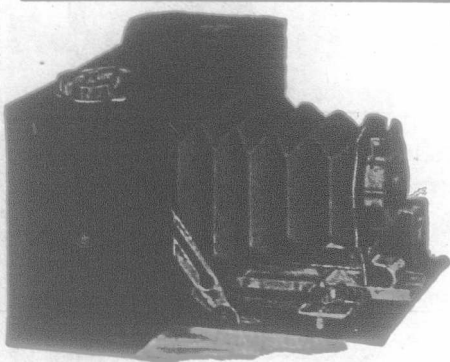


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cultural colleges and schools; and the development of men trained in the science and art of breeding; also the beginnings of a usable literature based on the technique developed in scientific plant and animal breeding, are all combining to make a new world for human efforts. And the facts should not be lost to sight, that men of many nations are beginning to seek the truth concerning the breeding of the human family. All along the line modern science and art have finally begun to attack in a systematic way the re-organization of unit characters in living forms into more useful types; and, if possible, to create new unit characters not before existent.

Mendel's discoveries and the discoveries of his disciples following his methods of research, have given us some valuable principles which have been used at least in a narrow range of breeding operations. But in addition to this, these investigations have most profoundly aroused science to the possibilities of investigating operations of heredity, both concerning natural evolution and artificial evolution or breeding. DeVries' investigations, with possibly even a larger immediate value than Mendel's, have also done much to attract some things which carry units of heredity from one generation to the next and often lie dormant, to appear possibly in their original purity after two or even many generations of recessive somnolence. While Darwin developed the fact of the evolution of species, these men have sharply turned attention both as to how nature's evolution may be studied, and also as to how man may rapidly recombine and evolve nature's forms into types of higher economic value.

The work of Bateson, Tschermak, C. B. Davenport, Castle, Webber, and many others who are making a specialty of the science of heredity, the work of Neilson, Zavitz, Garton, Burbank, Swingle, Williams, Gentry, Eckels, Craig, and many other breeders of plants and animals is rapidly expressing the possibilities of science and art in the terms both of beautiful forms and of dollars. And here and there we find a man who may be laying the foundation for a reputation for large public service in the pedagogics of breeding.

The aggregate efforts in the breeding of plants of the United States department of agriculture and of the state experiment stations and of similar institutions in other countries, are year by year increasing into a public work of large magnitude. These institutions are by no means usurping the field. They are in fact rapidly increasing the field for private efforts in plant breeding. As yet much less is being done in a public way for animal breeding; and theory and technical practice of plant breeding has within a decade far outstripped the theory and practice of animal breeding. It would seem easy to predict that public institutions concerned with animal improvement will rapidly take the new and inspirational point of view from the brilliant investigations in plant breeding and will lead to a rapid development of the science and art of improvement of domestic animals. It is of interest to note that a dozen years ago the plant breeders received their best inspiration from animal breeders, and that now the tables are turned and that breeders of animals need the inspiration from the accelerated work of the breeders of plants.

Probably the most important recent development in relation to plant and animal breeding is the revision of methods of teaching this subject which is now going on, and we may hope ere another decade passes that our colleges of agriculture and universities will have supplied a group of young men well-grounded in all that is known regarding research in heredity and in methods of breeding plants and animals. Certainly this field offers a most enticing prospect to young men with a liking for and with a genius for either research in heredity or for the work of creative breeding in public institutions or on private plant and animal breeding farms. And the field for amateurs who desire an interesting avocation is most enticing not only in relation to pet animals and ornamental plants but in relation to many minor staple crops, fowls, and smaller animals and even with beneficial insects.

I was asked specifically to say a word regarding the utility of the Mendelian theories as applied to economic breeding. The range of the use of Mendelian philosophy in re-combining in new types the most desirable of the unit characters found in available types, forms a much less portion of the field of economic breeding than Mendelian enthusiasts at first claimed. On the other hand, there is no doubt that formal re-combination of desired characters in the hybrid breeding of wheats, barleys, and many other crops can be carried out to large economic results. Spillman's work in the state of Washington clearly demonstrates this fact in a large commercial way.

Swingle has made many most promising re-combinations of citrus fruits, and Hansen and other daring compounders of radically different species and types within species are recording results which promise new forms in which the re-combinations of characters will give new values, and the re-combinations made by those engaged in theoretical research give both direction and inspiration to the radical Mendelian breeder.

It is proper to recognize, however, that the largest value growing out of these discoveries, lies in clarifying our plans for effecting the informal re-combination of characters. At first, the then astounding facts concerning the segregation of definite characters and the possibilities of their formal re-combination, almost as chemical atoms re-combine into new compounds, served to blind us from the larger concept of the very complex network of descent, which makes up most of our economic types of plants and animals. We have now gotten back to the fact that only under peculiar circumstances and in particular cases, can hybridizing be worked out with definite unit characters. In the great bulk of re-combining first and second generation hybrids, in uniting the blood of three or more original forms, and especially in blending related forms, and forms recently and much hybridized, and in the vast amount of necessary selection work, the art of breeding must be carried out without adhering closely to formal re-combinations.

Often the network of descent, which happens to most happily produce the most valuable combination does not always appear like the formula which represented the ideal toward which we started. Very often the new acquisition breaks in upon us with an unexpected combination of forms, which resist our attempts at analysis. The wise breeder chooses that which has the largest economic value, somewhat regardless of whether he can trace all the threads of both woof and warp in the new network of descent. And as the years go by the newly bred materials, many of which are highly complex compounds, increase in numbers the breeder will have at his command, larger and larger supplies of basic materials. In some cases the breeder will work downward or back up to purebred homozygotic basic materials along the lines pointed out by Shull's work with corn; and here formal Mendelian breeding can be practiced most effectively. But it would appear that the larger part of the plan, and of the humdrum details of the work of making over America's plant and animal forces would be outside the practical work of formal Mendelian re-combination. And I reiterate that the larger value of Mendel's discoveries and of DeVries' mutation theory will be to clarify our plans of doing the bulk of this less systematic work.

The new philosophy will be expressed in a new nomenclature, and as the years go by, breeding will be taught with more of the simplicity with which arithmetic is taught. It will always be an abstruse subject, and while the Mendelian philosophy may seem to simplify the re-combination of nature's original types, DeVries' mutation theory will continue to relate in a larger and larger way to the importance of using immense numbers, both in Mendelian hybridizing and in the extensive, less formal breeding, that occasional superior foundation-plants of exceedingly great variety-producing-potencies may be secured.

We need not be surprised if the researches of Mendel, DeVries, and others lead to other discoveries of still wider practical application in the improve-

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