PRACTICAL APPLICATIONS

OF

SPECTRUM ANALYSIS

by

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PREFACE

The purpose of this book is to provide a trustworthy guide, as complete and self-contained as is possible in a single volume, for the practical spectroscopist engaged in analytical work connected with any field of study whatever. The necessary complementary volumes are tables of wave-lengths—*The Massachusetts Institute of Technology Wave-Length Tables* (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London) certainly, and if possible the Kayser/Ritschl *Tabelle der Hauptlinien der Linienspektra aller Elemente nach Wellenlänge geordnet* (Julius Springer, Berlin; Adam Hilger, London; 1939) as well. Pearse and Gaydon's *The Identification of Molecular Spectra* (Chapman & Hall) is also very desirable. Those engaged in industrial work in which saving of time is important should also keep in constant touch with the catalogues of instrument makers in order to acquaint themselves with the latest devices for particular parts of the process. No attempt has been made here to describe more than the essentials of the various forms of apparatus for producing luminosity, forming an image of the source, etc., embodied in simple but adequate equipment for all purposes except that of producing the greatest number of results in the shortest time. New devices are constantly being produced, and it would have been foolish to occupy space with descriptions of those current at the moment, which would probably have been superseded before publication.

The book is essentially a record of personal experience rather than a general conspectus of all the methods that have been used. It is an appropriate time for such a record, since I am now leaving this work after having been engaged in it for nearly thirty years, during the first half of which I was in the closest association with the late Professor A. Fowler, F.R.S., to whom I owe the foundations of my knowledge of the subject. An almost unlimited variety of problems have been presented to us at the Imperial College, nearly all of which have been parts of some wider biological, agricultural, geological, metallurgical or other investigation, and the solutions have not been separately published. It would be a pity, therefore, not to make available for others, as far as may be, the general experience gained.

The small amount of space given to quantitative spectrum analysis properly reflects, I believe, the present state of achievement in this field, but not the promise for the future. I have not thought it desirable to give more than the general principle of the many *ad hoc* methods used in particular industries—lack of space alone would have prohibited this

—but I have given what I believe must be the foundation of any practicable general method for such work. The principles of the production of spectra are now sufficiently well understood to make a theoretical approach possible, and it is most desirable that the problem should now be dealt with in this way rather than by narrowly empirical methods which, however useful they may be for their own special purposes, have no trustworthy wider application. I do not know of any previous attempt at a theoretical approach to the general problem.

While the book is in no sense a theoretical account of spectroscopy, I have tried to give sufficient theory, both of the mechanism of radiation and of the optical principles exemplified in the spectrograph, to enable the worker to form a mental picture of what is happening and to readjust his instrument for any desired end. The book should therefore be useful not only for the fortunate worker who can obtain fresh apparatus for each special purpose, but also for him who has to use the same instrument for all purposes and even to construct that instrument from parts separately acquired.

I am glad to record my thanks to various students and colleagues at the Imperial College for help with the illustrations. They are too numerous to mention personally, and of the source of some of the earlier plates I have no record. Except where special acknowledgement has been made, the illustrations were all produced at the Imperial College or have been associated with it so long that they have come to be regarded as such. For all inadvertent omissions of acknowledgement I express my regret. My thanks are also gratefully accorded to Dr. G. R. Harrison for permission to include the M.I.T. list of *raies ultimes* in Table V; to the Director of the Lick Observatory and Dr. K. Burns for permission to include Table II; to the Physical Society and Drs. A. Hunter and R. W. B. Pearse for permission to include the Table on p. 53; to the Institute of Physics and Dr. R. W. B. Pearse for permission to include Fig. 9; and to Messrs. Hilger & Watts, Ltd., for permission to include Plate XVIIIA, their list of *raies ultimes* in Table V, and the portions of the iron arc spectrum in Plates X and XI.

H. D.

London,
June 1949

LIST OF PLATES

DESCRIPTION

Note—The plates are arranged in sequence at the end of the book.

PLATES I–XIX

DESCRIPTION

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VI Iron arc spectrum, region 3800–3460 A.

VII–VIII Spectrum of *raies ultimes* mixture with iron arc comparison, region 3560–2520 A. (*See* pp. 92–5.)

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XIII Flame, arc and spark spectra of thallium.

XIV (A) Arc spectrum of graphite.

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(B) Absorption spectra of neodymium chloride solutions of different strengths.

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XVIII (A) Example of standard spectra for special problem in quantitative spectrum analysis. (*See* p. 123.)

(B) Spectra showing danger of attributing lines of VII and TiII in impure graphite to BeII. (*See* p. 99.)

(C) Ghosts in grating spectrum.

XIX Spectra showing effect of salt in bringing out lines of impurities in graphite electrodes. (*See* pp. 79–80.)

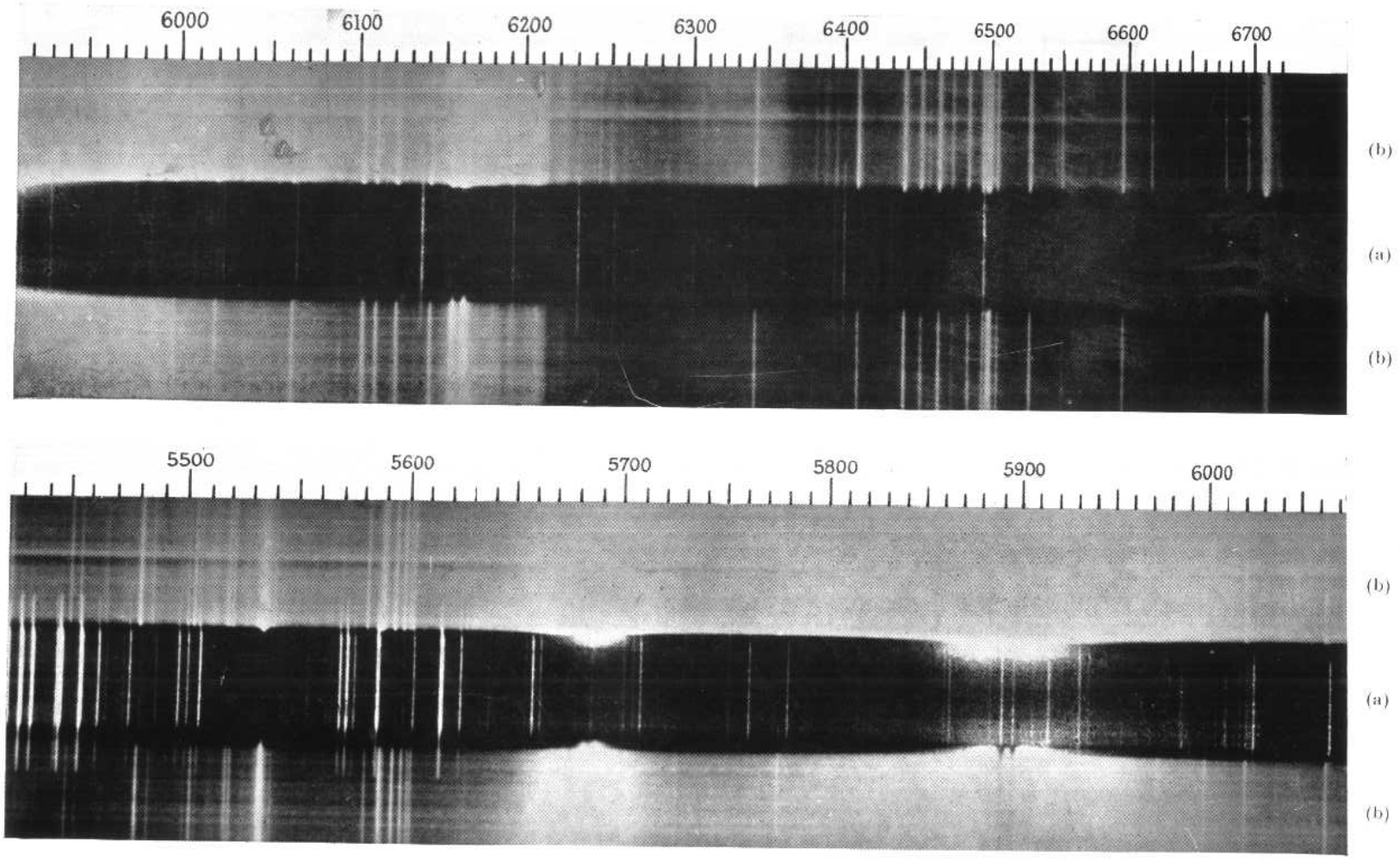

PLATE I
(a) Iron ; (b) Mixture

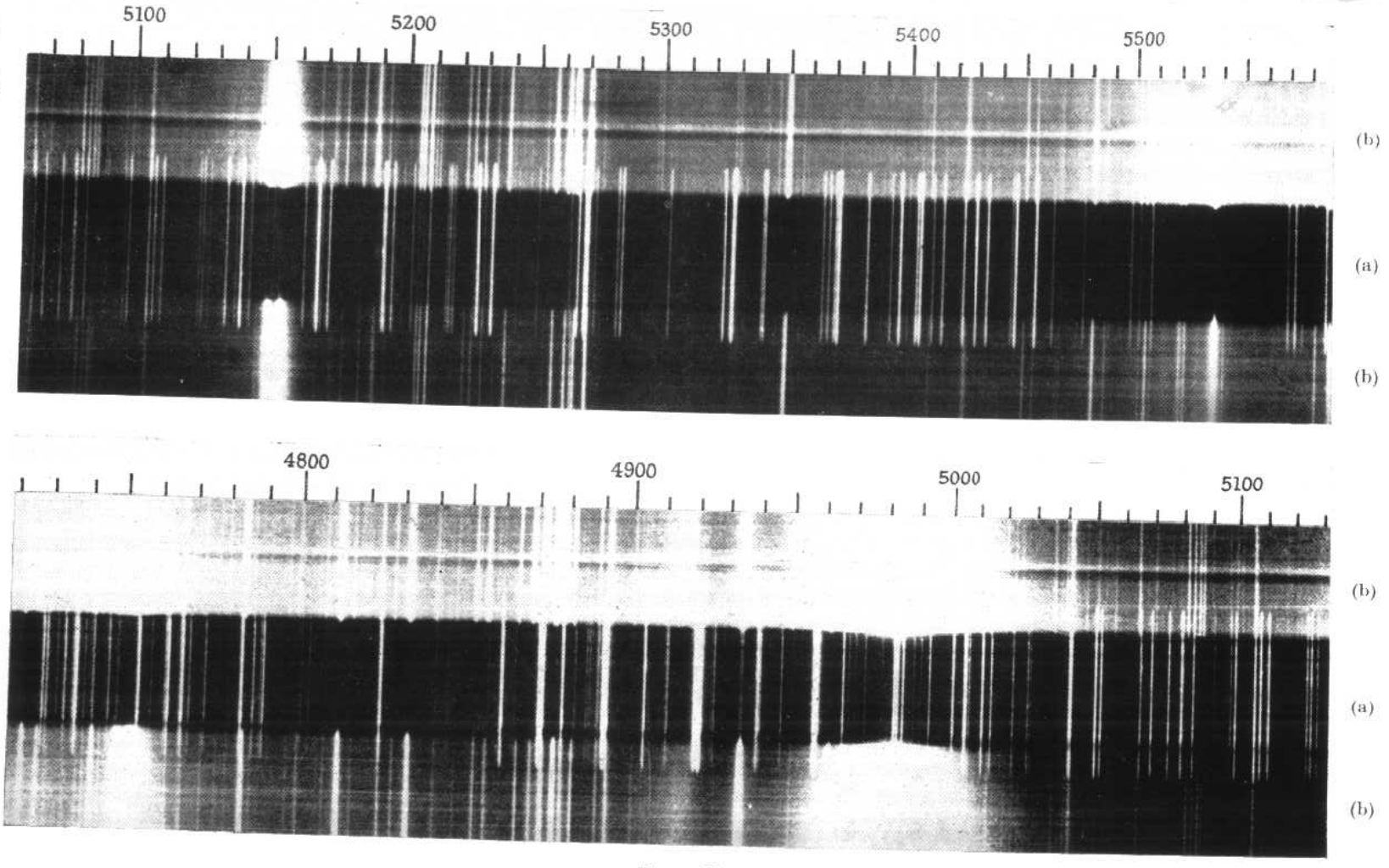

PLATE II
(a) Iron ; (b) Mixture

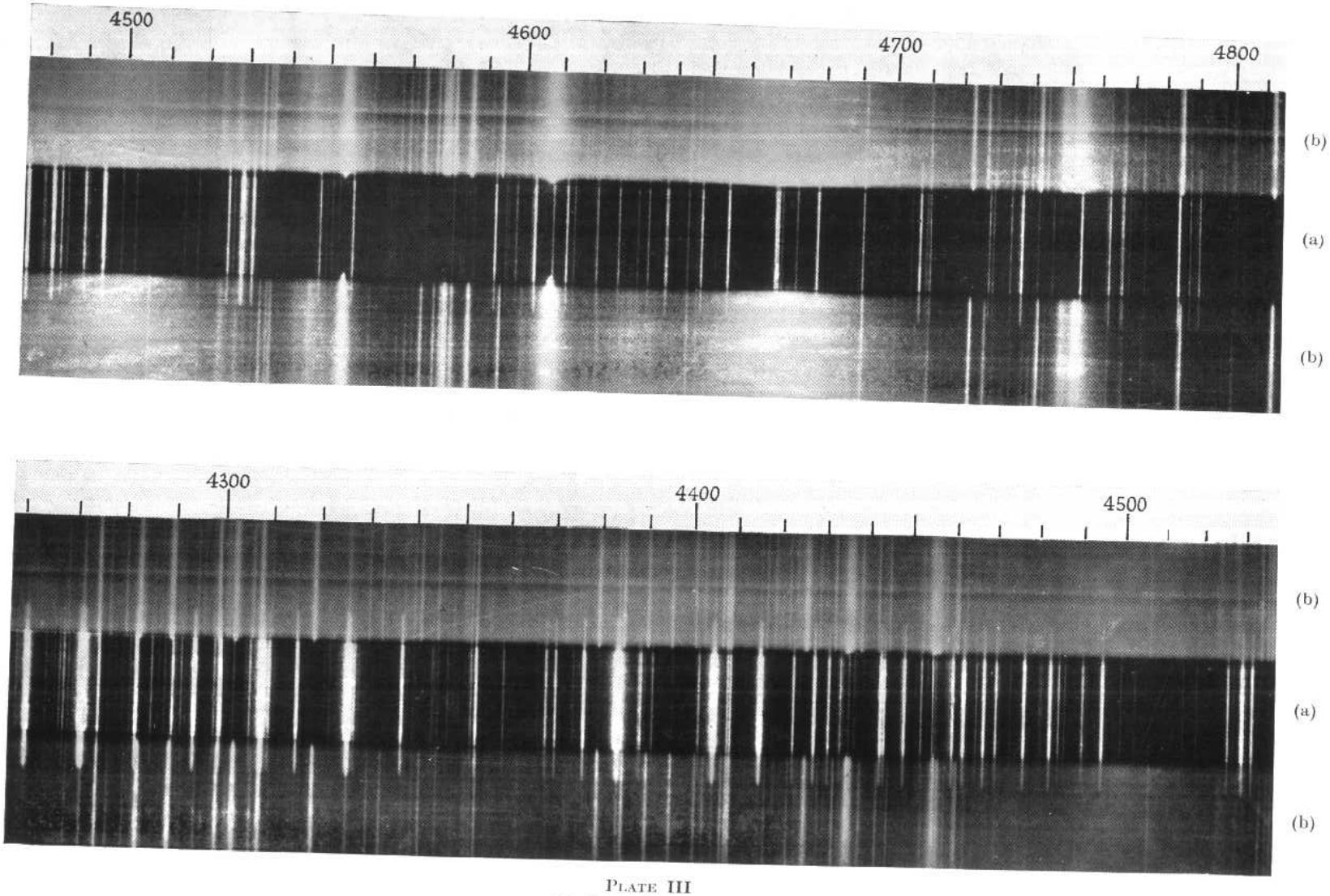

PLATE III
(a) Iron ; (b) Mixture

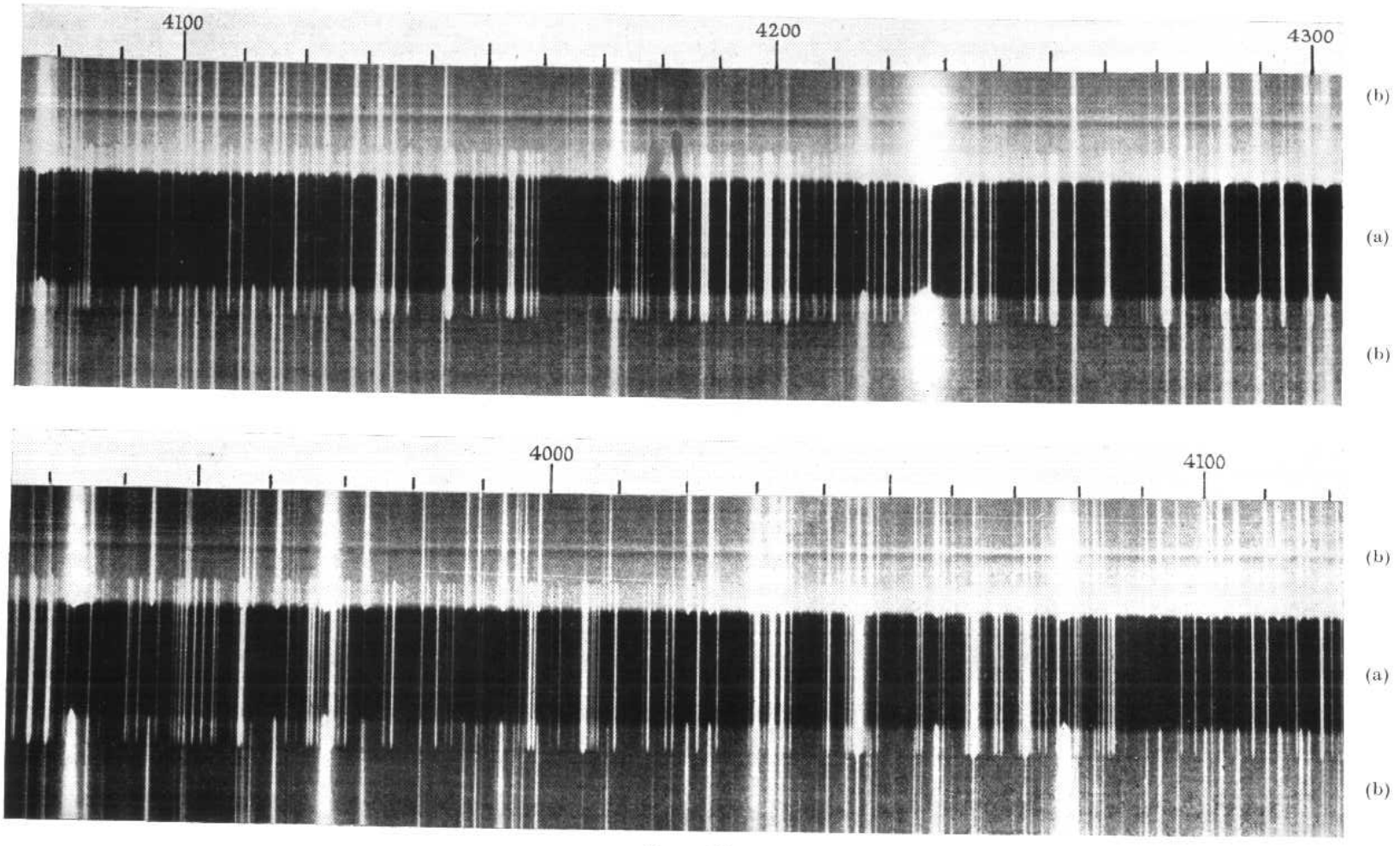

PLATE IV
(a) Iron ; (b) Mixture

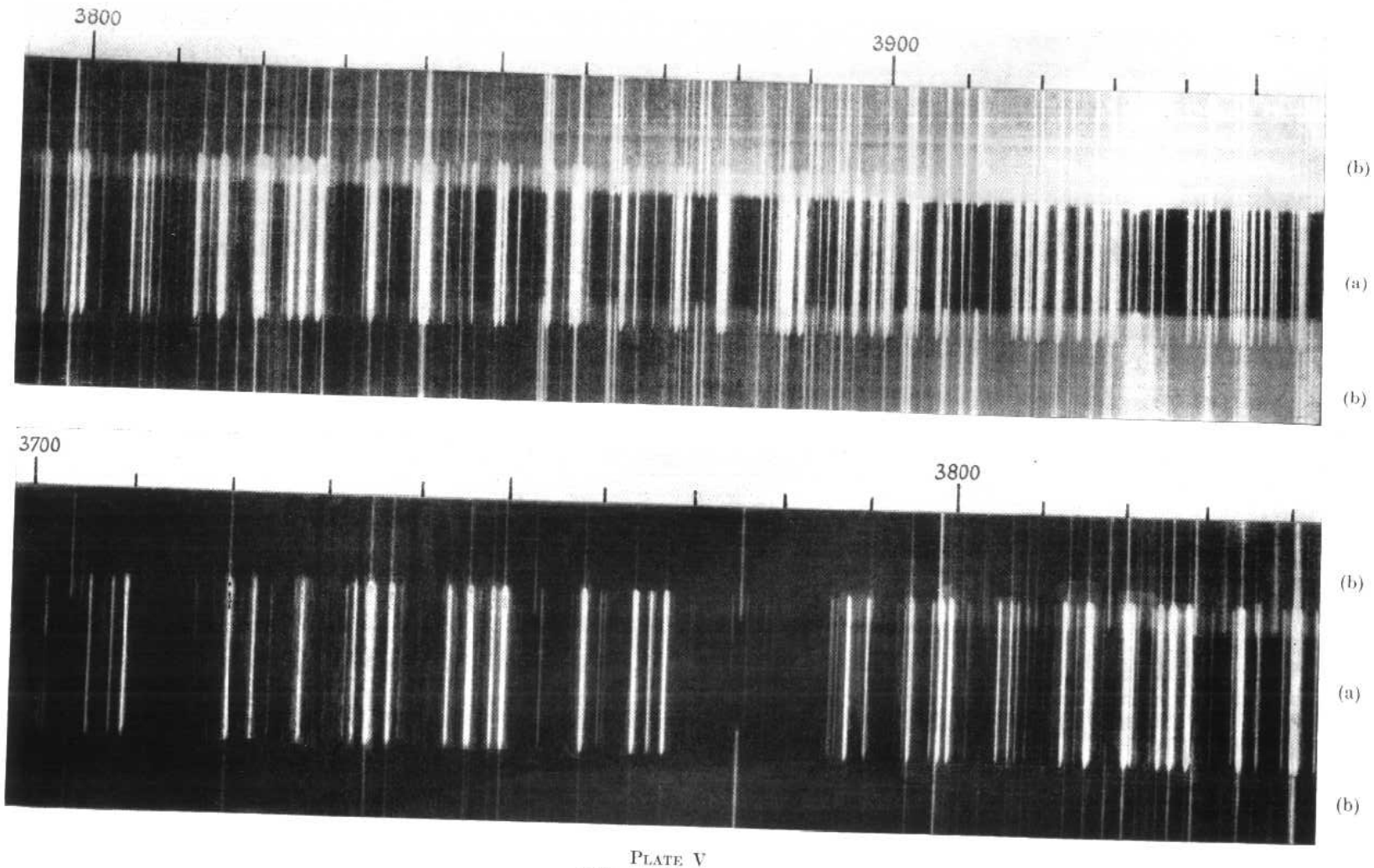

PLATE V
(a) Iron ; (b) Mixture

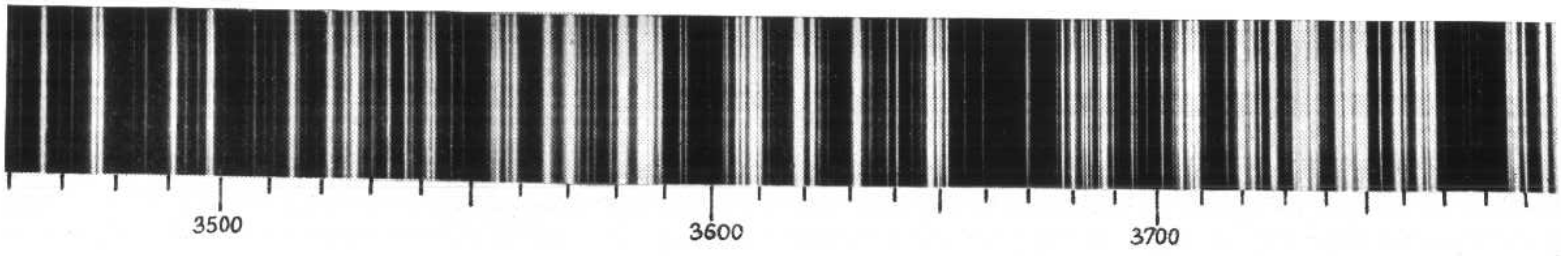

PLATE VI
Iron Arc Spectrum

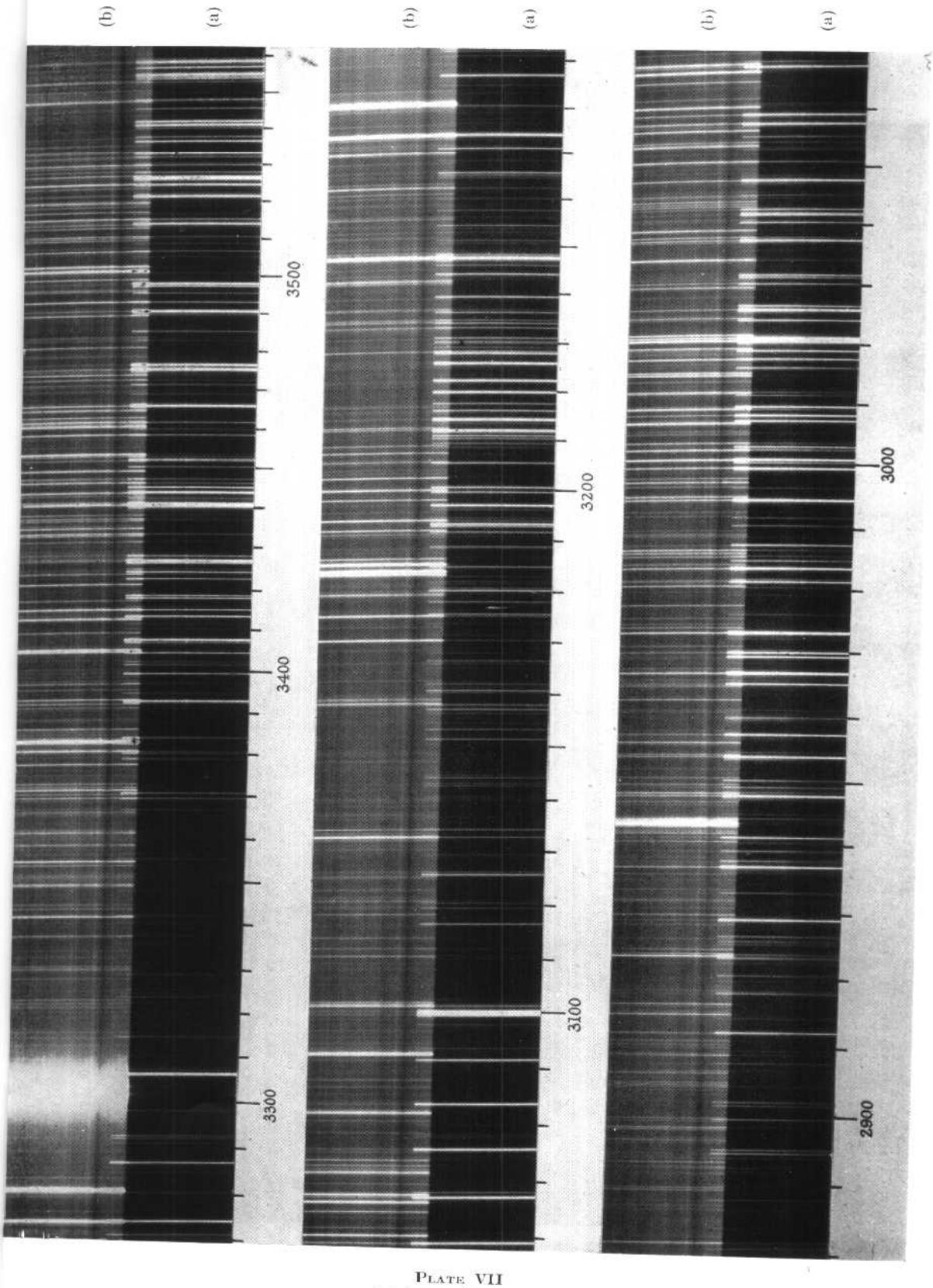

PLATE VII
(a) Iron ; (b) Mixture

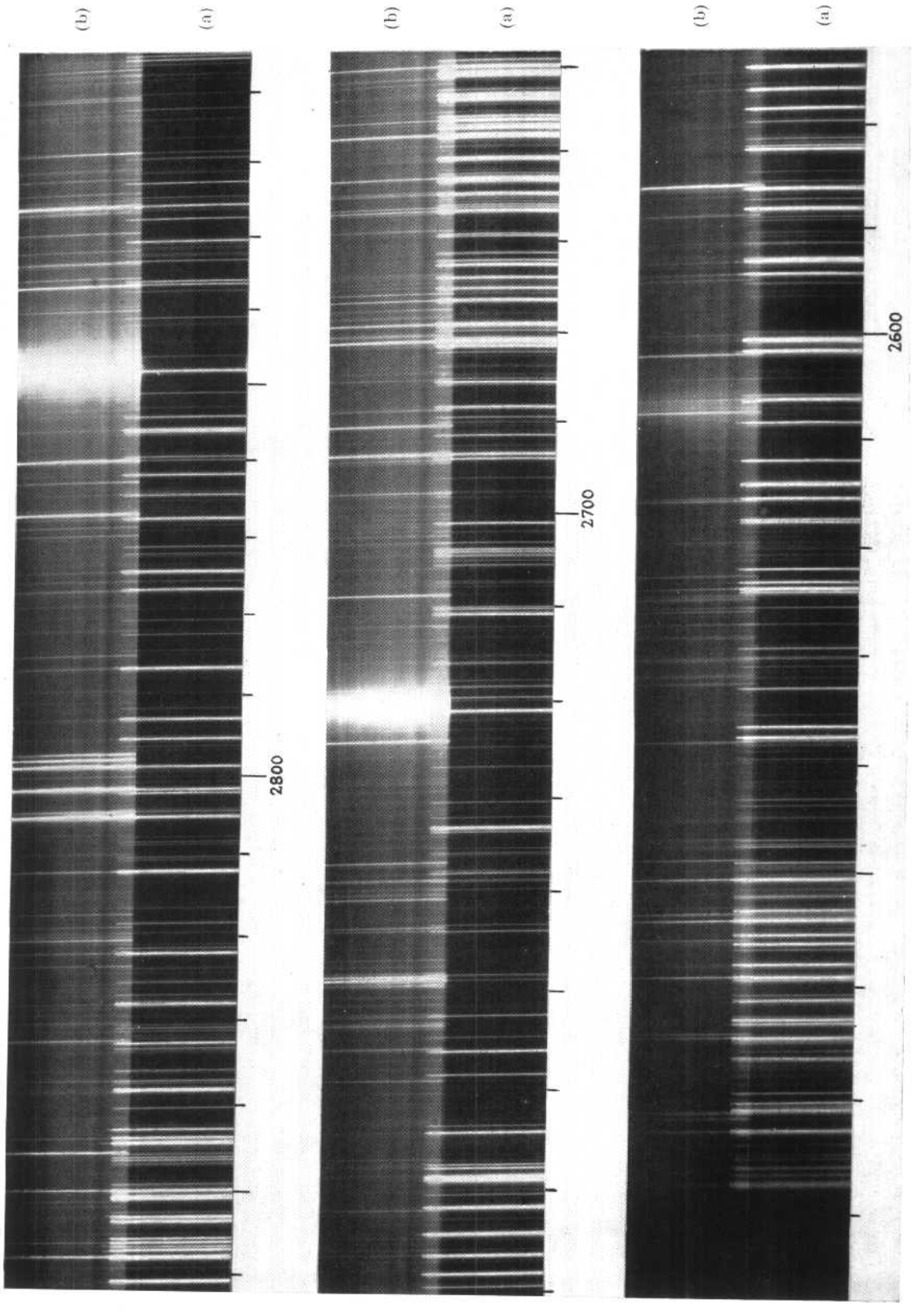

PLATE VIII
(a) Iron ; (b) Mixture

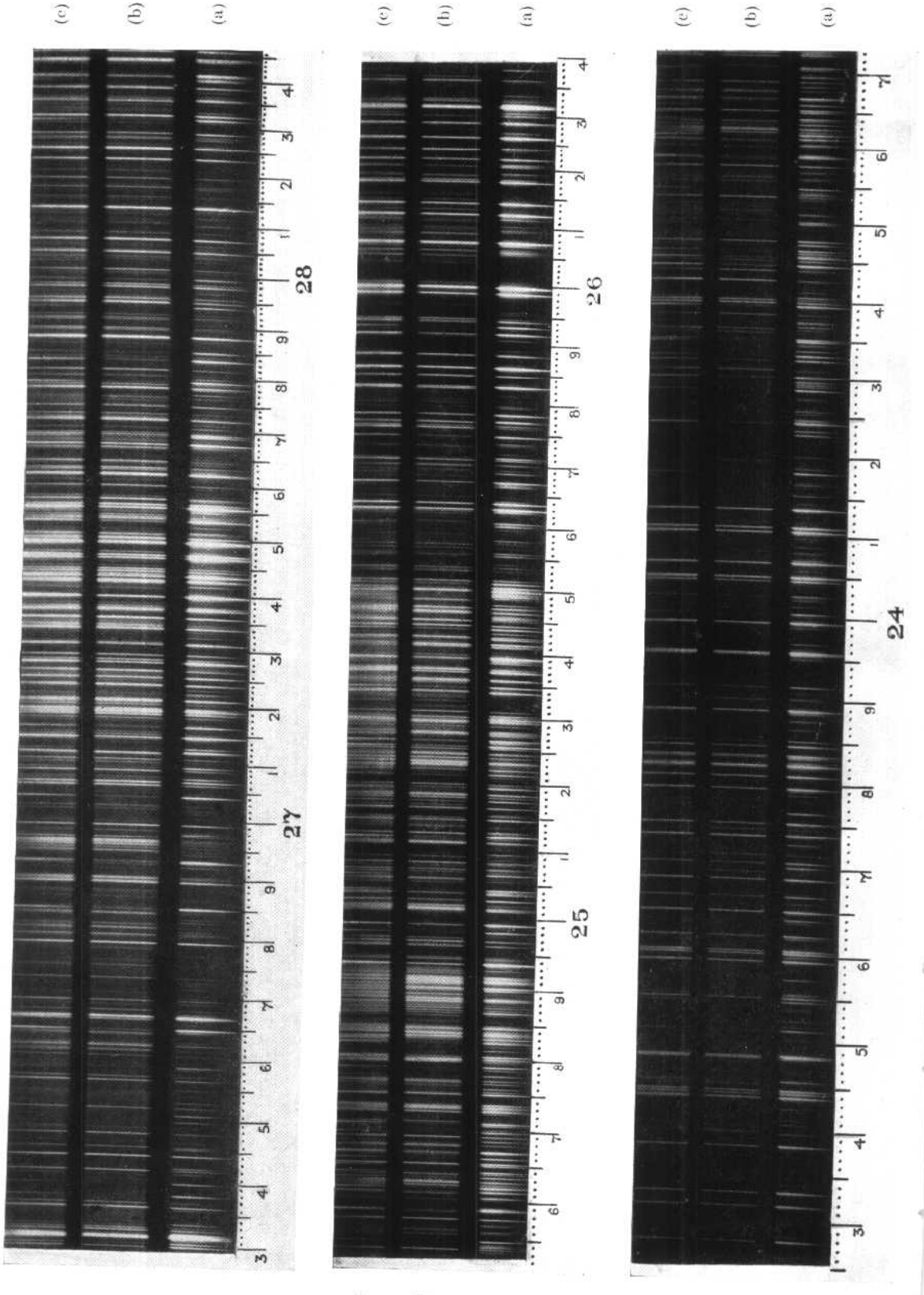

PLATE IX—IRON ARC
(a) Positive Pole ; (b) Centre of Arc ; (c) Negative Pole

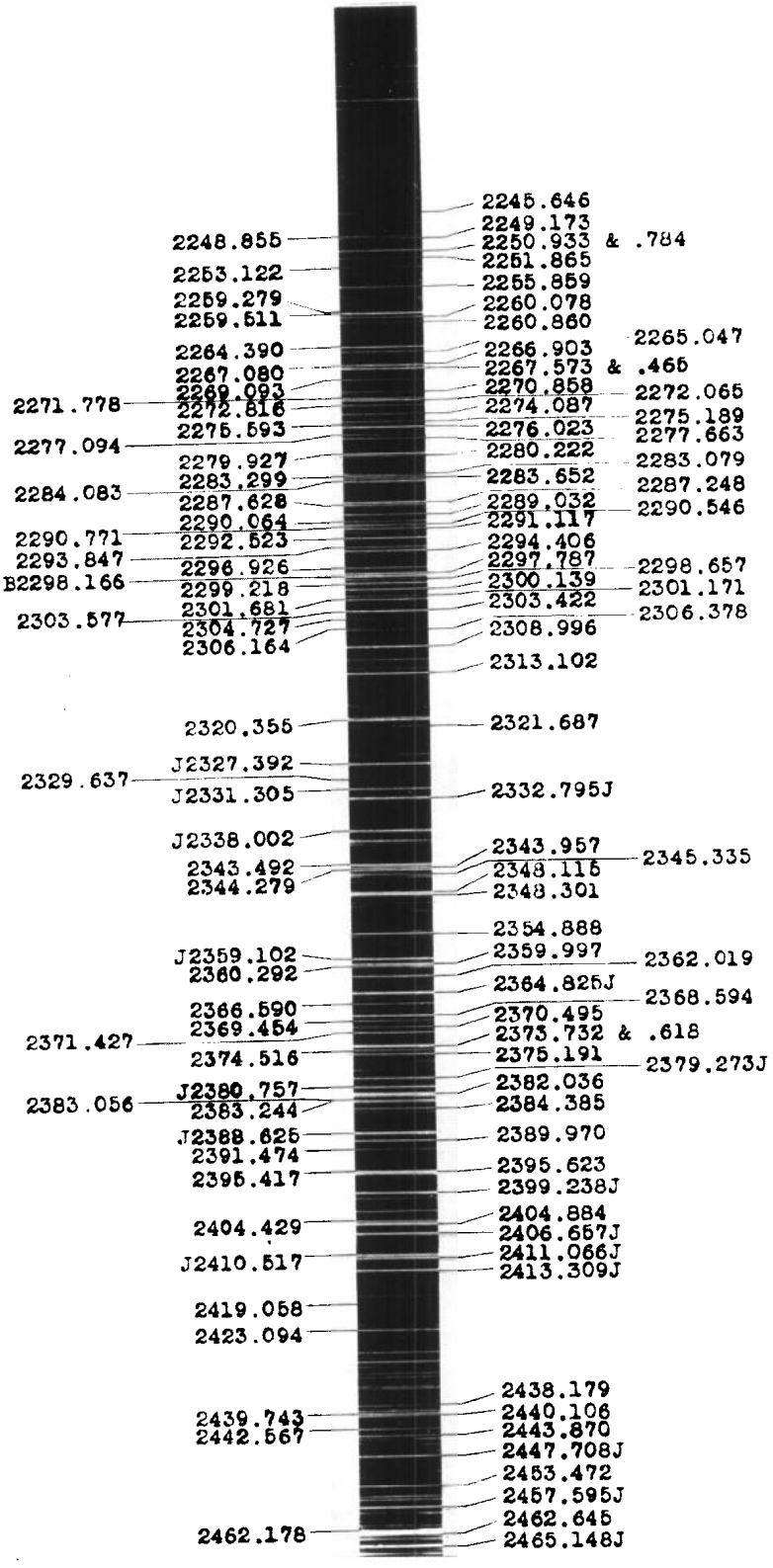

PLATE X
Iron Arc Spectrum

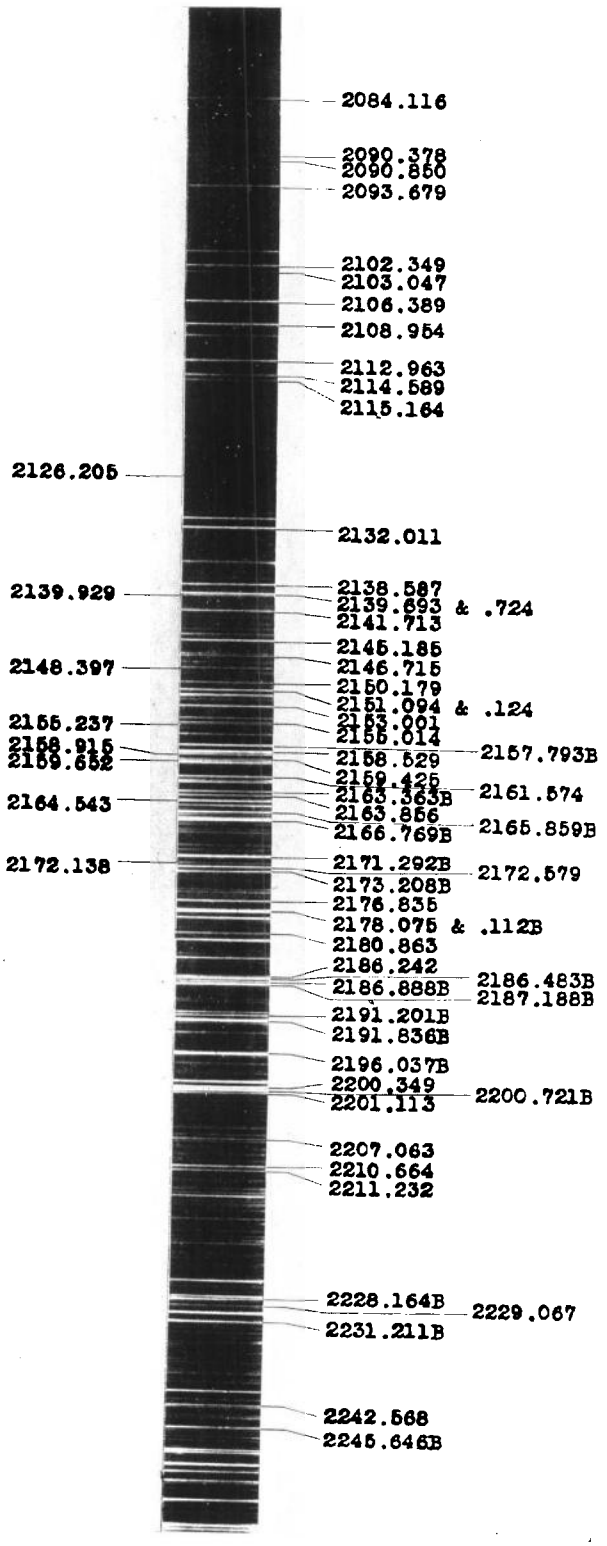

PLATE XI
Iron Arc Spectrum