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 *Hγ* (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.

Freehold, N.J.

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

some distance beyond his abiding-place by reason of mental pre-occupation. There are two lines of cerebral action going on at once, — one, the active mental study which engrosses him; the other, the unconscious action that keeps him out of danger from passing vehicles, or from other causes incident to city life. The limitation of direction which Professor Newcomb regards as exceptional, I consider as general: i.e., I believe that there are vastly more men who have no definite idea of lines as a standard of reference, than there are those who refer every thing in direction to such co-ordinates; just as there are many who never have any definite idea of the cardinal points of the compass, either as real or ideal points, and who never arrive at any clear conception of the bearings of familiar buildings, or the direction of streets, though they may live in the same city for years. The domination or tyranny of a fixed idea is explanatory of the difficulty which Professor Newcomb experiences. His ideal or subjective west was the domination of a fixed idea indelibly imprinted upon the super-sensitive cerebral cortex of youth, not necessarily associated with ideal or absolute direction, or with any system of horizontal lines, but an isolated conception, formed out of the perception of different positions, which in early youth could hardly be correlated with any abstruse reasoning. This idea of west, once ingrafted upon a developing brain, became a fixed factor, so dominant as to tyrannize over the understanding, and so persistent as to require some moments of study to dispel the illusion. This becomes evident from an analysis of his third division. The tyranny of the early idea has usurped control over the will, and, indeed, over the whole cerebral outcome. Even though the internal evidence corresponds with the external bearings to show that his preconceived west is really *not* west, but some other point, yet so strong is the power of this subjective idea, that by no process of argument can he rid himself of it. This is not uncommon, but by no means of frequent occurrence. But it is not a normal harmony of relation between the various reciprocal functions of the brain. It is likened to a habit formed in youth, so strong as to be ineradicable in manhood, and has been studied with much care by psychologists. Again: one may be mistaken as to direction, or become confused in tracing his route through the intricacies of his hotel, without associating such perversions with any states of subjective consciousness, so far as these states may involve the consideration or differentiation of the 'co-ordinates.' A man who is ignorant of the cardinal points of the compass, and who never can tell in which direction he is facing, loses his way because he has lost his bearings: the road was known by reason of the association of other facts, — a certain house just here, or a lamp just there, — and not because his horizontal lines have led him astray. In view of what we have learned of unconscious cerebral action, of habit, of the association of ideas, of the tyranny of a fixed idea, and of subjective states of consciousness leading on to abnormal objective conditions, it seems to me that Professor Newcomb's case is not an isolated one, and that what he has written of himself has already been written of and discussed.

HORATIO R. BIGELOW, M.D.

Washington, D.C.

Colorado climate.

For the benefit of other sufferers, please allow me to correct what is likely to lead to an erroneous impression, on reading Dr. Fisk's article on 'Climate in the cure of consumption,' as published in SCIENCE of Oct. 5. Dr. Fisk, in his very able article, like most of those who have written of the fitness of the climate of Colorado for consumptives, speaks as though Denver City were Colorado, and *vice versa*.

Now, this unintentionally misleading impression is calculated to do serious harm. During the late spring, and in summer and autumn, Denver and neighboring localities may be quite as pleasant and beneficial to the consumptive as localities south of the 'divide' that separates the waters of the Platte from those of the Arkansas.

But, during the cool and cold months, the Arkansas valley furnishes a very much better climate than can be found anywhere north of this divide in Colorado. It is scarcely necessary to state that the Arkansas valley furnishes all the necessary comforts of civilization, including convenient railroad transportation. As a rule, with rare exceptions, the consumptive should not sojourn in towns or cities, but rather in rural districts. But, should the consumptive prefer town or city life, Pueblo, Cañon City, and other places in the Arkansas valley, afford ample accommodation.

Having long been a sufferer myself, and having sought health in many portions of North America, I speak of the before referred to localities from observation and experience, and without prejudice or pecuniary interest. Q. C. SMITH, M.D.

Austin, Tex., Oct. 18, 1883.

[Dr. Fisk's article was written with especial reference to Denver, as the necessary data exist for that place, furnished by the records of the signal-service station: these do not exist for localities in the Arkansas valley. — EDITOR.]

A BIOGRAPHICAL HISTORY OF ASTRONOMY.

Heroes of science — astronomers. By E. T. C. MORTON, B.A., scholar of St. John's college, Cambridge. London, *Society for promoting Christian knowledge*, [1882.] 341 p. 16°.

FROM the title, 'Heroes of science — astronomers,' one might expect to find in this little book an account of the lives and a eulogium of the characters of the greatest astronomers, with some general indication of the nature of their discoveries. This expectation would be partially corrected by the opening paragraphs of the preface: —

"The primary object of this little book is, as its name implies, to give some account of the lives of the chief astronomers. But it is impossible to leave in the mind of the general reader any clear notion of their characters, without giving some account of their work. A good deal of space is therefore taken up with explanations of their discoveries; but, as this is only of secondary importance, the explanations are given in a popular manner, and no mathematics is introduced, except in ten pages (172–182), where a knowledge of the first book of Euclid and of the elements of algebra is assumed.

"The book may possibly be useful as an introduction to the study of astronomy, and, in this aspect of it, it is hoped that it may be helpful in two respects: First, by putting before the student the personal difficulties which the first investigators of the law