versity. An official position in the American Mathematical Society has brought him into touch with every active mathematician of this century in America, while in the course of frequent and extensive journeys in Europe to ransack bookshops and visit libraries, he has taken every opportunity to make the acquaintance in their own countries of the men and women whose writings he already knew. Enthusiastic, persuasive and learned, he has made the mathematical section of the library at Brown University one of the finest to be found anywhere, and he has created there for mathematicians the surest source of bibliographical and biographical information in the world.

Professor Archibald's published works include the definitive edition of one of Euclid's minor treatises, and the semi-centennial history of the American Mathematical Society, the latter a heavily documented volume incorporating twenty-seven biographical sketches. He is the author of a vast number of bibliographical articles, distinguished for an impersonal and uncritical thoroughness that conceals the toil and the knowledge that go to their compilation, and is, it must be confessed, sometimes carried to excess, for Archibald's modesty will not allow him to believe that if only, like Keynes and Muir, he would sometimes tell us after reading a paper that no one need ever read it again, others would gladly accept his judgment and be spared the tedium of making the discovery for themselves. Professor Archibald has served for long periods on a number of editorial boards, and is now editing for the National Research Council of the United States the youngest of mathematical journals, *Mathematical Tables and Aids to Computation*. To Professor Archibald, retirement will not spell indolence. It need scarcely be said that his expert advice will still be available in the library which he has made famous, he is continuing in his latest editorship, and he hopes to devote the time saved from routine to perfecting the organization of a library of English and American poetry and drama which he has been developing at Sackville since 1905 in memory of his mother. Increased leisure, if miraculously he achieves it, will mean enhanced opportunities to cultivate a second passion, for he is not merely a lover of music but also a musician of exceptional skill, who might easily have become a professional violinist and remained an amateur in mathematics. May he long enjoy a strenuous life.—*Nature*.

SCIENTIFIC BOOKS

THE BLOOD IN TUBERCULOSIS

Clinical Significance of the Blood in Tuberculosis. By GULLI LINDH MULLER. Pp. xvii + 516. The Commonwealth Fund. 1943. $3.50.

SINCE medical monographs assume places of authority in medical knowledge they should meet two requirements. First, the scattered literature on a subject should be concisely and completely presented. Dr. Muller has performed a commendable and difficult task in this phase of her book, although citations and bibliography are not complete. Second, the observations of the author should be presented in such fashion that the reader can easily grasp the full significance of the data presented. In some instances Dr. Muller has failed to fulfil this requirement.

The emphasis placed upon *qualitative* changes in neutrophiles when the author states "the omission of shift in the neutrophiles in the description of a leukocytic picture is a gross error comparable to an examination of the heart without counting the pulse" is a case in point. Discussion of the data presented in the table on page 57 emphasizes that "shifts to the left" are commonly present in normal leukocytic counts (author's standard). Hematologists would agree that a percentage of 8 or more "band forms" is beyond normal limits. As I reported in the *American Journal of Medical Sciences* in January, 1929, the upper normal limit of neutrophiles is 65 per cent. Dr. Muller presents no data, either from her own studies or from the literature, to refute the reliability of my data. On the basis that above 65 per cent. of neutrophiles is abnormal, the table on page 57 shows that two thirds of the counts are abnormal and one third normal. In the abnormal range 46.5 per cent., and in the normal range 15 per cent., reveal an increase of "band forms." As the percentage of neutrophiles increases, especially above normal, the percentage of "shift to the left" increases. Without minimizing the significance of qualitative changes one may question the wisdom of insisting that Schilling counts be done on all leukocytic counts. A better policy would be to let the hematologist decide when Schilling counts are essential. Careful thought must be given to the diversity and quantity of laboratory tests recommended for a routine diagnostic service.

The rather lengthy dissertation on the eosinophile seems to be out of place since Dr. Muller states "eosinophilia . . . may anticipate an *improvement or a deterioration*," *i.e.*, no definite interpretation can be given an eosinophilia *per se*. The suggestion that eosinophilia in tuberculous cases reflects "an allergic response" hardly seems valid, since only 20 per cent. of the cases exhibited an eosinophilia and probably the entire group would react to tuberculin.

Since hematologists agree that the percentage distribution of the different cell types is of paramount importance in leukocytic counts it would seem that the contents of Chapters 9 and 10 could be condensed to advantage. It is regrettable that Dr. Muller has not stressed the fact that a leukocytic count contains at least six variables and that it is the proportional relationship of the variables that constitutes the significance of any leukocytic count.

The chart shown on page 163 presents an interesting theoretical concept. It can not be accepted as factual for two reasons—first, it is extremely difficult to determine when a tuberculous individual has eradicated the tubercle bacillus from his system; second, to assume that a tuberculous infection may be "healed" because leukocytic counts remain within normal limits is unwarranted.

The occurrence of anemia in tuberculous patients is generally recognized and the need to determine the type of anemia is evident. Dr. Muller's presentation of this subject is valuable. A condensation of the text would enhance its value.

The sixty-page dissertation on the sedimentation rate of erythrocytes could be condensed considerably, thus emphasizing the salient facts. The correction table devised by Dr. Muller undoubtedly permits a more precise determination of the "rate of sedimentation." From a practical point of view the necessity for such precision may be debated. To the clinician the thing of importance is whether the rate is abnormal and, if so, how far it deviates from normal. In this respect the results should not be interpreted too finely—a difference of 0.5 mm per minute would be significant, whereas a difference of 0.2 mm would be equivocal. In a routine diagnostic service a single reading at one hour and a determination of the percentage of sedimentation based upon the plasma volume will give the clinician the essential facts, although admittedly this method does not guarantee the mathematical accuracy of Dr. Muller's method. Dr. Muller might have added to her requirements a uniform temperature for all sedimentation tests since temperature does affect the test to some extent.

In Part 4 Dr. Muller demonstrates that hematological and clinical findings often disagree, especially in individuals who seem to be progressing satisfactorily. It is where such disagreements occur that the hematological findings are of especial value. That the leukocytic reaction and the sedimentation rate are two independent phenomena which often disagree is also clearly demonstrated. This portion of the monograph would be improved greatly by a reduction in the number of tables and graphs. In some instances the number of patients and of serial tests is too small to carry much weight.

On page 311 Dr. Muller states: "The index is unfavorable in 37.8 per cent. of the examinations in Group A; as seen above these cases were clinically quiescent most of the time. Since there is an incidence of lymphopenia in only 14.1 per cent., and of neutrophilia in only 7.4 per cent., *the unfavorable index is obtained by the interpretation of essentially normal values.*" This interpretation is based upon the arbitrary normal values proposed by Dr. Muller, not upon the normal values which I reported in the *American Journal of Medical Sciences* in January, 1929. It is impossible to obtain an unfavorable index from normal leukocytic counts if the normal values I have determined are used. Furthermore, unless such normal values are acceptable the index values are not valid.

The reviewer is impressed by the fact that Dr. Muller considers changes within a rather narrow zone in Schilling counts and in sedimentation rates as significant, whereas rather broad changes must be present in a differential percentage before any interpretation is allowed. This is a common error among physicians and is due apparently to the difficulty of appreciating proportional changes between several variables. The entire purpose of the leukocytic index, as reported by the reviewer, was to demonstrate that proportionally the several variables could be abnormal in a leukocytic count that would ordinarily be accepted as normal.

Part 6 is well done. Dr. Muller could have insisted, with profit, on the counting of 400 cells to obtain a differential percentage to make the determination reliable statistically when different counts are to be compared. A reliable count can be obtained from a single well-made blood smear.

The general impression of the reviewer is that a much more concise monograph on this important subject would have evolved had the author had a much longer and broader experience in the field of tuberculosis.

E. M. MEDLAR

SPECIAL ARTICLES

AN EXPERIMENTAL TEST OF THE FRAMEWORK THEORY OF ANTIGEN-ANTIBODY PRECIPITATION

THE framework theory (lattice theory) of serological precipitation and agglutination, first proposed by Marrack,[1] has not been accepted by all investiga-

[1] J. R. Marrack, "The Chemistry of Antigens and Antibodies," Report No. 194 of the Medical Research Council,