

level at which it may be cut off. The leg of a crab also regenerates at a large number of different levels, and apparently this holds for all the different appendages. If this result had been acquired through the action of natural selection, what a vast process of selection must have taken place in each species! Moreover, since the regeneration may be complete at each level and in each appendage without regard to whether one region is more liable to injury than is another, we find in the actual facts themselves nothing to suggest or support such a point of view.

If, leaving the adult organism, we examine the facts in regard to regeneration of the embryo, we find again insurmountable objections to the view that the process of regeneration can have been produced by natural selection. The development of whole embryos from each of the first two or first four blastomes can scarcely be accounted for by a process of natural selection, and this is particularly evident in those cases in which the two blastomeres can only be separated by a difficult operation and by quite artificial means. If a whole embryo can develop from an isolated blastomere, or from a part of an embryo without the process having been acquired by natural selection, why apply the latter interpretation to the completing of the adult organism?

Several writers on the subject of regeneration in connection with the process of autotomy (or the reflex throwing off of certain parts of the body) have, it seems to me, needlessly mixed up the question of the origin of this mechanism with the power of regeneration. If it should prove true that in most cases the part is thrown off at the region at which regeneration takes place to best advantage, it does not follow at all that regeneration takes place here better than elsewhere, because in this region a process of selection has most often

occurred. The phenomenon of regeneration in the arm of the starfish, that has been described on a previous page shows how futile is an argument of this sort. If, on the other hand, the autotomy is supposed to have been acquired in that part of the body where regeneration takes place to best advantage, then our problem is not concerned with the process of regeneration at all, but with the origin of autotomy. If the attempt is made to explain this result also as the outcome of the process of natural selection acting on individual variations, many of the criticisms advanced in the preceding pages against the supposed action of this theory in the case of regeneration, can also readily be applied to the case of autotomy.

T. H. MORGAN.

*SOME CONDITIONS INFLUENCING SUCCESS
AT SCHOOL.*

THE law of universal variation as demonstrated by the pupils of our public schools has presented a most difficult problem to the superintendent. He is 'between the devil and the deep sea' in his attempts to give the individual his rights, and at the same time conform to a system which is capable of turning out good material in large quantities. Procrustean beds, with semi-elastic foot-boards are about the best that can be provided for the little folks in the large cities, even under the best conditions. The problem is an important one and far from a satisfactory solution, but we have all confidence in the brains which are brought to bear upon it, and it cannot be very long before some one of the systems which are now in the experimental stage will show itself worthy of more extended adoption. Whatever variety there may be in the attempts to solve this problem of promotion in the schools—for after all, it resolves itself to that—there are certain facts

underlying it upon which there is a most perfect consensus of opinion. One of them is the universal variability already alluded to. In every grade known to modern school systems are found some pupils who seem to fit the conditions almost perfectly and others who are palpable misfits. They are not only misfits where they are, but have always been so wherever they have been, and will probably remain misfits to the end of the school chapter. This is not to characterize them as useless members of society, nor as vicious, but simply as odd-shaped cogs which do not quite fit the educational mechanism. Clumsy machinery might work fairly well with them, but not the carefully adjusted tools of a big public-school plant, and some modifications must be made for them. Nor are these failures to coincide all in the same degree. Some go through the whole mill with only a moderate amount of friction. Others find

This study does not present a panacea for these difficulties. It is not remedial, but rather in the nature of a further diagnosis of the conditions. It asks the question: What physical and mental conditions in the child most often accompany success and failure in grade work? It also attempts to answer the question for the limited field covered.

The method and scope of the problem are as follows: About 2,000 copies of the blank here printed were sent out to the superintendents of schools in eight cities and towns of the State of Colorado, who had, in response to a letter previously sent out, signified their willingness to help with the problem. Colorado towns were not chosen because of any special geographical value, but for the simple reason that I was a resident of the State and acquainted with its educators. In fact, the geographical restriction perhaps limits the value of the

Grade ———	City ———	Sex ———	Age ———
1. Height (for grade), Tall	— ; Above medium	— ; Below medium	— ; Short
2. Weight (for grade), Heavy	— ; “	— ; “	— ; Light
3. Health (apparent), Perfect	— ; “	— ; “	— ; Poor
4. Native Ability—Bright	— ; “	— ; “	— ; Dull
5. Habit—Industrious	— ; “	— ; “	— ; Lazy
6. Temperament—Nervous	— ; “	— ; “	— ; Stolid
7. Home Conditions—Good	— ; “	— ; “	— ; Bad
8. Occupation of father	—————		
STANDING IN CLASS.			
(Based upon marks actually given.)			
9. Grading:	1st $\frac{1}{2}$ class	— ; 2d $\frac{1}{2}$ class	— ; 3d $\frac{1}{2}$ class
	— ; 4th $\frac{1}{2}$ class	—	
10. Deportment:	ditto	— ; ditto	— ; ditto
	— ; ditto	—	
Remarks	—————		

the wheels revolving too rapidly or too slowly. For the former, some parts must be gone through twice, for the latter, time is wasted. The greatest good for the greatest number is all that can be hoped for and in its accomplishments some few may long have to suffer for the weal of the many.

study, rather than enhances it. With the blanks were sent out full directions for filling them out. (1) That they be given only to such teachers as the superintendent felt would do the work with care and good judgment. (2) That the teachers to whom they were intrusted fill out one blank for each pupil in the grade, putting an X in

the proper space under each question. (3) That for each question there be an equal number for every grade, included in each of the four divisions of the question—*i. e.*, in the case of the first question for a grade of 32 pupils, let 8 be put down as tall and the same number for each of the other three classifications, and the same be done as nearly as possible for all the other questions (except 8). This it may be seen demanded careful judgment and discrimination on the part of the teacher, and I cannot vouch for its accuracy, but knowing many of the teachers as I do, I believe the returns are as valid as can be expected from any work of this kind. In the directions especial attention was called to the fact that answers to 9 and 10 were not to be based upon immediate judgment, but upon that of the past as far as possible. No exact measurements were called for even in cases of 1 and 2. The values are in every case relative and in this respect differ from those of other studies of a similar nature. This method has some advantages and some disadvantages. It obviates the necessity for exact measuring apparatus which the teacher might not know how to use, although it introduces an error of individual judgment. The important thing is, however, that we have for every individual grade or room considered, the fourfold classification along nine different lines, by a tabulation of which it is possible to determine whether, right through the grades, the pupils successful with their school work were as a rule the tall or the short ones, the heavy or the light, the healthy or the sickly ones, and by a fuller analysis possibly throw more light on the relative values of other conditions of heredity and environment.

In the preparation of the accompanying curves the data for only 1,000 pupils were used, and those wholly from the grades below the 7th. This was done that with

a later study a comparison might be made between the non-adolescent stage covered by this paper and the adolescent, made up of pupils of the 7th and 8th grades and possibly the first year or two of the high school.

The curves shown on the accompanying figures are all constructed upon the same general principles, and show the relation between the conditions of heredity and environment covered by the questions 1 to 9, inclusive (except 8), and success in school work covered by question 10. In other words, an attempt to show graphically the influence of the former upon the latter. Each figure shows this relation for a single one of the first nine questions. Neither specific grade nor age is considered, the grades from one to six being taken as a group. For each figure, the four columns represent the 1st, 2d, 3d and 4th quarter of the 1,000 pupils considered with respect to the condition of question 10, which has to do with their grading in school work. In every case the 1st column has to do with the pupils at the head of the class; the 4th with those at the foot; the other two, those of intermediate grading.

The curves upon the figures are for the condition covered by the other questions, and by their ordinate distances (*i. e.*, height above the base-line) show the relation between them and the grading. To explain more fully, upon each figure the heavy entire curve is for the first part of the question, tall, heavy, perfect, bright, etc., according as it is on the figure for height, weight, health, native ability, etc.; the dotted curve for the 'above medium' points of the question; the broken curve for the 'below medium'; and the light, entire curve for the remainder—the short, light, poor, dull, etc. Ordinate distances show percentages of children of each condition of heredity and environment in any of the divisions of the class with reference to the grading.

To interpret Fig. 1, which is for condition of height in terms of this description, by following the heavy curve—that for children designated ‘tall’—we find that 8 per cent. (in every case omitting fractions of percentages) of such children were in the 1st quarter of the class in their grading (left-hand column), 23 per cent. in the 2d quarter (3d column), 28 per cent. in the 3d quarter (3d column), and 32 per cent. in the quarter at the foot of the class as far as scholarship goes (last column). By following in the same way the dotted, the broken and the light entire curve we can see the relation between the children adjudged to be above medium, below medium and short of stature. To generalize from the figure as a whole, its indications are that the short children, as a class, were the ones for whom promotion was most probable, while the tall children seem to stand lower in their school work according to

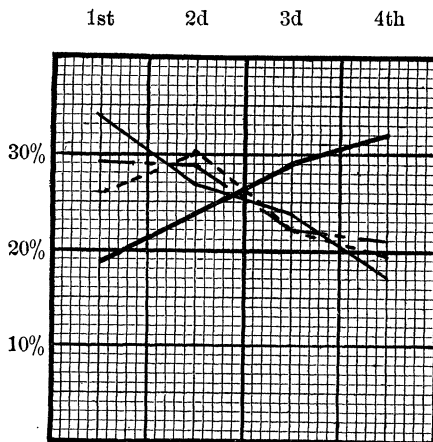


FIG. 1. Height.

the estimation of their teachers. This is not in accordance with the conclusions of some others who have studied the same problem; notably, MacDonald (see ‘Ex. Study of Children,’ *U. S. Com. Ed.*, 1897–8, Vol. I.), who finds a slight preponderance of height in favor of the bright pupils. A fixed relation, however, may exist between

height and physical conditions, and since the latter forms the basis of study for another figure I shall allude to it under that.

WEIGHT.

The curves upon Fig. 2, and the succeeding ones are to be determined exactly as the preceding. We find from an inspection of Fig. 2 that the heavy children gravitate toward the foot of the class, though not to a very marked degree. From the study of the separate sexes I find this to be more marked for the boys than the girls, though showing slightly for the latter. In the re-

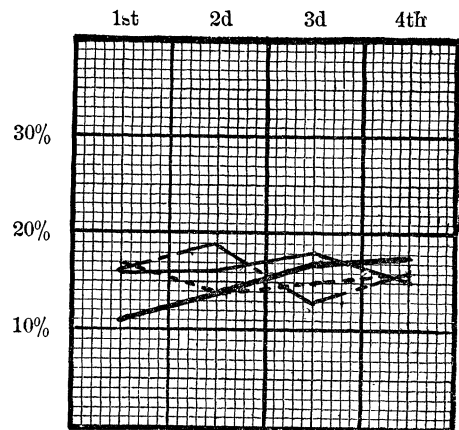


FIG. 2. Weight.

lation between weight and success in school work shown here we are also opposed by the authority just cited, as MacDonald states that in height, sitting height, weight and cranial circumference the bright boy excels the dull. This contradiction may be due to geographical differences. Something more than three-fourths of the children included in my study were residents of the mountain towns of an altitude of nearly two miles, and none were much lower than one mile. If the differences be due to this fact they are in accord with general anthropological studies made upon adults.

HEALTH.

We find upon Fig. 3 a very probable corroboration of the old dictum *mens sana in*

corpore sano. The seeming influence of good health upon good standing is certainly very marked, and the symmetry of the two curves for good and poor health is very striking. The study of the two sexes separately seems to throw some interesting side lights. For the boys and girls in perfect health about the same conditions are indicated as for the two groups, but for poor health it would seem that the direction is given the curve mainly by the boys. The percentages of girls of poor health in the 1st and 4th quarters of the class as to scholarship were the same (26 per cent.), while less than 1 per cent. of the boys in poor health were at the head of the class to 40 per cent. of them at the foot. This would seem to imply that even before the adolescent stage of development the girls have the power of forcing themselves to do work even when vitality is low, which has generally been attributed to them only at a

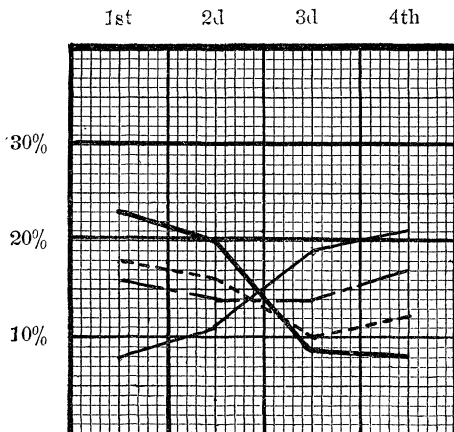


FIG. 3. Health.

later stage. If so, it is a fact which deserves more attention from the teacher, for it can only be accomplished at the expense of energy which is demanded by other activities. Pride and over-sensitiveness are responsible for many evils and probably are in evidence here.

NATIVE ABILITY AND HABIT.

Conclusions based upon the answers to their questions have perhaps less value

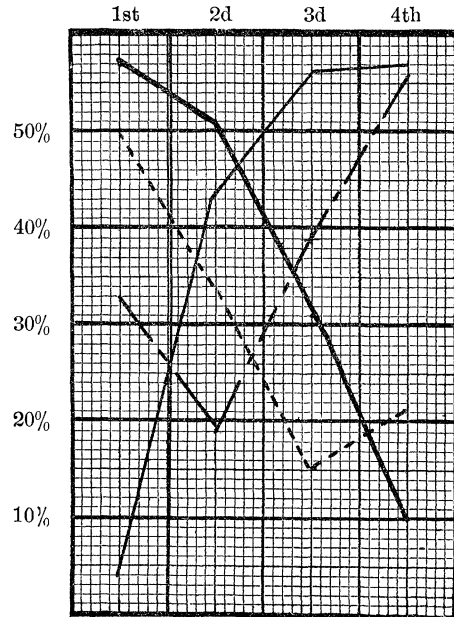


FIG. 4. Native Ability.

than any of the others, because of the difficulty the teacher must have in disassocia-

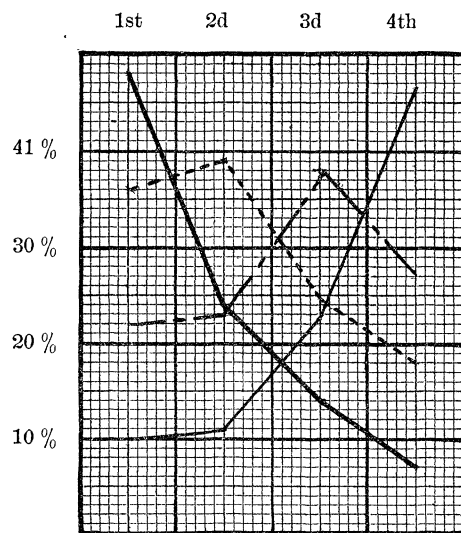


FIG. 5. Habit.

ting the conditions from those of scholarship

with which they are to be compared. When the teacher was answering them for a given pupil she could hardly fail to have in mind his class standing and be influenced by it; one can hardly tell how much influence this might have upon the results. We should expect, however, on other grounds to find the bright and industrious pupils in the 1st quarter of the class as to grading, and *vice versa*, and the curves show them to be there. Based upon the teachers' judgment, there seems to be little difference in the influence for the two sexes. In each case about half of the bright and industrious pupils were at the head of the class, while the other half were unequally distributed through the other three divisions, with very few at the foot.

TEMPERAMENT.

Fig. 6 shows that the children whom the teacher characterized as 'nervous' pre-

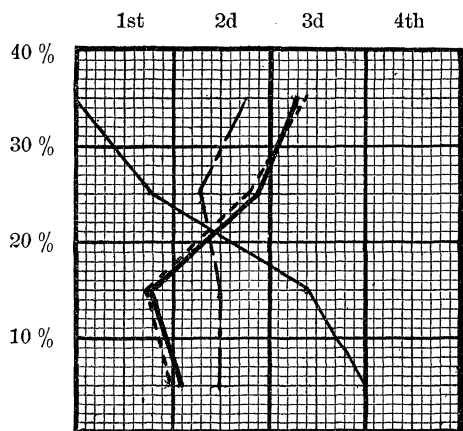


FIG. 6. Temperament.

ponderated in the upper half of the class, considered from the standpoint of work. No directions were given as to classification under this head, and we cannot say that all had the same conception as to its meaning. The term may be made to cover a multitude of different manifestations, but it is perhaps safe to conclude that for the most

it meant an excess of energy worked off through motor channels other than those of the legitimate business of the school. It will be noticed that the greatest percentage of 'nervous' children were in the 2d quarter of the class, with the first showing them next in abundance. This would seem to imply that an abundance of nervous energy is essential to good work but somewhat detrimental to the best of work. It has perhaps been noticed that in our treatment of the whole problem we have been forced to study each condition as if the others were not at the same time active. That is, in isolating the matter of temperament for the curves under discussion, we have disregarded native ability, habit, health and all the rest between which and temperament there may exist a fixed relation. In fact, it would be quite reasonable to suppose that such a relation did exist between some of them, and perhaps the most probable would be that between temperament and health. It was proved that children of poor health were seldom found at the head of the class. But children of poor health are not infrequently excessively nervous. Putting these two facts together, the failure to find the greatest number of nervous children in the 1st quarter of the class seems quite reasonable. For the other extreme of nervousness, which I have characterized as 'stolid,' there is a gradual increase in number from the head to the foot of the class. With the girls there seemed to be the greatest difficulty in overcoming the seeming impediment of stolidity, there being but a fraction over 1 per cent. of those so characterized in the 1st quarter of the class. Perhaps they lacked to an extreme the elements of pride, which is such an instigation to work.

HOME CONDITIONS.

The directions for answering this question stated that home conditions which

were to be considered as good were those which were considered as conducive to study and regular attendance at school, while bad home conditions were those that made this improbable. The latter might be due either to the general attitude of the parents toward school work in general, or the economic condition which left little time for study or caused frequent absences. The curves upon Fig. 7 are about what might with reason be expected, showing but a small chance for good scholarship under the latter condition. The study of the two sexes separately showed that the home influences had a wonderfully more tenacious grip upon the girls than upon the boys; less than 1 per cent. of the former whose home conditions were designated as poor, could force themselves into the 1st quarter of the class, while 20 per cent. of the boys managed to pull themselves out of the mire to that standing. Washing dishes

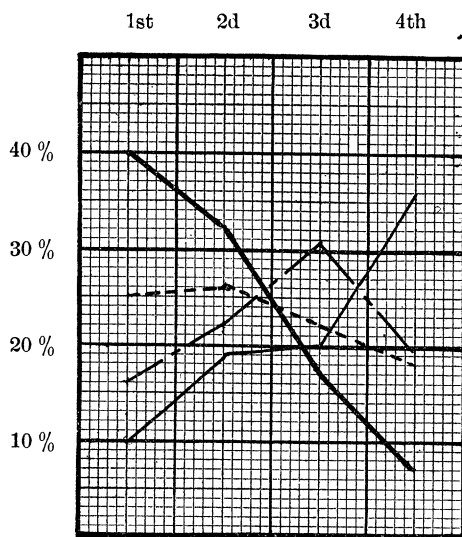


FIG. 7. Home Condition.

and doing other home duties may have had something to do with the difficulties of the girls—duties from which the boys frequently escape—but I am inclined to think that the difference is largely due to the

more dominating influence upon the girl of the attitude of the home toward educational matters. She can hardly escape from it. She carries it to school with her, and if it be poor it drags her down. With the boy it is different. A game of ball or of marbles before school puts him into another world, and he does not reenter the depressing one of home until he is forced to, and even then he makes an early escape.

DEPORTMENT.

I do not consider the curves upon Fig. 8 of much value. They show a very marked relation between good deportment and good

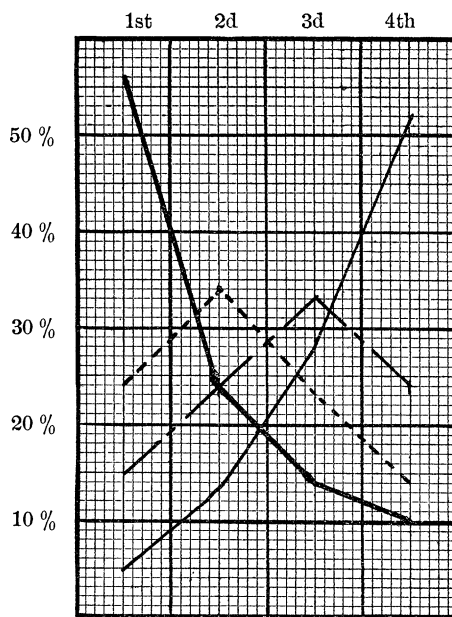


FIG. 8. Deportment.

class standing, but it takes a very hard-hearted teacher to give the best pupil in the grade, or those who are pushing him closely for honors, a mark for bad deportment, and I know the good teachers of Colorado too well to believe that they could easily do it. His marks, by a kind of mental osmosis intermingle, and with all respect for the good intentions of the teacher, I put this in more as a study of them and an apostrophe to

their good nature than as having any great scientific value from the standpoint of our problem.

EDWIN G. DEXTER.

UNIVERSITY OF ILLINOIS.

*MEMBERSHIP OF THE AMERICAN
ASSOCIATION.*

THE following have completed their membership in the American Association for the Advancement of Science during the month of July:

Frank Anderson, Mining Engineer, 255 East 2nd St., Salt Lake City, Utah.

William S. Andrews, Electrical Engineer, care of General Electric Co., Schenectady, N. Y.

Marshall H. Bailey, M.D., 47 Brattle St., Cambridge, Mass.

Professor Solon I. Bailey, Associate Professor of Astronomy, Harvard College Observatory, Cambridge, Mass.

Wm. C. Banks, Electrician, Gordon Battery Co., New York, N. Y.

Philip P. Barton, Superintendent Niagara Falls Power Co., 127 Buffalo Ave., Niagara Falls, N. Y.

James P. Baxter, President Maine Historical Society, Portland, Me.

Josiah H. Benton, Jr., Lawyer, Ames Building, Boston, Mass.

Clarence H. Blackall, Architect, 1 Somerset St., Boston, Mass.

Joseph E. Blackburn, State Dairy and Food Commissioner, Box 231, Columbus, O.

Miss Charlotte Bowditch, Pond St., Jamaica Plain, Mass.

Edward C. Briggs, Professor of Dental Materia Medica and Therapeutics, Harvard Medical School, Boston, Mass.

Paul T. Brodie, Professor of Mathematics, Clemson College, S. C.

Rev. Earle A. Brooks, 161 Laidley St., Charleston, W. Va.

Joseph S. Brown, 241 South 5th St., Reading, Pa.

Luther Burbank, Horticulturist, Santa Rosa, Cal.

I. Tucker Burr, Jr., Banker, Readville, Mass.

Irvin Butterworth, Denver Gas and Electric Co., Denver, Colo.

Charles T. Carnahan, Mining Engineer, Equitable Building, Denver, Colo.

Dr. Franklin R. Carpenter, Mining Expert, 1420 Josephine St., Denver, Colo.

Ermine C. Case, Professor of Chemistry and Geology, State Normal School, Milwaukee, Wis.

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Robert A. Cooley, Zoologist and Entomologist, Montana Agricultural College, Bozeman, Mont.

A. Beekman Cox, Civil Engineer, Cherry Valley, N. Y.

Hugh W. Crouse, M.D., Victoria, Texas.

Clayton E. Crafts, Lawyer, 5433 Washington Boulevard, Chicago, Ill.

John F. Crowell, Bureau of Statistics, Treasury Department, Washington, D. C.

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E. Dysterud, Electrical Engineer, Monterey, Mexico.

Richard H. Edmonds, Editor of *Manufacturers' Record*, Baltimore, Md.

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Professor Chas. K. Francis, Adjunct Professor of Chemistry, Georgia School of Technology, Atlanta, Ga.

Charles W. Frederick, Computer, United States Naval Observatory, Washington, D. C.

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Arthur L. Fuller, Brunner, Texas.

Edward L. Fullmer, Professor of Natural Science, Dakota University, Mitchell, S. D.

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