VI

## Genetics I

Until now we have been concerned with ordinary biochemistry, i. e., with what the cell does with substrates introduced from without, and have considered some of the mechanisms which the cell employs in handling metabolism. The chief results in this field consist in the discovery of reaction chains, of enzymes, and of the interrelations of complex enzyme systems. This aspect of biology constitutes the most direct approach from the side of chemistry. Obviously, this line is exceedingly limited in its achievements. It enables us to discern some of the accomplishments of the cell, but it falls far short of a complete understanding. Nowhere do we even get near the question how a particular cell gets into possession of a particular enzyme system let alone questions of differentiation and of reproduction.

Problems of differentiation are not entirely insusceptible to an attack from the side of chemistry. In many instances we know that differentiation is in part under the control of hormones. Some hormones can be identified chemically, but the trouble is that in most cases the <u>response</u> to the hormone, i. e., differentiation of the cell, cannot be characterized chemically nor can the <u>condition of the cell</u> which makes it responsive to the action of the hormone be described in terms of chemistry. Hormone research is helpful in disentangling the networks of functional relationships in an organism, but it does not aim, as yet, at consistent interpretations in terms of one science. It operates, as it were, simultaneously with two systems of concepts, that of chemistry and that of morphology.

Let us now consider the case of genetics and its actual or potential relations to atomic physics. It is necessary first to take a bird's eye view of the basic experiments and results of genetics. It starts with Mendel's experiment on the behavior of single factor differences in various crosses.

Cross green (g) peas with yellow ($g^+$) peas. The $F_1$ individuals are <u>all alike</u>,

the phenotype is the same in reciprocal crosses and is yellow, because yellow happens to be dominant. The $F_2$ gives 3 yellow to 1 green, the back cross to the green strain gives 1 yellow and 1 green, the back cross to the yellow strain gives all yellow offspring. This is interpreted by the well-known factor scheme. It is assumed that the green parent contains the green factor in duplicate. During formation of the sexual cells segregation of these two factors takes place so that each sexual cell contains the green factor singly. Fertilization between green and yellow sexual cells forms a diploid cell containing both the green and the yellow factors. The individual growing out of this combination contains in each cell both the green and the yellow factors. When this individual forms sexual cells the two factors segregate as above, resulting in cells which contain only one or the other of the two alternative factors.

Essentially the same experiment may be done with a haplont, i. e., an organism whose body cells contain only single sets of factors, like the sexual cells above.

Cross, for instance, a wild type mold, Neurospora crassa, with a mutant strain which differs from the wild type in that it needs p-aminobenzoic acid (pab) as a growth factor, because it has lost the ability to synthesize it. Crossing produces a diploid zygote which develops a small amount of diploid tissue, and in this tissue the asci develop in which segregation takes place. It is found that in each ascus there are exactly 4 spores which germinate to give wild type mycelium.

This type of Mendel experiment is simpler in principle than the usual one because the character is read from the haploid generation, and there is, therefore, no complication from dominance relationships.

The most important feature in this type of experiment is the recognition of entities which are passed on from cell to cell, irrespective of the phenotype, while they in turn control the phenotype. These entities have been proved to be associated with the chromosomes. Their uniform delivery to the daughter cells is assured by the elaborate procedure of mitosis. Their segregation during the for-