

**DESTRUCTIVE DISTILLATION: A
MANUALETTE OF THE PARAFFIN,
COAL TAR, ROSIN OIL,
PETROLEUM, AND KINDRED
INDUSTRIES**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649314225

Destructive distillation: a manualette of the paraffin, coal tar, rosin oil, petroleum, and kindred industries by Edmund J. Mills

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Cover @ 2017

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DESTRUCTIVE DISTILLATION:

A MANUALETTE

OF THE

PARAFFIN, COAL TAR, ROSIN OIL, PETROLEUM,

AND

KINDRED INDUSTRIES.

BY

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Ex fumo dare lucem.
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LONDON:

JOHN VAN VOORST, PATERNOSTER ROW.

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MDCCLXXVII.

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LONDON:
HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY,
ST. MARTIN'S LANE.

P R E F A C E.

DESTRUCTIVE distillation is a very ancient industry, whose intricate and numerous problems have been from time to time investigated by the ablest chemists. Its study has thus had a prominent influence in developing the science of Chemistry.

This little book is the first to present as a whole the industry of destructive distillation. Its contents are the substance of a course of lectures delivered in Anderson's College, Glasgow, in 1875-76, and illustrated by actual inspection of many of the processes to which it refers. Students will profit most from its perusal who have such illustration at command; and manufacturers will, it is hoped, be interested in the modern principles of the science that underlies their processes, and reap some advantage from learning how others treat the very same problems that are presented to themselves.

The author begs to express his sincere thanks to the managers of works and other friends who with much kindness, and sometimes with much trouble, have contributed to his information on this important subject.

"YOUNG" LABORATORY OF TECHNICAL CHEMISTRY,
ANDERSON'S COLLEGE, GLASGOW.
November 1st, 1877.

DESTRUCTIVE DISTILLATION.

GENERAL CONSIDERATIONS.

1. DESTRUCTIVE distillation is the decomposition of a substance in a close vessel, in such a manner as to obtain liquid products.

By a *product* is meant a body not originally present in the substance distilled. A body merely extracted without change by distillation is termed an *educt*. Manufactured ozokerite consists in part of educts from the native mineral, but this is an almost singular case in the industry of destructive distillation.

2. If an extended list of substances volatile without decomposition be examined, it will be found that the numerical values of their chemical symbols, or formulæ, are, on the whole, comparatively low; while bodies that do not volatilise without decomposition have, on the whole, a comparatively high symbolic value. These laws are both comprised in the more general one—that chemical activity increases on the whole with symbolic value.

3. The apparatus employed in destructive distillation consists essentially of a *retort*, followed by a *condenser* and a *receiver*. The substance to be operated on is placed inside the retort, to which heat is applied; the volatile products pass over and are condensed in long straight or helical tubes, which are kept more or less cooled. The average contraction, from heated vapour to liquid, may be taken at about 1000: 1. The retort or still has various

forms, and may be set either in a horizontal or vertical position; in the latter case the bottom may consist of water. Its material may be glass, iron, clay, or brick. Heat is applied directly either to the sides or bottom, or both; or superheated steam alone may be driven in at one end. Steam of varied initial temperature, and direct heat, are sometimes used together.

4. The nature of the products depends (a) on the composition of the substance heated; (b) on the degree of heat applied; but (c) not to any serious extent (on the large scale) on the material of the retort.

(a.) If an organic substance contain much infusible mineral matter (as, for instance, in the case of ordinary bituminous shale, which contains a great deal of aluminic silicate), the latter will hold down the former, and compel recourse to a higher temperature. Thus gum-benzoin, when distilled alone, yields benzoate; when mixed with sand, it furnishes benzol. In cases of this kind, the fine state of division or porosity of the earthy constituent contributes, with the higher temperature, to a change in the nature of the prevailing reaction. Thus, the later products in the preparation of coal tar consist in part of dehydrogenated fatty hydrides.

The presence of chlorine, sulphur, oxygen, nitrogen, and hydrogen, in carbon compounds, gives rise to chlorides, sulphides, oxides, etc., in the distillate. Oxides generally precede hydrides in the condenser, as is strikingly seen in the destructive distillation of wood. Excepting plants known as *Cruciferae* and the like, animal compounds give the most highly sulphurised distillate.

5. (b.) The nature of the decomposition which takes place on heating, is indicated by the term *cumulative resolution*. Instances of this are very common in inorganic chemistry. Thus, three units of manganic dioxide decompose in

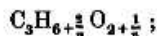
partnership, yielding a unit of trimanganic tetroxide and a unit of oxygen;



When glycerin is heated, polyglycerins are formed by the union of n units of glycerin, which lose $(n-1)$ units of water;



This last expression, when divided by n , becomes—



so that the ultimate stage of this accumulation, when n becomes indefinitely great, must be a polymer of glycide, $C_3H_6O_2$. Pursuing the same course with glycide, &c., we have the following table of results:—

Glycerin Alcoholoids.	.. ..	Extreme Accumulation.
$C_3H_8O_3$	.. ..	$nC_3H_6O_2$
$nC_3H_6O_2$	.. ..	nnC_3H_4O
nnC_3H_4O$	.. ..	nnnC_3H_2$

The above mode of resolution is common to all poly-alcohols. In the important case of woody fibre (whose minimum formula is $C_6H_{10}O_5$) we have the two series—

Cellulose Alcoholoids.	.. ..	Extreme Accumulation.
$C_6H_{10}O_5$	.. ..	$nC_6H_8O_4$
$nC_6H_8O_4$	.. ..	$n^2C_6H_6O_3$
$n^2C_6H_6O_3$	.. ..	$n^3C_6H_4O_2$
$n^3C_6H_4O_2$	.. ..	$n^4C_6H_2O$
$n^4C_6H_2O$	.. ..	n^5C_6

In this manner, we eventually arrive at carbon as the result of retort operations upon wood; the gentler process of nature furnishes coal.

The preceding theory is practically modified by the law of decomposition already given. The numerical values of