

A STUDY OF THE BLOOD PROTEINS
AND THEIR ALTERATION IN DISEASE.

BY

F. RAY HONE, M.B., B.S., B.Sc..

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Introduction.

The view of the ancients that the blood was the vital part of the body, a view that gained expression in the system of humoral pathology, in which an attempt was made to ascribe all morbid processes of the human body to variations in this fluid, naturally led to an eager study of its composition in health and disease. The application by Lavoisier in 1780 of accurate scientific methods of measurement and analysis to vital processes, and his famous declaration that "La vie est une fonction chimique," opened up a new era in medical history, so that it is not surprising that the first half of last century saw the publication of many painstaking researches on the chemical constituents of the blood, and the alterations that might occur in disease. By 1850 however, the death knell of humoral pathology had been sounded, and the doctrine that disease depended rather on modifications in the processes of cells than in the fluids which nourish them had been firmly established. This teaching, which owed much at its inception to Virchow's work, has resulted in the huge system of cellular pathology as it is now known, a system which although it has brought great advances in medicine, has led thought too much the other way, has resulted in our pathology books belying their name and becoming text books of morbid anatomy, and has brought about an almost total neglect of the chemical processes of the body in health and disease. The last ten years, however, have seen the pendulum slowly swinging back, and the biochemist with ever improving means at his disposal is stepping forward to take his place along with the bacteriologist, immunologist, and morbid anatomist in the fight against disease.

The history of the researches on the serum proteins reflects these changing view points as to the main factor in the causation of disease. Whilst the middle part of last century saw many inquiries into the normal quantities of the serum albumin and globulin, and into the changes brought about in the amounts in various diseases, the interest in the subject evidently

waned, for little mention is made of these bodies in the literature at the commencement of this century. Perhaps the cessation of the practice of bleeding for all complaints, and the consequent fact that blood was not so available for examination, partly accounted for this. It is only since about 1912 that the study of the serum proteins has been revived, since when there has been a considerable amount of work done to determine their function in the organism, and the part they may play in disease.

So we find that Gamgee (1) writing in 1880 gave a very full account of the subject, M. Foster (2) in his physiology in 1393 estimates the total proteins as being 3.9% of the serum, and mentions that the relative quantities of albumin and globulin are very variable. Writing at the commencement of this century, however, Metchnikof (3) in his "Immunity in Infective diseases," apart from noting the fact that the antitoxins are precipitated with the globulins, takes no notice of the changes in the serum proteins in infections. Ehrlich (4) in his "Studies in Immunity," and later in his work with Lazarus on Anaemia does not refer to these bodies at all. Wm. Hunter in his careful account of Pernicious anaemia, omits any mention of the proteins of the blood; and Buchanan (5) in his book entitled "Blood in Health and Disease" published as late as 1909 has nothing to say about the subject. In the last few years it is remarkable to note that standard works like Starling's and Halliburton's physiology text books, and Adami's, MacCallum's, and Beattie and Dixon's pathology books only state baldly that the blood contains serum albumin and globulin. The best modern accounts of the work are given by Hammarsten, (6) Luciani (7), Robertson (8) and Macleod (9), but these are all very brief, and in the first two cases rather erroneous.

In the account given below, an attempt has been made to indicate the views held concerning the serum proteins at different times, and to give in more detail the modern work that has been done in attempting to solve the problem of these substances.

The account of the estimations of the serum albumin and globulin made at different times by various workers is by no means complete, for Rowe (10) published a very full bibliography of the subject in 1916. Rowe in his account, however, only gives, practically, a list of the values for the total proteins, serum albumin and globulin, found by different workers up to that date, with the references. He does not enter at all into the subject of the functions of the blood proteins, or of the use that may be made of their estimation in medicine. Whilst most of the references to old work made below will be found in his article, yet in some instances literature has been found to which he evidently did not have access. Moreover, much work has been done since his articles appeared, so that the account below is in no way simply traversing the ground again, but is rather supplementary to his article, looking at the subject from a different view point, and also giving new work done since that time.