BOLOMETRIC INVESTIGATIONS; A CORRECTION.

PROF. JOSEPH LE CONTE has kindly called my attention to an error in the above article. On page 175, 7 lines from the bottom of first column, it should read million instead of thousand, and after line 5 insert million, that is, the limits are four hundred million million and seven hundred million million times per second. The error was made in transcribing the original manuscript and was not caught in my proof reading. WILLIAM HALLOCK.

SCIENTIFIC LITERATURE.

The Growth of U. S. Naval Cadets. By HENRY G. BEYER. (Proceedings of the United States Naval Institute, Vol. XXI., No. 2. Whole No. 74).

In this paper Dr. Henry G. Beyer discusses measurements of U. S. Naval Cadets. These measurements form an exceedingly valuable material for the study of growth. The character of the material may be judged from the following remarks of the author:

"It has been the custom at the Naval Academy for the last thirty years or more to make an annual physical examination of every cadet in training at that school, and, at the same time, to keep a record of certain anthropometric measurements of every cadet undergoing such examination. * * * Up to a few years ago the height standing, perineal height, circumference of chest, waist measure and the lung capacity were the only items recorded. Within recent years the height sitting, span of arms, strength of squeeze, acuteness of vision and hearing have been added to these records; the number of observations under the first-named items is, consequently, much larger than that under the last named. * * * * The cadet who stays the full term of four years at this school leaves on the books the records of five successive examinations taken one year apart; after graduation two years are spent at sea, after which time the cadet returns to the Academy for his final examination, leaving the records of another physical examination. This makes six in all. Since the age for entrance into the Academy is limited to from 15 to 18 years, and taking six years as the time necessary to elapse between the first and last examinations, the period of growth covered by these records ranges all the way from 15 to 24 years of age."*

The most important part of the investigation is the discussion of individual growth which proves beyond a doubt that the assumption which was made by Bowditch and Porter, namely, that on the average individuals of a certain percentile rank retain this rank through life does not hold good. Dr. Beyer considers boys of 15 years of age and representing the 25th and 75th percentile grades. It appears from the tables given by the author that the average statures of both classes approach more and more the 50th percentile grade. I have computed the rank of these boys from year to year from the statements given by Dr. Beyer, and obtained the result that boys who ranked at 15 years 26% and 73% ranked in the following years:

Years	15	16	17	18	19	20	21
Grade	26	28	26	34	27	38	38
Grade	73	74	69	69	68	65	—

It appears that the approach of the lower grade towards the middle is greater than that of the higher grade. In the consideration of weight the approach of the lower grade toward the middle grade appears even stronger, while the higher grade even exceeds the corresponding normal grade. It is difficult to understand the reason of this phenomenon. It would seem likely that when we select a certain grade at a certain age, and follow the development of the individuals composing the grade, that the conditions of life during the following years are favorable in some cases, unfavorable in others, but, on the whole, correspond to the average conditions. When, therefore, the initial age is remote from the adult stage, we should expect a gradual approach to the average. This phenomenon is observed in the case of stature, but does not appear clearly in the case of weight. As Dr. Beyer does not give his original observations, it is impossible to judge what may be the cause of this curious fact.

The same subject is treated in a small but useful table (XVII.), which proves that when a small group of individuals whose statures at

* In addition to these data we should like to know the restrictions governing the selection of cadets which are of great importance in interpreting the observed distribution of measurements.

a certain age lie between narrow limits are treated alone, the variability of the series increases steadily until the adult stage is reached, and that furthermore this increase in variability is the less the nearer the initial point approaches the adult stage. It appears at the same time that each of these series approaches the middle values as time elapses from the initial age.

Another important phenomenon which is brought out in this paper is that tall boys of 16 years grow much less than short boys, because they are nearer the adult stage. As the table which Dr. Beyer gives is rather complex and not quite clear, I have computed it again and give it here in a modified form. I have compensated the series and find that among each 100 boys the following amounts of total growth occur:

Statures at 16 years.		62 and 63 in.	64 and 65 in.	66 and 67 in.	68 and 69 in.
Frequency of various amounts of total growth from 16th to 22d year in inch. among 100 individuals.	−0.9–0.0	—	1	—	2
	+0.0–0.9	3	9	15	14
	1.0–1.9	8	24	*35*	*39*
	2.0–2.9	14	*32*	31	31
	3.0–3.9	17	21	12	12
	4.0–4.9	*18*	10	2	2
	5.0–5.9	17	2	1	—
	6.0–6.9	10	1	3	—
	7.0–7.9	5	—	1	—
	8.0–8.9	6	—	—	—
	9.0–9.9	2	—	—	—

These figures show that the typical amount of growth of the 16-year-old boy who is 62 or 63 inches tall is about 4.4 inches; of the boy who is 64 or 65 inches tall 2.4 inches, and of those from 66 to 69 inches only 1.8 inches. It also shows that the boys grow more uniformly the taller they are, and this is probably the cause of the more rapid approach of the lower grades towards the middle values. The curves showing the total amount of growth are necessarily very assymetrical and the assymetry effects the averages of the statures of the boys who originally belong to the same grade. Therefore these averages which were used by Dr. Beyer in following the growth of a certain group of individuals are only very rough approximations to the typical value of that class. For the 17th year I obtained the following distribution and approximate typical values of growth from the 17th to the 22d year of age:

Stature at 17 years.		64 and 65 in.	66 and 67 in.	68 and 69 in.
Frequency of various amounts of total growth from 17th to 22d year among 100 individuals.	−0.9–0.0	3	5	5
	+0.0–0.9	22	35	42
	1.0–1.9	*31*	*38*	*42*
	2.0–2.9	25	16	9
	3.0–3.9	10	5	1
	4.0–4.9	4	1	1
	5.0–5.9	5	—	—
Typical growth from 17th to 22d year; inches.		1.6	1.0	0.3

This consideration cannot be carried on, because the selection made by the author of individuals of equal stature of 16 years of age influences the distribution of measurements taken during the later years too much.

It appears from these tables that it would be an easy matter to determine in this manner, how many individuals of each class are adult at a certain age, and this is one of the fundamental points required for a better understanding of the laws of growth. But it would have been much better to start with individuals who as adults have the same measurements and to investigate how these measurements are distributed in earlier years. This is the only means by which the difficulties arising from the irregular distribution of the period of growth in different individuals can be overcome.

The investigation suffers greatly from the fact that only a selection—and not a very systematic selection—of data from the rich material has been utilized. The author deserves our special thanks for having given these data in an unabridged form. They are contained in Tables XIV. to XVI., which represent the heights of 63 tall, 71 middle-sized, and 52 short individuals, measured mostly annually from their 16th to their 22d year, but the measurements for the 21st year are missing in most cases. The grouping, however, is not favorable, the limits of the lowest and highest classes being too wide. The shortest class contains individuals of from 60.5

to 65½ inches; the middle-sized group individuals measuring 65 and 66 inches, the tall group individuals of from 67 to 69.5 inches. In arranging such a table either the total material must be utilized or a certain portion selected at random, and the limits which are originally selected must be adhered to most rigidly. Therefore it is not admissible to include in these tables individuals whose measurements at 16 years are not given but whose later development is similar to that of other boys of the class. The deviations of these three tables which are given at the foot of the columns have been miscalculated.

It is very curious that although the paragraphs discussed here show that the theory of percentile grades as applied to the study of growth cannot be held any longer, nevertheless the whole valuable material is presented in this form so that it is all but useless for the purpose of further investigations. The very conclusions which the author draws from his study of individual records prove that all the tables (XXIX. to XLVIII.) which contain the annual increases for the different percentile grades have no biological significance whatever and ought to have been omitted.

Dr. Beyer's investigations show that it is quite indispensable to publish the original records of each individual as the only means of really furthering our knowledge of the laws of growth. Only on such tables can future study be founded, and if there is to be a wholesome advance in the science of anthropometry such tables must be accessible to all. We hope that the author may find an opportunity of extending the brief abstracts of such individual records which are printed in tables XIV. to XVI. and give us the whole valuable material which would represent the most important contribution to the study of growth made for a long time.

FRANZ BOAS.

Untersuchungen über die Stärkekörner; Wesen und Lebensgeschichte der Stärkekörner der höheren Pflanzen. Von ARTHUR MEYER, Professor der Botanik an der Universität Marburg. Mit neun Tafeln und 99 in den Text gedrückten Abbildungen.

As the title suggests, this work contains an exhaustive treatment of the subject. Its principal interest lies in the fact that the manner of origin and growth of the starch grain has been for many years a subject of patient investigation, and different theories respecting the unit of organized structures have been based on the facts thus obtained.

The work is divided into five parts. The first treats of the chemical nature of the starch grain, its relation to the action of the ferment diastase; the second, of the physical character of the grain; the third, of its biology; the fourth consists of biological monographs of the starch grains of various plants; the fifth is a short discussion of the relation of the starch grain to the living protoplast.

In order to make clear the conclusions reached by the author in the first part, it will be necessary to explain that Naegeli was the first to construct a theory concerning the chemical nature of the starch grain, its manner of origin and subsequent growth. Since his book was written many facts have come to light, which have invalidated some of his conclusions. His work, however, forms the basis of all subsequent investigations. He considered the grain made up of two substances which he named starch cellulose and granulose. The latter he thought contained the essential principles of starch, and is that part which is dissolved by the action of saliva on certain acids; the former he supposed differed but little from the substance composing the principal part of the vegetable cell wall, or cellulose; this starch cellulose forms the skeleton or framework left after the grain has been treated with saliva or acids as before described. Later investigators, among whom is Walter Naegeli, claim that the intact grain consists of one substance only, and that the skeleton is the product of the chemical action of the acids on this substance, and they name this product amylodextrine.

According to the results obtained by the author in a long series of experiments, he concludes that the grain consists of one substance, amylose, which exists in two forms or modifications, and a slight amount of another substance, amylodextrine, which is a dissociation product of amylose. The two forms of this latter substance he names for convenience β- and α-