heredity and the theory of the determiner. The field is well covered.

Of the sections dealing with variation and selection it may be said that they contain the sharpest analysis yet made of the biological significance of the variation polygon and of its modification under diverse ancestry and environmental conditions. Considerable space is devoted to the interpretation of skew curves, indicating that, for organisms at least, they are not due to an inequality of the plus and minus selective forces but rather are a necessary consequence of an initial inequality of growth combined with the law of *proportional,* as contrasted with absolute, increments. As to selection, the results of extensive experiments, of which the details are given, indicate that selection can not create genotypic differences. Among abnormal frequencies, bimodal polygons receive fullest attention and several causes are deduced, such as: presence of two races, of two age classes, of two environmental conditions, of dimorphism and of mendelian segregation. In treating of correlation tables the author reaches the conclusion, now generally accepted by modern workers in heredity, that, while useful for many purposes, such tables are useless in the study of heredity in the strict sense.

The general effect of the prolonged argument of the author is to arouse enthusiastic acceptance of the principles he works out, which, indeed, seem in the line of necessary development of modern ideas. Every breeder of experience must have noticed the fact that even trivial, often quantitative, differences may be inherited as unit characters and persistently refuse either to blend or to regress. Such are the genotypes of our author. Nevertheless, the body of heredity data is still so small that we may well hesitate to accept in any other spirit than as a working hypothesis the principles of Johannsen. If it should prove to be possible, in a case where the existence of a biotype-complex can be excluded, to pass by "selection" from one genotype to another, then the value of the hypothesis would be greatly diminished. To this test several scientific breeders are devoting their energies and we shall soon have more data on the matter.

CHAS. B. DAVENPORT

SPECIAL ARTICLES

THE ACTION OF RADIUM SALTS ON RUBIES

IN 1906, Marcellin Berthelot[1] found that crystals of amethyst from Brazil became decolorized when heated to 300°, but that on exposing the decolorized crystals to the action of radium chloride, contained in a sealed glass tube, the original color was regained in the course of a few weeks, owing to the reoxidation of the manganese salt. He suggested that the color of amethyst, and possibly of some other precious stones, may be due to the action of radioactive substances while the stones lie buried in the lithosphere.

The following year Bordas[2] reported that when a blue sapphire is exposed to the action of radium bromide of activity 1,800,000, the color changes to a green, then to bright yellow, and finally to a deep yellow. Under the same conditions, a red sapphire was found to change through violet, blue and green to yellow. Bordas stated that the intensity of the reaction can be varied by altering the distance of the stone from the radioactive salt, or by employing radium bromide of different activity; and concluded that since yellow sapphires are the most common, and blue and yellow ones are frequently met with together, it seems probable that the soil in which these precious stones are found is radioactive, and that the stones are undergoing a very slow change analogous to that he observed. Later[3] Bordas observed that by bringing a tube of radium bromide of very high activity (1,800,000) into direct contact with a corundum, and varying its position every few hours, the coloration can be effected evenly in some days. It was ascertained that colorless corundums can be rendered yellow, and the color of natural topazes and faintly colored rubies intensified in color. Artificial rubies were found to be similarly affected.

[1] *Compt. rend.,* 143, 477.
[2] *Compt. rend.,* 145, 710.
[3] *Compt. rend.,* 145, 800.

About the same time Daniel Berthelot[4] published a statement concerning the changes which specimens of certain minerals, placed by Marcellin Berthelot in November, 1906, in the neighborhood of radiferous barium chloride, had undergone in a years' time. It was found that a colorless quartz from la Gardette and a white, cleavable fluorspar were unchanged; that a violet, amethystine quartz (containing manganese) from Uruguay, which had been previously decolorized by heating, was recolored; and that a violet fluorspar from Weardale (Durham) had behaved similarly.

Later Bordas[5] observed that the coloration of crystallized alumina by exposure to radium bromide is not due to the action of the α-rays, since these were absorbed by the glass envelope containing the bromide; but that the γ-rays are operative in this respect, for colorless corundum becomes distinctly yellow after forty minutes, and topaz colored after several hours' exposure to the action of the Röntgen rays, and these rays are analogous to the γ-rays of radium.

On April 5, 1909, the writer received several crystals of ruby from W. P. Dewey, of Los Angeles, Cal. Two of these specimens were placed in radium chloride of 7,000 activity; one in a tube containing radium chloride of 7,000 activity, in order that the emanation would act upon it; and several in a box containing radium of the same activity. These were then set aside in the dark, and examined recently after six months' exposure. No change in color was observed, and the specimens were entirely unaffected.

Chas. Baskerville
College of the City of New York,
November 12, 1909

DEMONSTRATIONS OF ELECTRICAL OSCILLATIONS

The production of high-frequency oscillations from arc or spark has become such a simple matter that the use of the experiments described by Professor Huff in Science for November 12 is strongly to be recommended, especially as demonstrations before classes in alternating currents. With extremely simple means one can exhibit to an almost extravagant degree some of the effects of alternating currents which at commercial frequencies either do not appear at all, or only with the aid of more costly apparatus.

In this connection the following notes may be of service:

1. Steadier and more rapid oscillations are attainable with the metallic arc than between carbon electrodes. The iron arc in free air gives good oscillations, especially when capacity and self-inductance are so adjusted that the note is a shrill squeak.

2. Many commercial condensers show well the phenomenon of the "musical capacity," *i. e.*, the production of a musical note synchronous with that in the arc. The arc should be placed at a considerable distance from the condenser.

3. Simon's "speaking arc" is shown with a pair of flaming arc carbons and 220-volt supply, making the arc as long as possible. Connect in parallel with the arc a capacity of from 1 to 5 m.f. and the secondary of a small transformer. The transformer primary is in series with a battery and telephone transmitter capable of carrying an ampere. After a little experimentation the arc can be made to reproduce sounds audible throughout a large room.

4. Should the arc go out accidentally, it may be found that the transformer continues to reproduce the sounds, illustrating the "speaking transformer."

5. Some effects at much higher frequencies can be shown by means of the type of discharge recently described by the author.[1] When a discharge at about one tenth of an ampere is passed between metallic terminals in illuminating gas, or better in a mixture of hydrogen and acetone vapor, oscillations of the order of a million per second are generated without the aid of capacity or self-inductance

[4] *Compt. rend.*, 145, 818.

[5] *Compt. rend.*, 145, 874.

[1] *Am. Jour. Sci.*, September, 1909, p. 239. *Phys. Zeitschr.*, September 15, 1909, p. 623.