other words of an inactive body into an active one. In the second instance, there is not only activation, but the extremely important addition of the male stereochemic system which by admixture with the female system constitutes a female-male system. Therefore, in the first place the offspring is developed solely from the female stereochemic system, and in the second place from the combined female and male systems, one or the other of which may be wholly or in part dominant in determining certain peculiarities in the developmental changes. Moreover, owing to the transmutability of stereoisomerides and the multiphase transmutability of stereochemic systems, coupled with the reversibility of metabolic processes which may be due to even the simplest of changes in physico-chemical mechanisms, we have a logical basis for the explanation of the phenomena of sexual dimorphism that is expressed in the so-called male and female ova, and male and female spermatozoa; of primary and secondary hermaphroditism; of paradoxical sex developments where the unfertilized egg develops into either male or female offspring; and of sexual transmutability of the inherently male or female ovule.

It follows upon the basis of our theory that because of the inherent peculiarities of the stereochemic systems of the germplasms and the definitely predetermined nature of the entire series of reactions in accordance with the laws of physical chemistry that "like begets like" because like every other physicochemical phenomenon, individual or serial, under given conditions, it is *a physico-chemical fatality.*

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THE CONTENT AND STRUCTURE OF THE ATOM[1]

This lecture has presented to you a vision of the recent struggle toward a better knowledge of the atom. Both experimental results and theory have been briefly discussed. You can readily place confidence in the former, but in the realm of theory you are unable to distinguish truth from error. I have brought to you, then, not the satisfaction which one enjoys in believing he hears the final truth, but rather the discontent with which the scholar views the limitations of knowledge in his field. Such discontent gives birth to zealous endeavor to learn new truth and is thus the precursor of that research in science which our society is organized to encourage. An attempt to think in sub-atomic terms very quickly makes one conscious of the limitations of our knowledge. But I wish to emphasize that such limitations occur in all sciences and, indeed, at any point that a scholar chooses to make his special study. These limitations are not usually easy to extend, especially in the older sciences. And just such difficulties furnish the challenge of scholarship in science to the young men and young women of ability.

There is, however, no need to offer explanations to those who are dissatisfied with a discussion in which truth and error can not be separated. The unscientific mind possesses but two compartments, one for truth and one for error, and such a mind has no compartment in which to place a discussion of the nature and structure of an atom. The scientist, however, recognizes no such compartments, for absolute truth and absolute error are unknown to him. After weighing the evidence furnished, his decisions consist only in selecting the degree of his confidence that is merited by that evidence.

Having given you a bird's-eye view of the evidence, it may now be appropriate to present a brief résumé in perspective of the great achievements in science which have been the subject of this lecture. We can now regard the existence of the sub-atomic electron with as much confidence as that given any other experimental fact in physics. There is yet a question as to whether or not the electron actually is our smallest unit of negative electricity, but the affirmative evidence is much the greater. The mass of the electron can be called "apparent," with the restriction that we know this to be true only to the de-

[1] The closing portion of the address of the retiring President of the Iowa Chapter of Sigma Xi, delivered on October 14th.

gree of accuracy of the experiments. But one can be fairly confident as to the electrical character not only of the electron, but also of the entire atom, for there is much evidence in favor of such a view and none that is contradictory. The conception of a nucleus, as given in the Rutherford theory, is so well verified in the experiments in the deflections of the alpha-particles, the velocity of the struck atom, and the high frequency spectra and in the splendid use made of it by Bohr's theory, that it will probably remain, suffering but little change in the future. It is reasonable to believe that the charge of the nucleus is a natural atomic unit, supplanting the atomic weight in determining the position of an element in the Periodic Table, as now understood. This suggested important function of the nucleus charge seems to afford an explanation for the existence of "isotopes," or elements occupying the same position in the Periodic Table, possessing the same chemical properties and giving the same spectrum, but exhibiting different radio-activities. Moreover, it is becoming more evident that our conception of the atomic weight as a natural unit is incorrect, that the atomic weight is merely the resulting apparent mass of the atom, or practically of the nucleus, and that this apparent mass is not merely the sum of the apparent masses of the charges in the nucleus considered separately, for the apparent mass of a charge is influenced by the proximity of other charges.

The very valuable theories of atomic structure, especially that of Bohr, can not, of course, command one's complete confidence. Indeed, Bohr's theory has been extended to but a partial investigation of the simplest elements and does not pretend to be complete. It possesses great interest because it is a relatively simple effort to account for the exceedingly complex functions of the atom. At the present stage of development of this theory its chief faults are the questioned validity of its assumptions, its lack of uniqueness, and the impossibility of extending it to complex atoms. The question of the validity of the assumptions involved should not be taken too seriously, for any assumptions that will lead to an agreement of theory and experiment will be welcome. The lack of uniqueness need not be a matter of immediate concern, for experimental facts at the present time go far beyond any suggested theory. There is, however, a strong contention on the part of Nicholson that the present theory of Bohr can not be extended to more complex atoms without marked modifications in the present assumptions. But the theory is a remarkable contribution even if it does no more than explain many facts known in the case of the simplest elements. When one contemplates the narrow scope of even this brilliant theory, what a limitless field for research seems ahead! Fortunately, there are at hand a number of methods of investigation that have not yet been fully utilized. Some of the most promising lines of research in this field are the extension of theory into the fields of heat radiation and magnetism and to a larger number of elements, the study of high-frequency spectra, the scattering of swift β particles, the production of Röntgen rays by the impact of positive rays, the low temperature characteristics of elements, and the effects of the magnetic and electric fields upon line spectra. To this might be added a long list of experiments which are more indirect, but which, nevertheless, are very important. An illustration is the investigation of the electrical and optical properties of selenium crystals, which is now being carried on in the laboratory of this university by Doctors Brown and Sieg. Before all these lines of approach are fully occupied new ones will be found, and there is no indication of a cessation of the attack upon the atom for years to come.

Where will the investigation end? It will be without end. Notwithstanding the prospect of such a lively attack upon this problem, one can readily appreciate that progress is likely to be made with much difficulty, taxing all the resources of the physicist and the mathematician. Yet science rarely completes a task before new problems that are more fundamental are found. For example, electricity was first discovered as electrification or strange variations of matter. The problem of matter was not solved before that of electricity was undertaken. Indeed, through the study of this variation in matter we came to appreciate that in it lay the path to the understanding of the atom. Will this experience now be repeated? Will a variation in the electron, not accounted for by electrical laws, be found, and will an investigation of that phenomenon lead to knowledge of the electron and thus of the atom?

I now desire to direct the attention of the younger members of the Society to two significant points that are illustrated by the material in this lecture. The first is that a problem may be too difficult for a direct attack, and one may need to await discoveries which furnish new and unsuspected clues. Röntgen rays were not discovered for the purpose of studying atomic structure. Neither was such a purpose the cause of experiments which led to the discovery of radioactivity. Thus the scientific worker can never know the future importance of his own work. His motive should be to follow up the most promising clues with which he is favored and to trust that all he accomplishes will be worthy of his effort.

The second point is suggested by the fact that most of the methods of attack here mentioned are comparatively new and probably will never become part of laboratory technique taught in a university curriculum. Method in scientific research is fundamentally not a thing to be learned by graduate or research students. For scientific research is nothing more than the successive application of complete acts of thought to experimental and theoretical problems. One needs but to think and to act.

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METHODS OF RESUSCITATION

IN line with its campaign to reduce the number of deaths in the mines of the United States, the Federal Bureau of Mines some time ago appointed a committee of eminent physicians and surgeons to develop an efficient method of resuscitation to be administered by miners or other persons to a fellow-workman overcome by electric shock or by gases in places which can not be reached by a physician or surgeon in time to save life.

As a result of this committee's report just made, the Bureau of Mines, through Director Joseph A. Holmes, recommends the following procedure in rendering first aid to those in need of artificial respiration.

The recommendations apply not only to men who are overcome by electric shock or gases in mines, but also to persons suffering from the effects of illuminating-gas poisoning or from electric shock anywhere. The recommendations are, therefore, of importance to many thousands of workmen:

In case of gas poisoning, remove victim at once from the gaseous atmosphere. Carry him quickly to fresh air and immediately give manual artificial respiration. Do not stop to loosen clothing. Every moment of delay is serious.

In case of electric shock, break electric current instantly. Free the patient from the current with a single quick motion, using any dry non-conductor, such as clothing, rope, or board, to move patient or wire. Beware of using any metal or moist material. Meantime have every effort made to shut off current.

Attend instantly to the victim's breathing. If the victim is not breathing, he should be given manual artificial respiration at once.

If the patient is breathing slowly and regularly, do not give artificial respiration, but let nature restore breathing unaided.

In gas cases, give oxygen. If the patient has been a victim of gas, give him pure oxygen, with manual artificial respiration.

The oxygen may be given through a breathing bag from a cylinder having a reducing valve, with connecting tubes and face mask, and with an inspiratory and an expiratory valve, of which the latter communicates directly with the atmosphere.

No mechanical artificial resuscitating device should be used unless one operated by hand that has no suction effect on the lungs.

Use the Schaefer or prone pressure method