

INTRODUCTION TO THE RARER ELEMENTS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649088195

Introduction to the rarer elements by Philip E. Browning

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

PHILIP E. BROWNING

**INTRODUCTION TO
THE RARER
ELEMENTS**

INTRODUCTION
TO THE
RARER ELEMENTS.

BY

PHILIP E. BROWNING, PH.D.,
*Assistant Professor of Chemistry, Kent Chemical Laboratory,
Yale University.*



SECOND EDITION, THOROUGHLY REVISED.

FIRST THOUSAND

NEW YORK:
JOHN WILEY & SONS.
LONDON: CHAPMAN & HALL, LIMITED.
1908.

3500

Copyright, 1903, 1908.
BY
PHILIP E. BROWNING.

The Scientific Press
Robert Drummond and Company
New York

PREFACE TO THE SECOND EDITION.

DURING the five years that have elapsed since the appearance of the first edition of this book, the chemistry of the rarer elements has undergone no small measure of development. In that division of the field known as the rare earths, Dr. C. Richard Böhm's *Darstellung der seltenen Erden*, in two volumes of about five hundred pages each, has given to chemists some conception of the mass of work which, up to that time, had been done; and since the publication of those volumes the activity along this line has not abated. During the same period the study of the radio elements has developed a well-defined department of research, and the rare metals vanadium, tungsten and tantalum have become important members of the chemical family on account of their technical applications. These examples illustrate the recent advances which demand recognition even in a handbook of small compass.

In presenting this edition the author makes grateful acknowledgment to Dr. B. B. Boltwood of Yale University for his contribution of the chapter on Radio Elements, to Dr. C. L. Parsons of New Hampshire College for kindly suggestions regarding the revision of the chapter on Beryllium, to members of the author's recent classes in the rarer elements for their experimental work leading to the selection of separation methods, to the critics of the first edition for useful hints, and to his wife for much painstaking work upon the preparation of the manuscript for publication.

NEW HAVEN, Conn., October, 1908.

iii

PREFACE TO FIRST EDITION.

THIS small volume, prepared from material used by the author in a short lecture course given at Yale University, is intended to serve as a convenient handbook in the introductory study of the rarer elements; that is, of those elements which are not always taken up in a general course in chemistry. No attempt has been made to treat any part of the subject exhaustively, but enough references have been given to furnish a point of departure for the student who wishes to investigate for himself. Experimental work has been included except in the case of those elements which are unavailable, either because of their scarcity or because of the difficulty of isolating them.

The author has drawn freely upon chemical journals and standard general works. In his treatment of the rare earths he has made especial use of Herzfeld and Korn's *Chemie der seltenen Erden* and Truchot's *Les Terres Rares*, works which he gladly recommends. He gratefully acknowledges the valuable assistance of his wife in preparing this material for the press.

NEW HAVEN CONN., April, 1903.

TABLE OF CONTENTS.

CHAPTER	PAGE
I. THE ALKALIES	1
II. BERILLIUM	17
III. THE RADIO ELEMENTS	25
IV. THE RARE EARTHS	35
V. GALLIUM, INDIUM, THALLIUM	82
VI. TITANIUM, GERMANIUM	96
VII. VANADIUM, NIOBIUM, TANTALUM	107
VIII. MOLYBDENUM, TUNGSTEN, URANIUM	125
IX. SELENIUM, TELLURIUM	144
X. THE PLATINUM METALS, GOLD	161
XI. THE RARE GASES OF THE ATMOSPHERE	190
XII. TECHNICAL APPLICATIONS	196
XIII. QUALITATIVE SEPARATION	202