testimony of the student who relies on his microscope and starts out with the idea of subordinating his facts to the answers it may give, or that of the field-observer, who only studies the grander structures and has a predisposition to explain such as the foregoing by referring them to sedimentation, shall here be received with the greater credence."

The Bulletin here quoted embodies the results of portions of two seasons' field-work, as well as a large amount of laboratory study of the greenstone schists. However fairly the figures may "present the issues," it is unfortunate for Professor Winchell's argument that he did not select some of the many similar examples with which his field experience has made him personally acquainted. The fact is, that the two occurrences selected by Professor Winchell from Bulletin No. 62 demonstrated in the field the dynamic origin of their structures so convincingly, that no microscopical examination was ever made of them. It would never have occurred to Professor Winchell or to any other "field geologist" to explain the particular features which, in the Bulletin, these two figures represent, by sedimentation, if they had observed the natural exposures. A single narrow shear-zone, crossing a great wall of massive diabase 60 feet in height, makes it certain, without help from the microscope, that the chlorite schist which borders the zone is the result of the fraying-out of the rock by the motion. Nor is there less certainty that the wide gaping gashes in the basic eruptives are due to some mechanical strain. There are cases without number, as every one who has worked in the crystalline schists well knows, where their is doubt as to whether a parallel structure is due to sedimentation or to dynamic metamorphism; but why Professor Winchell should select two cases as clear as these, it is difficult to understand. In the text descriptive of the original figures, it is plainly stated that the first is unsatisfactory because it represents only a *hand-specimen*, whereas the structure, to be appreciated, must be seen on the face of a high rock-wall. In regard to the second figure, it is also stated that it is only a diagramatic representation of an *area* on the rock-wall about three feet square. If there is difficulty in arriving at correct conclusions from the study of natural exposures, all the more caution is necessary in interpreting another author's figures, especially when these are distinctly described as inadequate.

In reality, what are known in the Lake Superior region as "greenstones" and "greenstone-schists" are not one thing, but a great variety of different things. Some of them are massive lavas, others accumulations of ash material stratified by gravity or water. They possess structures of diverse origin, which may to the field geologist appear very much alike. These must be studied first and foremost in the field, but to avoid confusion and misinterpretation we need all the help available, even from the microscope. Here we may see plainly that what macroscopically looks alike is in reality different. In fine, there is no discrepancy between the results of field and laboratory work, and if he who is *only* a field geologist find his conclusions at variance with those of a field geologist who is also a student of the microscope, it behooves him to revise these conclusions before he casts asice the results of modern petrographic research.

WORCESTER SCHOOL CHILDREN. — THE GROWTH OF THE BODY, HEAD, AND FACE.

BY GERALD M. WEST, CAMBRIDGE, MASS.

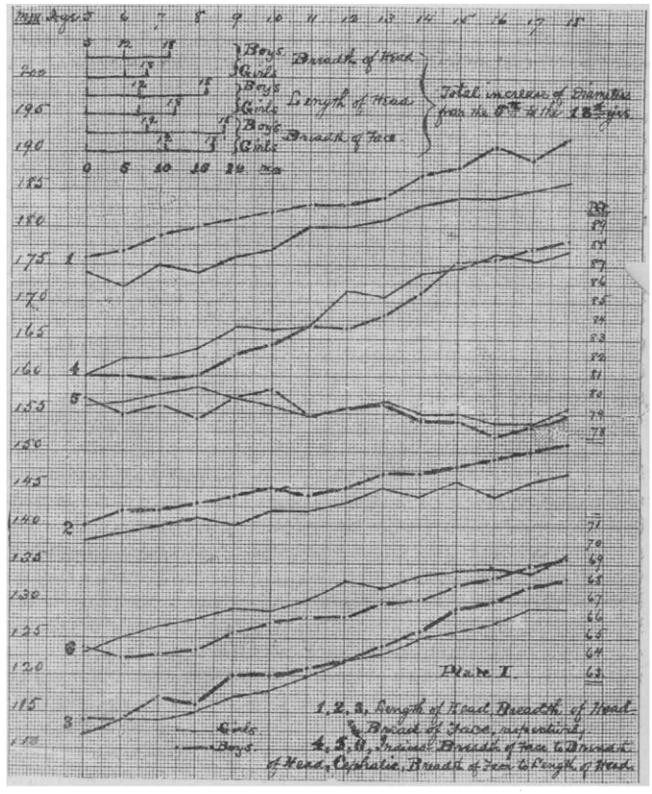
AN investigation into the laws governing the growth of various parts of the body was instituted in the Worcester schools in the spring of 1891, and a short notice of the growth in width of the faces of girls was published in *Science* (July 3, 1891). I now propose to give a summary of some of the other results obtained.

The observations were made in the primary, high and normal schools, and in two of the private schools in the city of Worcester. The number of individuals examined was 3,250, the ages ranging from 5 to 21 years. The nationalities were numerous, but about 66 per cent were of American parentage, 20 per cent of Irish, 7 per cent of English and Scotch, and 6 per cent scattering.

Plate I. contains the curves of growth of the diameters of head and face, with their indices.

Absolute measurements.	1. The maximum length measured from the glabella.	Head.
	2. The maximum breadth.	Head.
	3. The " " of the face.	
Indices.	4. The proportion of the breadth of the face to the breadth of the head.	
	5. The proportion of the breadth of the head to the length of the head.	
	6. The proportion of the breadth of the face to the length of the head.	

Length of Head (1). — In absolute length we see that the girls' length of head is less than that of the boys throughout its whole period of growth, and consequently throughout life. We find, however, that this difference in length does not remain the same year by year, but varies considerably, being, for example, 3 millimeters at the ages of 11, 12, and 13, and rising as high as 6 millimeters before, and 7 millimeters after, that age. We find also



that the annual increment is very irregular in both sexes. We have periods of growth alternating with a cessation of growth.

In girls the greatest length of head is reached at about the beginning of the eighteenth year. In boys the head continues to grow until at least the age of twenty-one. The period of greatest irregularity in the annual increment seems in the case of girls to be before, in the case of boys after, the eleventh and twelfth years.

Breadth of Head (2). — The breadth of head presents phenomena very similar to those of the length of head, i.e., periods of alternate growth and cessation of growth. The girls' width of head is less than that of the boys, but the difference diminishes markedly about the eleventh year, from this age until the fourteenth year the curves are parallel, then this again becomes more widely separated. The age of maximum width in girls is about seventeen, in boys the maximum is not yet reached at the age of twenty-one.

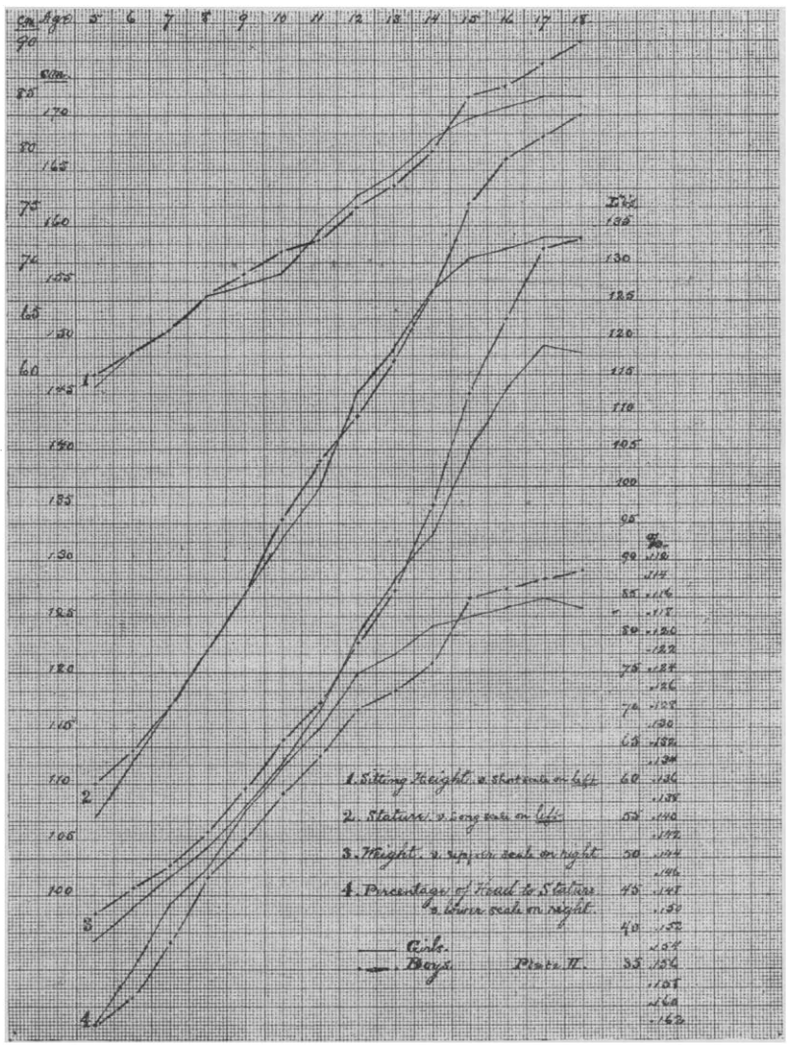
Breadth of Face (3). — Here again we meet with similar phenomena; the breadth of face of the girls increasing rapidly with irregular annual increments until the seventeenth year, when the maximum growth is reached. The faces of the boys continue to grow until the eighteenth year and probably beyond.

As in the case of the two preceding diameters, the breadth of face of the boys exceeds that of the girls. But there is this slight difference here; the diameters of the girls' heads approached more nearly those of the boys' heads during a certain period, approximately, from the eleventh to the thirteenth years; but in the diameter of the face the girls not only approach, but at the twelfth year seem quite to reach that of the boys.

These three curves evidence four things: first, that the time of growth in the diameters of the heads and faces of girls is shorter than in the case of boys; second, that up to about the twelfth year these diameters grow more rapidly in girls than in boys, while after that age the contrary is the case; third, that by an apparently sudden rise in the annual rate of growth in the girls their diameters approach much more nearly that of the boys during the period of the eleventh, twelfth, and thirteenth years. Finally, the average annual rate of growth in the diameters of the girls heads and faces is nearly uniform during the two periods before and after the eleventh-thirteenth years. While in the case of boys it is considerably greater, actually and relatively, after than before. Between the fifth and the eighteenth years the length of head of boys increases 16 millimeters, in the same period the breadth of head increases 11 millimeters, and the width of face 18.5 millimeters. The corresponding measurements in the case of girls increase 12 millimeters, 8 millimeters, and 17 millimeters, respectively, for the same period of time. The horizontal lines on the upper left hand of the diagram indicate the entire altitude of the curves, the cross-bar indicating the altitude at twelve years. A comparison of the annual increments of the length of head and of the breadth of head seem almost to suggest an alternation in growth between the two diameters, as we shall see, the alternate rising and falling of the curves of the cephalic index would seem to strengthen this suggestion.

Let us now turn to the three indices, numbered on the plate 4, 5, and 6 and taking up as first in order the cephalic index.

The Cephalic Index (5). — The curve of the cephalic index shows, as would be expected from an examination of the component curves of length of head (1) and breadth of head (2), a considerable degree of irregularity in its annual stages. There is, nevertheless, a certain general regularity displayed, taking the curves as a whole; both displaying three periods, composed each of a decided maximum and minimum. These periods are from about the fifth to the eleventh, the eleventh to the sixteenth, and the sixteenth on in girls; from the fifth to the tenth, from the tenth to the thirteenth, and from the thirteenth to the eighteenth in boys. The whole range of the two curves is very small, scarcely two and a half per cent; the final index being, for boys, about one and one-half per cent below that of the index at five years of age; the final index of the girls being very nearly the same as at five years of age. The greatest altitude of the curve is, for boys, at ten years, and for girls at eight years. The greatest depression is at about sixteen years of age for both sexes. The cephalic index of girls is for the period of growth higher than that of boys, except at about the ages of nine and ten.



Breadth of Face to Breadth of Head (4).— In comparing the growth of the breadth of the face to the breadth of the head, we find that the breadth of face grows much more rapidly propor-

tionately than the breadth of head. This is shown by the rapid rise of the curve of the index. That the increase is actually greater than the width of face we have already seen. The breadth of face as compared with the breadth of head is greater in the case of girls than in the case of boys until the fifteenth year, at which time the boys' curve becomes the higher, falling again the next year, and rising finally in the seventeenth year.

Breadth of Face to Length of Head (6).— As in the index just discussed, the breadth of face increases more rapidly proportionately than does the length of head. We have the index of the girls higher than that of the boys until about the sixteenth year, when the two curves intersect, that of the boys becoming the higher for one year, and again falling below in the eighteenth year.

We see, therefore, that in proportion to the length of head, the width of head and the width of face of girls are generally greater than those of boys, and that in proportion to the width of head the width of face also is greater in girls than in boys.

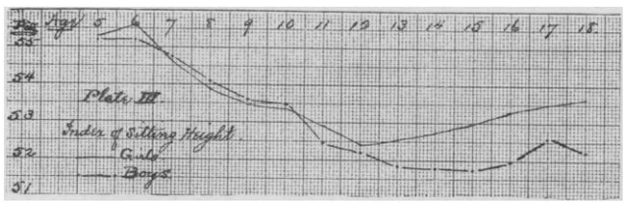
Body measurements (Plate II.):—

1. Sitting height.— Vertex to oleacronon, approximately.
2. Stature.— Standing erect without shoes.
3. Weight.—In in-door clothing.
4. Comparison of length of head to stature, expressed in per cents of stature.

Plate III.:—

Index of sitting height.— Comparison of sitting height to stature, expressed in per cents of stature.

The Stature (2).— Taking the stature as properly first in order, we find the boys starting out at five years of age apparently taller than the girls, but the girls appear to catch them in the seventh year and continue at an equal stature up to and including the



ninth year, after which the boys again rise above the girls for two years. At about the twelfth year the girls suddenly become taller than the boys, continuing taller until the fifteenth year, when the boys again and finally regain their superiority in stature. After the age of seventeen, there seems to be very little if any increase in the stature of girls while the boys are still growing vigorously at eighteen, and probably continue to grow for several years after that age.

The intersection of the two curves at the ages of twelve and fourteen is a more accentuated instance of the phenomenon which we have already met with in the curves of the diameters of the head and face. We shall see it again in the curves of sitting height and of weight.

The Sitting Height (1).—The curves of the sitting height present the same characteristics, somewhat more accentuated, as the curves of stature. The boys start out at five the taller, but by the next year the girls are of equal stature and continue equal until and including eight years of age. From eight until eleven the boys are again the taller. In the eleventh year, nearly a year earlier than in the case of stature, the girls shoot ahead of the boys, the latter not regaining their superiority until the fifteenth year, about half a year later than in the case of stature. Again, we find the girls' curve stopping abruptly at seventeen, while the boys continue to grow for some years longer.

The Weight (3).— The curves of weight, while preserving the general characteristics of the curves of stature and sitting height, show minor differences. The boys are in all years from five to eleven inclusive heavier than the girls. From the twelfth to the fourteenth year the girls are the heavier. From fourteen on the boys are again superior in weight. The superiority of the girls in respect to weight is for a much shorter period than in respect to total height or sitting height.

In weight, also, the girls seem to reach their maximum average at seventeen, the boys continuing to increase in average weight until a much later period in life.

Comparison of Length of Head to Stature (4).— The curves of this index bear a strong resemblance to those of stature. From this comparison it seems that until the fifteenth year the length of head of girls is less in proportion to their stature than is that of boys to their stature. At fifteen the ratio of the boy's length of head to their stature suddenly drops, while that of the girls gradually rises, indicating that in the adult the heads of women are proportionately longer than those of men. This is also true of the width of head and the width of face.

The Index of Sitting Height (Plates III.).— These curves, starting at a high per cent at five years of age, drop rapidly until the twelfth year in the case of girls and the fifteenth in the case of boys. From the twelfth year on the girls' curve rises; from the fifteenth to the seventeenth years, inclusive, the boys' curve also rises, but drops again during the next year. These movements of the curves seem to indicate that the greater part of the growth in stature, up to the twelfth year in the case of girls and until the fifteenth year in case of boys, is made in the lower limbs, while after these respective ages it is made in the trunk. Except for about two years, throughout the period from five to eighteen, the limbs grow more rapidly than the trunk in boys, while in the case of the girls the period of greater comparative growth is divided nearly equally between the extremities and the trunk. Except from about the seventh to the tenth year, the trunk is proportionately longer in girls than in boys, after the thirteenth year the difference is much more marked.

As we found in the case of the diameters of the head and face, girls grow more rapidly than boys up to twelve years of age, less rapidly after that age. Comparing the two periods, we find that in the case of stature and sitting height the annual rate of increase for girls is considerably less after twelve than it was before it. The boys maintain the same rate throughout. Although both sexes make greater annual rates after than before twelve, yet the girls make their greatest absolute increase before, the boys theirs after, that period.

These results seem conclusive evidence that women reach maturity several years before men. There seems little doubt that for all the measurements of the body, except the weight, girls have completed their growth by the eighteenth year.

BIRD-MUSIC IN AUGUST.

BY MARY HYATT, STANFORDVILLE, N.Y.

Much has been written about the songsters of spring and early summer, but there is something of a lack of information concerning the birds that sing in August. It would be interesting to compare notes from different localities on this subject.

Bird-music in this month of oppressive heat is doubly welcome, and the few singers that help to enliven the sultry days should receive their share of attention and praise.

Burroughs says that there are but four songsters that he hears "with any regularity after the meridian of summer is past, namely, the indigo bird, the wood or bush sparrow, the scarlet tanager, and the red-eyed vireo." He further observes that "birds sing as long as nidification goes on. . . . Hence our wood-thrush will continue in song into August if, as frequently happens, its June nest has been broken up by the crows or squirrels." The wood or bush sparrow mentioned is, we think, Spizella pusilla, a faithful little minstrel of morn and eve all through the heated term. The goldfinch, whose lively notes as he dips and rises through the air are so prominent in mid-summer, and whose canary-like song is occasionally heard, should certainly be included among August songsters. With us the yellow throated vireo is as regularly tuneful in August as the red-eyed, while the white-eyed vireo is heard now and then.

In a note-book kept through August of 1889, we have an account of such birds as were in song for many days during the month in our vicinity. Beginning Aug. 3, we have on record: Indigo bird, chewink, Baltimore oriole, wood pewee, red-eyed