BRAIN MECHANISMS

IN

CORONARY DISEASE

CAUSATION, TREATMENT AND PREVENTION

By

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With Two Appendices :

1. FROM THE CONDITIONED REFLEX TO THE SCIENCE OF BRAIN DYNAMICS. Paper delivered at the XVIIIth International Congress of Physiology.
2. REFLEXOLOGIC BASES OF PERSONALITY. Paper delivered at the Ninety-Sixth Annual Meeting of the American Psychiatric Association.

WITH 45 ILLUSTRATIONS

PREFACE

THE present study did not originate from any preconceived theoretical outlook relating to the genesis of coronary disease. It evolved from the observation of a number of patients afflicted with this ailment, whose mental make-up had arrested my attention. Naturally, it is very possible, even probable, that my vigilance was aroused owing to my cerebro-physiological investigation, in general, and to my studies concerned with the brain mechanisms of personality expression, in particular.

It is interesting that most students of coronary disease, when investigating the all-important problem of its etiology, have paid the greatest attention to changes of a rather peripheral character—morphological, physiological or biochemical. Thus special attention has been given to anatomical considerations relating to the structure of the coronary vessels, or to the effects of a disturbed chemical metabolism (sugar, cholesterol), or to severe anæmias, hyperthyroidism, etc., and, in all cases, to hereditary factors. Of course the significance of hereditary factors cannot be denied, but, as in so many other cases, heredity rather represents the ground, more or less propitious to the development of the disease, not the actual etiologic factor or complex of factors causing it. The possible role of cerebral dynamics in the pathogenesis of coronary sclerosis, has never been given proper attention. Instead, what is often referred to is the " strain and stress," or the " hustle and bustle," or the " high pressure," peculiar to modern life—all of them concepts without adequate scientific meaning. This is all the more astounding since in recent years a great amount of experimental and clinical evidence has accumulated, pointing to the cortical representation of many autonomic functions and specifically, of that of the cardio-circulatory system. The mechanisms through which life experience may exert an effect upon these " autonomic representations " within the cortex therefore acquire special interest.

In elucidating the nature of the relationships involved, the conditioned-reflex method of investigation has proved of the greatest importance. Indeed, it has been shown by systematic experiments that deep changes in the physiological properties of the heart activity and in the aspect of the electro-cardiographic curve (marked changes in the form of the T wave) can be produced

through the conditioned-reflex mechanism. It has also been shown that frequently repeated emotional outbursts, or even verbal symbols associated with them, can, as conditioned stimuli, affect the activity of the heart and initiate the pathogenic cycle leading to hypertension and to organic changes in the vascular wall.

As a result of my laboratory experiments and clinical observations I am inclined to consider two pathogenic mechanisms as essential in the genesis of coronary disease. One is what I have called a *collision of nervous rhythms*, the well-defined concept of *nervous rhythm* being a direct offspring of that of the *temporal* conditioned response. The second is the relationship between the fundamental processes of the nervous system—*excitation* and *inhibition*—and the effect exerted upon their interplay by *inductive* phenomena. Both mechanisms are treated in detail, and the mode of their operation is explained. In particular, it is shown how the pathogenic cortical phenomena are evoked by the environment and, more specifically, by the person's mode of life, and how, through the intermediary of the autonomic nervous system, they lead to the morbid cycle in the cardio-circulatory realm.

The conclusions drawn with regard to the etiology of coronary disease have been submitted to a thorough statistical evaluation. The latter has been carried out on a broad scale, and conditions have been thoroughly investigated in three different countries—the United States, Britain and Switzerland. This *comparative* statistical study has again and again reminded me of the danger which lies in the habit, adopted by many students in the field, to work with " blind " averages. Thus, I came across cases in which a writer, when encountering an American figure for the coronary mortality rate in a certain year, of 805 per million people, and an English figure for the same year of 455 per million, would give the arithmetical mean of 630 per million as the more reliable rate. In other words, while noting the striking difference in the mortality from coronary disease in the two countries, instead of elucidating the possible cause responsible for the difference, he actually masked and removed it from the visual field of the research worker.

The same applies to many other averages. For example, most writers have stressed the general M/F mortality ratio. On the other hand, the much more significant M/F mortality ratios within specific age groups have not received adequate attention. If this had been done, many theoretical assumptions concerning

the possible role of a number of specific biological agencies—a sexual hormonal factor, a special dietary factor, and several others—could have been avoided. The reader will see very illustrative cases of this kind. They all testify to the importance of using *detailed* data in their "pure," non-hybrid form, not concealed by general averages.

I would like to make one other remark here concerning statistics in relation to coronary disease. A very lively discussion has arisen in the medical literature regarding the increase in the incidence of coronary disease. Many writers, in spite of the considerably higher mortality rates reported in recent years by the statistical bureaux of various countries, deny such an increase, calling it an illusion, and ascribing it to our improved methods of diagnosis, to the increased number of old people, and to changes in the system of certification of cardiac deaths. I have devoted a special study to this question. As a result, evidence is given proving beyond doubt not only that the incidence of coronary disease is increasing, but also that this increase is very rapid, that it penetrates more and more into the younger age groups, and that it becomes a serious threat to the health of our society as a whole. Also, the causes of this steady increase in the incidence of coronary sclerosis are discussed and the mode of their operation shown.

The last section of the monograph is devoted to those prophylactic and therapeutic measures which logically follow the conception of the etiology of coronary disease set forth here. These measures should, in my opinion, form the basis of an effective long-range fight against the gravest and most threatening killer, among diseases, of our time.

Before concluding, I should like to emphasize the significance of comparative pathological and statistical studies on an *international* scale. This approach has proved extremely fruitful in the study of coronary disease, and I am convinced that it can find most useful application in other fields of human pathology.

In order to familiarize the reader with the present status of the *science of brain dynamics*, whose concepts and methods of investigation have been utilized in the present study, I have attached two appendices to my text. The first, entitled *From the Conditioned Reflex to the Science of Brain Dynamics*, is a communication which I made to the Eighteenth International Congress of Physiology; the second, *The Reflexologic Bases of Personality*, is a paper delivered at the Ninety-Sixth Annual Meeting of the American Psychiatric Association. These communications will

help the reader in interpreting more correctly those short references to cerebro-dynamic occurrences and relationships which he will encounter throughout the text.

I wish to express my appreciation to the American Heart Association for supplying very valuable statistical data published by the U.S. Public Health Service, to the Registrar-General of England and Wales for the courtesy of putting at my disposal the Registrar-General's Library, to Mr. A. F. Cull in charge of the library for his hospitality and help, and to the Swiss Federal Bureau of Statistics for supplying very extensive and detailed data relating to coronary disease in Switzerland. As always, I am indebted to my friend, Dr. W. G. Macdonald of London, for his assistance in reading the manuscript and proofs and in preparing the illustrative material. I also wish to acknowledge my obligation to Henry Kimpton, Medical Publisher, notably to Mr. G. E. Deed, for his very efficient co-operation and the care given to the general appearance of the book.

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TABLE OF CONTENTS

I

II

III

IV

APPENDIX I

FROM THE CONDITIONED REFLEX TO THE SCIENCE OF BRAIN DYNAMICS

APPENDIX II

REFLEXOLOGIC BASES OF PERSONALITY

LIST OF ILLUSTRATIONS

BRAIN MECHANISMS
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I

INTRODUCTORY REMARKS. APPROACH TO THE PROBLEM. HISTORICAL NOTES

THE close relationship which exists between mental life and the activity of the heart was known in the remotest antiquity. From the moment man conceived a dualism between soul and body, he placed the seat of the soul in the heart. It is significant that language reflected this fundamental concept that the seat of the soul of a person is his heart. Even later, when medical scientific progress had proved the heart to be as mechanical an organ as we can possess since it represents only a pump for the distribution of the blood, the linguistic designations of the close relationship between the " soul " and heart were not corrected. Numerous expressions of our present day language show this very graphically. We know that Mrs. X. has a *kind heart* or a *heart of gold*, that Mr. X. has a *heart of steel* or a *heart of stone* and that Mr. Y. has a *heavy heart* ; Mr. N. wears *his heart on his sleeve* ; Mrs. N. is *lighthearted*, while her husband's *heart bleeds*. Mr. A. is, *at heart, not a bad fellow* ; when he *opened his heart* to me, I took his case *to heart*. Someone may be too *soft hearted*, while someone else may be *heartless*. I can engage in some pleasant activity to my *heart's desire*, and I also can do something *half-heartedly*. I may lose my *heart to somebody* or I may *win somebody's heart*. A certain impression may be to us *heart warming* or, on the other hand, it may be *heart breaking*. Somebody's *heart may ache*, and there are always, of course, *lonely hearts*. These are only a few examples taken from current English usage. Their list could be lengthened considerably, and, what is more, similar, though not identical expressions exist in equally great numbers in all other languages.

Thus, from time immemorial the most intrinsic connection between the activity of the heart and mental, especially emotional, life has been noticed. In recent years some light was shed on the biological background of this connection. This occurred when the role of the autonomic nervous system, in particular of its sympathetic portion, was more thoroughly investigated. As the work of Loewi, Dale, Cannon and others showed, the sympathetic nervous system is mostly concerned with *emergency situations*, that is, situations which acquire the greatest significance in the survival of the animal and which consequently deeply affect his mental life, usually evoking a strong emotion, say, fear of a danger, that will lead to flight, or anger that will provoke aggression, etc. It is obvious that in order to accomplish the responsible task that may be created by the emergency, for instance, in order to combat an enemy or to flee from him, or to save the young from a similar danger, the animal must produce the greatest amount of muscular activity possible, which always means a great stress upon the heart. It is the heart which, through the circulation, will supply the muscles of the body with the source of the energy necessary for the fight or the flight, if the organism is to survive. It is therefore only logical that between the heart, on the one side, and the sympathetic nervous system, concerned with handling emergency situations, on the other, there has developed an intrinsic, not only physiological, but also morphological, connection.

According to the general law governing all biological effects (1), the regulation of heart activity is effected not by one single agency but by a combination of antagonistic agencies, in this case, by the two divisions of the autonomic nervous system—the sympathetic and the parasympathetic—which are subject to the principle of reciprocal innervation or, expressed more correctly, to the principle of *induction* * : sympathetic excitation and, consequently, parasympathetic inhibition accelerate the heart, while sympathetic inhibition and parasympathetic excitation slow it.

The sudden and strenuous work to which the heart may be subjected in emergency situations calls for a highly efficient and fast operating blood supply to the heart itself. The latter, assured by the two coronary arteries, must obviously display a sensitivity and lability which would keep pace with the multitude of emergency signals reaching the autonomic nervous system. One readily realizes why the close relationship between the auto-

* See pp. 111–125.

nomic nervous system and the heart shows itself most conspicuously in the coronary vessels. It is the coronary arteries which are practically covered with nerve fibres connecting them with the autonomic nervous system. The nerve supply to the coronary arteries is so rich, compared with the direct supply of nerves to the heart itself, that for some time anatomists erroneously believed the heart to be without nerves and all nervous distribution to be directed to the coronary arteries. This richness of innervation seems to be unsurpassed in any other artery in the body. Both sympathetic and parasympathetic fibres are present, the latter serving chiefly as vasoconstrictors, while the former are vasodilators.* It becomes understandable why the coronary arteries can reflect the most varied changes occurring within the nervous system, at least within its autonomic division.

Thus, the connection between the heart and the autonomic nervous system was clarified to a great extent. However, more intriguing, and also more important, was the question concerning the influence exerted upon the cardio-circulatory system by the higher portions of the brain, notably by the cerebral cortex where the finest reactions of psychic life take place.

The possibility of such influence was visualized by individual scientists at different times and found expression in a few witty aphorisms. The well-known physiologist, I. F. Zion, for instance, used to say that with the help of a cardiograph a dying millionaire could find out exactly the degree of sincerity of the grief of his heirs.

The grave significance of the effects that may be exerted upon the heart by the higher nervous centres was likewise grasped long ago. The famous surgeon, John Hunter (1728–93), who was himself a victim of coronary sclerosis and suffered from attacks of angina pectoris, wrote : " My life is in the hands of any rascal who wishes to worry and tease me." Sir Everard Home (1756–1832), in a biographical note on Hunter, stated : " It is a curious circumstance that the first attack of these (Hunter's) complaints was produced by an affection of the mind, and every future return of any consequence arose from the same cause ; and although bodily exercise or distention of the stomach brought on slighter affections . . . it still required the mind to be affected to render them severe ; and as his mind was irritated by trifles, those produced the most violent effects of the disease. His

* Several authors have claimed that the coronary vessels are constricted by sympathetic nerves and that these run in the superior sympathetic cardiac nerves. However, experiments with cutting these nerves yielded very conflicting and little convincing results.

coachman being beyond his times, or a servant not attending to his directions, brought on the spasms, while a real misfortune produced no effect!" At St. George's Hospital he met with "some things which irritated his mind, and, not being perfectly master of the circumstances, he withheld his sentiments, in which state of restraint he went into the next room, and turning round to Dr. Robertson . . . he gave a deep groan and dropt down dead" (2).

If one compares this fine description of a lethal psycho-somatic disturbance, given over 150 years ago, with the loose and light-hearted use of the term "psycho-somatic" in many contemporary writings, one is all the more impressed by the remarkable accuracy of Home's observation and his excellent evaluation of the relationships involved (for instance, of the fact that "trifles" may produce a much more violent effect upon heart activity than "real misfortune").

I witnessed a similar fatal psycho-somatic occurrence in a patient suffering from coronary thrombosis. Encouraged by the competent and tactful approach of his attending physicians, he preserved a good and promising mental and physical balance. A consultant, called in one day at the request of his family, displayed such a rough and frightening attitude that literally within seconds the patient, after a look at him, gave a groan and collapsed, dead. (It may be noted that the consultant suffered from Basedow's disease, and his exophthalmic look made the impression even more distressing.) The effect was too immediate and obvious to be ascribed to a coincidence.

Recently the morphologic substratum of such influences was likewise considerably clarified since specific connections were demonstrated between the cortex and the autonomic nervous system.

Thus, experimental studies with electrical stimulation and with ablation of various cortical areas, and also cases of injury of the cerebral hemispheres demonstrated the most varied forms of autonomic representation within the cortex. Specifically, very profound cardiovascular reactions were obtained by faradic stimulation of areas 4 and 6; pressor as well as depressor points were located, and several foci identified which influence the heart rate; both the sympathetic and parasympathetic divisions were shown to be represented. However, the most important cortical centre of autonomic control seems to be the forepart of the cingular gyrus, notably area 24 on the medial aspect of the hemisphere.