INVISIBLE RADIATIONS OF ORGANISMS

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WITH AN INTRODUCTION TO THE PHYSICS OF RADIATION

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FOREWORD

Visible biological radiations have always greatly attracted man's curiosity; fireflies and glow worms, luminescent wood, phosphorescent meat, and the illuminating organs of deep sea fish are among the well-known wonders of nature. The biological importance of this luminescence seems to be in no proportion to the impression it makes upon the human mind. While it is assumed by some biologists that it has the purpose of attracting the prey, of frightening enemies, or of luring the male to the female, other investigators have contested these theories. The phosphorescent bacteria usually lose the ability to produce light when cultivated for some time on artificial media, without any apparent decrease in vitality. The emission of visible light is probably of no greater importance than color; it plays no essential role in the cell physiology of the organisms.

Quite to the contrary, the invisible radiations of living organisms are of considerable physiological significance. They play a distinct part in cell division and in growth. They are evident in the healing of wounds. Old age is accompanied by complete cessation of ultraviolet emission; perhaps this is the cause of old age. *Beta*-radiation controls the heart beat. The loss of blood radiation is used in the diagnosis of cancer; it may be that radiation, or some disturbance of its mechanism, is linked with the cause of cancer. Its role in the metamorphosis of amphibia has been demonstrated. Mutual influences of one species upon another by radiation have been observed.

Biologists and physicists have always been suspicious of radiations from living organisms, perhaps only because the average man (not to mention woman) likes to believe in human radiations. However, the principal reason for the rejection of the discovery

of ultraviolet emission from living cells was the inability of some to repeat the positive experiments of others with the same results. This had led to the fallacy that negative results disprove positive ones. It is quite evident that if two experimentors obtain different results, they cannot possibly have made the same experiment. Both results are correct, and the important task is to find out in what points the investigations differed. With a phenomenon so little understood as these biological radiations, it is not surprising that these apparent contradictions have not as yet been explained in every case, though several factors responsible for negative results have been discovered.

The objection to biological radiations has been strongest in this country, but even here, a more conciliatory attitude has become noticeable since it has been shown that mitogenetic radiation is not a mysterious force, but the result of biochemical processes. Many simple chemical reactions have been found to emit weak ultraviolet rays. Another factor is responsible for the slow adoption of this new influence in biology: practically all papers on this subject are published in foreign languages, and of the very few in English, almost all happen to contain negative results. This very fact has been one of the authors' reasons for presenting the more important facts in this book.

The book deals almost exclusively with mitogenetic rays which exist in the ultraviolet range of the spectrum. No definite proof for the emission of infrared rays by organisms could be found (if we limit the infrared to radiations near that of the visible). *Beta*-ray emission from potassium is biologically important, but it is not really characteristic of the living cell; it is proportional to the potassium content, and is just as strong after death as during life.

The arrangement of the subject matter is not historical, but logical. An attempt has been made to show that ultraviolet radiation from living organisms is nothing at all strange. If GURWITSCH had not discovered these emanations 10 years ago, they would now be predicted from the results of physico-chemical investigations. An approach to historical presentation is found in Chapter IV which discusses the various methods used.

The book is not meant to represent a compilation of all literature on this subject. This would have increased its size greatly. A fairly complete list of references, up to the beginning of 1932, may be found in the book by STEMPELL (1932). The literature compiled at the end of this book refers only to those papers which have been quoted in the text; we suppose that this includes the more important publications.

A very brief summary of the entire book, chapter by chapter, is given at the end. This might be more useful in some respects than the customary Table of Contents.

One of the authors had occasion, during a recent journey to Europe, to see many of the biologists and physicists working in this field, and he wishes to acknowledge the many valuable suggestions he received from those convinced of mitogenetic radiation as well as from those who are convinced of its non-existance. The authors are further under great obligation to Professor ALEXANDER GURWITSCH for sound advice on various points, and to Professor MAGROU for the kindness of sending original photographs of his experiments for the reproduction in this book.

The authors are further under great obligations to Mrs. MARGARET N. BARNES for her ceaseless assistance in editing this book, and to Miss A. J. FERGUSON for her help in proof-reading.

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