INTRODUCTION

Until recently, histology and biochemistry have been two practically independent branches of biology. Histologists have prepared thin sections and stained them to elucidate details in the microscopical structure of the specimen. Biochemists, on the other hand, have mainly been interested in the chemical composition of gross anatomical samples of organisms. During the last few decades, however, sharply increasing numbers of studies have appeared, in which the chemical nature of various microscopical parts of organs and tissues have been subjected to a special investigation.

For such a study, there exist two possible methods. Either small samples of material collected with the aid of microdissection, differential centrifugation etc., are analysed with ordinary microchemical methods or thin tissue sections are treated with special techniques which make visible the chemical compounds to be examined. Both of these methods are actually histochemical. In current use, the term histochemistry nevertheless usually refers to the latter method of study.

The morphological and chemical conditions of the histochemical analysis have been ingeniously described and critically examined by Lison [1936] in his fundamental treatise »Histochimie animale«. This book marked the beginning of modern histochemistry.

Since 1936, many new histochemical methods have been described and their application has given much valuable information in the fields of cytology, endocrinology, pathology, pharmacology and physiology. Recently, collections of modern histochemical methods have been published (Glick [1949], Gomori [1951]) and the contributions of histochemical research to various biological sciences have been reviewed (Dempsey and Wislocki [1946], Dempsey [1948], Lillie [1948 b], DeRobertis, Nowinski and Saez [1948], Danielli [1950 a], Bourne [1951]). Further, critical articles on histochemical techniques have appeared (Danielli [1946 b], Baker [1951], Sanders [1951]).

The rapid methodical development makes it understandable that numerous organs and tissues still await the study of their histochemical structure. On the other hand, new methods are often carelessly used, without critical application along the lines already clearly drawn by Lison [1936]. To quote Danielli [1946 b]:

»Unfortunately many of the lessons to be drawn from the studies of earlier workers have escaped notice: this oversight has been attended by a lamentable failure to obtain rigorous and incontrovertible proof of the validity of many cytochemical techniques, some of which are in wide use. . . . Cyto-chemical techniques have been used without sufficient criteria of proof, particularly from the physico-chemical aspect. The number of papers published involving the use of these unestablished techniques is enormous.«

A good example in this respect is the histochemical method for alkaline phosphatase (Gomori [1939], Takamatsu [1939]). This method opened a new area in the field of histochemistry, the study of enzymes. If used with due regard to the conditions of specificity and localization, the
technique is of great value [Danielli [1946 a, 1950 b], Moog [1951], Moe [1952]). However, owing to diffusion phenomena complicating the procedure [Jacoby and Martin [1949], Martin and Jacoby [1949], Toko-yama, Stowell and Mathews [1951]), routine application of the method like a histological staining technique gives results of questionable or no value. This fact has invalidated a large number of painstaking studies.

The present writer began in 1948 a histochemical study of the adrenal medulla. Preliminary experiments confirmed that it possesses an exceptionally vivid acid phosphatase activity as earlier observed by Gomori [1941] as well as by Wolf, Kabat and Newman [1943]. Further studies showed, however, that, as pointed out by Danielli [1946], Lison [1948] and Sanders [1951], »a critical analysis of the technique will be needed before full confidence can be placed in its results« (Sanders). The present paper describes the results of such a critical study, which led to improvements in the histochemical technique for acid phosphatase. Further, the distribution of acid phosphatase in the adrenal medulla is examined in the rat, normal or under some experimental conditions. In addition, some other histochemical techniques have been applied on the adrenal medulla. Results obtained with them are described and correlated with the findings by the acid phosphatase procedure.