several times been asked the function of the long processes of the sternum as found in the Gallinae, I would make the following suggestions: —

If the sternum be examined *in situ*, the outer processes will be seen to extend far back, and well up the sides of the body, while the inner pair extend over the abdomen. The notches between the processes are closed by very tense, fibrous membranes. By this means a large area is afforded for the insertion of muscles with a minimum of bone. This must contribute slightly to diminish the weight of the posterior end of the body. Passing now to the muscles, we find that the great pectoral arises from the entire posterior border of the sternum, while the subclavius fills up the angle between the keel and body of the bone.

So much for the anatomy. What are the physiological results, and why could they not be attained in other ways? The results are an increased amount of pectoral muscle, and an increase in the length of the fibres, as compared with many other birds. Both of these are very desirable results for heavy birds of short, rapid flight, — the first, because with the increase in muscle comes a corresponding increase of force in the stroke of the wing; the second, because, by virtue of the long fibres, rapidity of contraction and a long stroke of the wing are secured. The rapidity is gained by all parts of the fibres contracting at once, whence the longer the fibre, the more quickly will a given amount of motion result. Both the first and the second are also aided by the fact that the first part of a muscular contraction is more powerful than the last part.

There is but one other way in which the same results, so far as the insertion of the muscles goes, could be attained; that is, by their origin from the ribs which lie under the sternum, as in the mammals, instead of from the overlapping sternum. To this, however, there is an all-powerful objection. If a man be watched while violently using his arms, it will be noticed that the upper part of the chest is held stationary. The pectoral muscles must have a firm point to pull from, in order to move the arms. As a result, respiration in the upper part of the chest is impeded, or, better, respiration is impeded by the diminished amount of tidal air. This principle is illustrated in the long, slow stroke, about twenty to the minute, of men trained to row great distances. The breathing is done, while the pectoral muscles are relaxed, at the normal rates. The same, only in a much greater degree, would hold good for birds. Were the muscles inserted into the ribs, respiration would be interrupted several times each second during flight: hence it is evident that the muscles could not be inserted into the ribs.

But again: why should the Gallinae require rapid powerful motions of the wings? Why should they not have long wings, and a comparatively slow stroke? This is forbidden by their habits. Long wings would be very cumbersome when the bird was on the ground, and absolutely worthless in much of the brush through which a grouse will fly with wonderful rapidity.

Therefore we may say that the processes are developed to give, with the greatest economy of material, a large area for the insertion of the pectoral muscles in such way as not to interfere with respiration, and that such area is required for the flight of the bird.

J. AMORY JEFFRIES.

A bifurcate tentacle in Ilyanassa obsoleta.

Some years ago, when collecting for my marine aquarium, in Raritan Bay, at Keyport, N.J., I obtained an Ilyanassa obsoleta of such a strange form, that I made a pencil-sketch and notes of it at the time. The left tentacle was bifurcated at the shoulder, or place where the normal tentacle abruptly narrows. The two sub-tentacles thus caused, seemed to be equally sensitive, as each was capable of separate and independent movement. Several instances have been long known to me of bifurcation of the caudal spine of Limulus; but the additional prong in every instance was functionless, and, in fact, an inconvenience. I have also seen malformed antennae in microscopic insects. As I have not heard of a similar instance in the mollusca, it seemed to me that the case should go on record.

SAMUEL LOCKWOOD.

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The mechanism of direction.

Shortly after reading Professor Newcomb's paper in SCIENCE for Oct. 26, 1883, I had the pleasure of meeting him, and of discussing some matters of mutual interest in regard to subjective states of consciousness. It seems to me that the professor does not give sufficient weight to habit, and to unconscious cerebral action. In the strict sense of the word, one is not always *conscious* of the way he is going; for although he may avoid obstacles of any kind, yet he may pass