

Q. I. Simpson presented the following paper :

BIOLOGY AND OTHER SCIENCES AS APPLIED BY A  
BREEDER.

About the time when Dr. Burrill was teaching *all* the sciences at this university, a professor of Natural Science, my father, was leading a class of six, all the product of his own loin. He taught causality for all nature's phenomena, the immutability of law and universal kinship. Hence the application of science to our life work.

Two centuries of nursing, pampering and inbreeding of the English thorobred had brought the foals to almost the delicacy of *Homo*, and the country "hoss" doctor and our own experience could not cure their many baby ailments. But "*kinship*" brought the village physican, and our losses were then at an end. The Government, after many researches concerning hog cholera, had discovered an impractical form of immunization, and had put out a *drug* formula for cure and prevention that was as useless as a *drug* cure and preventive for small pox. We were lost and feared we must lay aside the most profitable money maker of the farm. But we read how a physician in Georgia had lowered the death rate in typhoid by abstinence from all diet. We had seen the bacteria of typhoid and of cholera in a Government laboratory, and noted that they were in appearance alike. Dissection of our swine showed that they were diseased as described for typhoid. The intestines were weakened by numerous little boils, so that a little pull or pressure would produce a hole which allowed foods to escape into the abdominal cavity. Even the pulling of the lateral and longitudinal muscles which causes peristaltic action was sufficient to tear these tissues. Then we *fasted* all cholera swine and the

disease to us lost its terror. We do not court this enemy, but by the application of strict quarantine prevent it, or hold it to a particular field or pen. A neighbor, his dog, or horse, or vehicle, from a cholera farm would be as little welcome at our farm, as would a leper at our residence.

I am proud to know that Illinois has now a better method of preventing great loss from cholera, in the immunization now being directed by Dr. Peters, and which has been so well established by Dr. Connaway of Missouri.

The isolated farmer has not the "atmosphere" that you men of the universities have, and you will laugh at our modes for research and inspiration, but when we looked thru the libraries for laws and rules and principles governing breeding, we found just one, handed down from Aristotle, the law that like begets like; and it is a lie.

It seems that most of the research, which during the last half century has changed biology, was instigated in some way by the great truth propounded by Charles Darwin. He and Mendel brought life down from the clouds where thinking men may handle, analyze, and theorize as they do in the exact sciences of dead elements. The sexual principles of Gregor Mendel were the first that were absolutely true in their application to the breeding of plants, animals, and man. They were given before the Society of Brunn in 1865, but lay unnoticed until the spring of 1900, when three papers by DeVries, Correns, and Von Tschermak were published stating again its substance. Each of these three writers was able to confirm Mendel's conclusions from his own cases.

At this time Spillman was developing these laws in wheat hybrids, and they were almost immediately confirmed by Castle, Bateson, and others with small pet stock. Your writer, on a farm, isolated from learning and with little scientific literature, did not hear of these principles until he read an article by Castle in 1904. We had been making a variety of hybrid experiments with swine; using pedigreed animals of strongly contrasted visual features, partly for determining the economic value of their many mixtures, but chiefly to determine the then mooted

question of sex value, the relation of potential between male and female, and when we read these laws we had in our fields a half hundred pig hybrids proving their truth and accuracy.

We at once became Mendelian enthusiasts; for these were the first proven laws for the guidance of heredity characters. We do not now require Pearson biometries nor Galton tables, but try to simulate the chemist, physicist, and astronomer by direct application, borrowing the principles of exactness and law from kindred sciences.

With Mendel's laws we five years ago propounded the theory of magnetic-polarity, the why-for of sex as shown by the action of chromosomes at fertilization and thruout all the mitotic divisions and reproductions of the cell, to old age in the individual. And the theory has been established by other lines of research under the more general name of "the electro-chemic theory of life." This was well illustrated by Dr. Lillie at the Boston meeting of the A. A. A. S. recently, in a paper on fertilization, wherein he showed how the entrance of a single sperm negatively polarized the egg against further encroachment.

When we learned of Mendel laws, we had in our group of pig hybrids much diversity and non-correlation of characters on single individual hybrids, which told us that the conception of the half nuclei was an insufficient explanation. Some experimenters and cytologists were claiming that the independence of the finer division of these half nuclei—the chromosomes—were the origin of the independant unit characters that showed a non-correlation with other characters from their four grandparents. In our first reprints sent to Mendelian and cytological workers, many of these men would advise us "to go slow with the chromosomes as bearers of heredity; that we are not yet sure that they are the vehicles." But further hybridizing of strongly contrasted breeds and the aggregating of three and four of these contrasted breeds in a single hybrid brood has enabled us to almost count the chromosomes, and convince *ourselves*, if none else, that *they* are the *things* that *do it*.

From these experiments and the Mendel-chromosome combination of theories, we are now able to analyse supposedly pure animals and prove and name their specific impurity. We are doing it now with swine purchased from reputable foreign breeders with the exactness and surety of a chemical laboratory.

Many experimenters are using the same methods under different terms. The "allelomorphs" of Bateson and Castle and the "factors" of other experimenters are proof of the chromosomes' action. The direct experiments of myself that have cost me far more work than a doctor's title, have enabled me to say that the individual, independent chromosomes of the male and female nuclear colonies are the things that determine units of heredity.

With this chromosome-Mendelian-unit-segregation-idea, we are synthesizing the units from various individuals as does the chemist; and building animals to "blue print" as does the architect. And when built, we then with these same principles and some empirical knowledge test the individual as to the purity and homogeneity of its inner germs.

With these we do not fear *latency*, *reversion*, or *throwing back*, and can create *reversion* at will when so desired. We can formulate new "made-up breeds" to suit the economy or the fancy. We can fix these breeds in the purity of their characters with certainty and precision, without the long line of inbreeding, as used by disciples of Aristotle. We are working in an advanced field on a dim trail, and must use every finding from kindred experimenters that will lead the way.

The climatic mutants from Tower's potato bugs, the mutants of Webber's frozen orange stump, the variants from McDougal's chemical plants, and the feather-pigment researches, by Riddle, are all telling things that relate to our work of creating pigs to order; and show that life is only a chemical laboratory and subject to chemical and physical laws.

Weismann brought Mendelism into unity, by showing that *albinos* were of *no* pigment; and *whites*, like white hogs and white leghorns, an over oxidation of pigment, a fading out to white. This explained the *dominance* of *white* hogs,

and the *recessiveness* of *albino* mice, when crossed with pigment. His graduation of pigment colors worked out in the chemical laboratory agree, in my opinion, with Emerson's and Shull's hypostatic and epistatic grades of pigment in bean hybridizing, and the dominant and recessive colors in swine of our own mixtures.

Men with biometrics had found little gain from outcrossing corn, but the precise individual methods of Dr. Shull and Dr. East in producing absolutely pure types, and crossing these, have brought this grain under the general law of "magnetic polarity," the out-cross rejuvenation as found in crossing inbred animals. Former experimenters had been trying to inbreed hybrids (corn with *biotypes*), and it was like the inbreeding of the Collings nondescript short horns, *not* inbreeding.

The facts found by cytologists that all animal cells from paramecium to man inclusive, and all plants above bacteria contain chromosomes; that they show precise division and reduction of these at prefertilization, and an exact fixed number in all germ and somatic cells of any particular variety of plant or animal; and that they constitute a mode of reproduction of these chromosomes, has led us to offer a theory, which I gave at Omaha. This tries to account for the mutability and varietal changes of organisms by explaining the chemical and microscopical action of the finer details of these organisms. Unless we can guess the specific units that make and regulate life, we will be hardly able to make and control it to our own particular fancy. The chemist and physicist have found usually that what nature can do man may also accomplish when he learns how she has done it. That she has and is doing things in the lines of mutability in life we have abundant proof.

When we had apparently found to our satisfaction that the chromosomes are the builders of the cells, then we asked how they do it. And this I will try to tell you, accepting the hypothesis that the chromosomes are bacterial catalytic entities, and act on the blood or lymph of animals and the cell sap of plants, analysing and synthesizing the chemical cytoplasm of the cells, as their kindred the bacteria work chemical change in a jar of

agar, or starch solution. Boveri in the year of 1888 had said "The splitting of the chromosomes appears to be a vital manifestation; an act of reproduction on the part of the chromosomes." And every authoritative cytologist since has said that they divide and reproduce by fission, making two from one. But some of these have thought that they sometimes arise anew from simple cytoplasm, because they have not found them under certain conditions in some cells.

McClung, Wilson, Miss Foote and Miss Stevens have found that sex is determined by the odd or even number of these chromosomes; and all the direct breeding experiments of artificial mutability of individuals have led to this idea of their bacterial semblance.

When we consider the embryo's development from a fused germ cell, and the many different chemical forms of hoof, hair, pigment, bone, and glandular cells, we must surely ask if there is not something inside these particular cells that works a chemical change, or metabolism, on the homogeneity of the common lymph and common sap.

We were ready to spring this theory of "the bacterial semblance of the chromosomes" a year ago, but some cytologist said these chromosomes at times lose their identity. Further work in complicated hybrids of contrasted breeds, enabled us to nearly count these chromosomes by the non-correlation of distinct and heritable units. We searched volumes on chemistry for a perpetuating chemical enzyme. Platinum finely divided and some sulphates would work catalytic change on lymph, sap, or starch solution, but would not reproduce.

There is but one reproducable catalyser yet known, the hated bacteria. So by the logic of simple elimination we attribute to bacteria the building of plant and animal cells from the undifferentiated lymph or sap that filters thru the cell wall into the cell. First the lymph exists as cytoplasm. Then after metabolism by bacterial chromosomes it becomes pigment, bone, hoof, or epithelium. Since this theory was given at Omaha, we have found much further confirmation, and we are receiving support from able men.

We had assumed that a bunch of bacteria had balled-up and by secretion of slime, had caused the first cyst or cell sac. Dr. Condon and Dr. Fischer showed us there was not need for the assumption, for there are now in the evolutionary stage capsulated and non-capsulated bacteria in single species. An editorial in the Journal of the Am. Med. Assn. of Dec. 18, 1909, gives Jensen's classification of bacteria and their supposed evolution into higher plants and animals.

The theory that we present is in substance that the chromosomes are the vital entities that make life, and that carry heredity from germ to maturity and from generation to generation. These chromosomes are of bacterial evolutionary origin, yet retain the bacterial properties of creating metabolism. In the slow reproduction of germ cells from the blastomere to the ovary or testis, thru only a line of epithelial cells, they do not change their species, but in the rapid division of the somatic cells mutate into the various properties required for the particular cells which they build.

In conclusion, I wish to express a breeder's gratitude to you scientific workers, who by your exact methods of thought and research and your accomplishments set example to the slipshod methods of my class, and show us what may be found by direct experimentation. Our application of evolutionary kinship we owe to the precision of the systematist. The Mendel laws, by which all accurate determination of the action of genetic units is derived, was formulated by a trained botanist. Proofs of the cause for these laws are obtained with the aid of the microscope by workers of your universities. Most that the breeder has obtained since Aristotle's time has been learned from trained scientists.

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