CLINICAL TOXICOLOGY

THE CLINICAL DIAGNOSIS AND TREATMENT OF POISONING

S. LOCKET, M.B., B.S., M.R.C.P. (*London*)

with Special Sections by

W. S. M. GRIEVE, M.Sc., Ph.D., F.R.I.C.

and **S. G. HARRISON,** B.Sc.

CLINICAL TOXICOLOGY

The Clinical Diagnosis and Treatment of Poisoning

by

S. LOCKET

M.B., B.S., M.R.C.P.(London)

Senior Physician, Oldchurch Hospital, Romford, Essex.
Physician-in-Charge N.E. Metropolitan Regional Barbiturate Unit, Oldchurch Hospital, Romford, Essex

With special sections
on
THE IDENTIFICATION AND ESTIMATION OF SOME COMMON TOXIC SUBSTANCES

by

W. S. M. GRIEVE

M.Sc., Ph.D., F.R.I.C.

Biochemist, Oldchurch Hospital, Romford, Essex

and
THE IDENTIFICATION AND BOTANICAL CHARACTERISTICS OF SOME OF THE MORE FREQUENTLY ENCOUNTERED POISONOUS PLANTS

by

S. G. HARRISON

B.Sc.

Senior Scientific Officer, Royal Botanic Gardens, Kew, England

With 27 illustrations, including 2 coloured plates

LONDON
HENRY KIMPTON
1957

Made and Printed in Great Britain

To Margery, Gillian and Virginia.

PREFACE

Most books have a preface, and the reasons for this would appear to fall into four groups.

Initially—and this book is no exception—the writer gives his reasons for writing the book (and often his apologies), indicating at the same time for whom the book is intended, explains how best to use the book, and finally thanks all those who have helped in making the book possible.

My reasons for writing this book are relatively simple. A modern book covering this section of clinical practice was a necessity. Since such a book did not in fact exist it became necessary to write one. There are practically no books on clinical toxicology written by physicians in active clinical practice. Sections on toxicology in various textbooks or tomes on toxicology by laboratory workers, biochemists, pharmacologists, public health officers, pathologists and forensic pathologists are frequent. When the author deals with the subject in which he is trained, these books are often invaluable and have a definite place in the subject of toxicology. The majority of these writers have never treated a sick patient and certainly not in the past few decades, yet most of them advise on treatment. Many of these writers do not even possess a medical qualification, yet all advise on the best treatment for poisoning.

Unfortunately, the treatment of a patient in practice (like all other highly skilled technical procedures) is far different and far more difficult than a few casual words written in a book or journal. The correct treatment of the sick requires considerable clinical experience over and in addition to book knowledge, and the most effective treatment for any condition can only be decided by a clinician who has experienced the disappointments and successes that clinical practice can produce. On the other hand, there must be very few clinicians who have had the opportunity of treating any considerable number of cases of poisoning, and therefore of obtaining the requisite experience derived therefrom.

The unit under my care is primarily concerned with the treatment of poisoning by the barbiturates and sedative drugs. We also admit from a wide area, and treat, a vast number of cases of poisoning of many different kinds which are sent to us in view of our known interest in this subject. Our situation in the centre of a highly industrialized district also enables us to both see and treat, in addition, many cases of industrial poisoning. As a result our experience in the field of clinical toxicology is almost unique. In addition, members of this unit are always on call, day and night, to advise doctors who telephone

us requesting advice on the emergency treatment of poisoning cases in their care. Since all patients admitted to my poisoning unit are treated side by side with acute general medical cases and by the same team of doctors, we can certainly say that poisoning cases in our care are treated basically on the same lines and by the same methods as are used in current standard medical practice. Dubious methods of treatment, almost approaching witchcraft, are just as out of place in clinical toxicology as they are in normal medical therapeutics.

We here are only too pleased not only to help in the treatment of poisoning cases at all times, but we are also always willing to receive information on poisoning. A telephone call to the Medical Registrar or Registrar-on-call for the Poisons and Barbiturate Unit, Oldchurch Hospital, Romford, Essex (available twenty-four hours a day), will always elicit advice and help in any emergency. Information on cases of poisoning will always be welcome, and preferably should be sent by mail to Dr. S. Locket, Senior Physician, Oldchurch Hospital, Romford, Essex, England. Information given should be as full as it is possible to give. Ideally it should state date and time of poisoning episode, age and sex of victim ; whether accidental, suicidal or homicidal ; name or nature of poison or toxic agent, quantity taken (if known) and how taken or given (e.g. inhalation, ingestion, injection) ; date and time of onset of symptoms, order in which symptoms occur and their duration, all biochemical and other clinical and laboratory information available ; treatment given, when treatment was instituted and how long it was continued, and the eventual outcome of the poisoning episode. If death should have occurred any autopsy information would be of great value. If poisoning has been brought about by a root, seed, fruit or berry or plant, then, if available, a specimen of the plant in question (or as much of it as possible) would be of great help.

The prevention of industrial poisoning, which is essentially a hygienic measure, is not dealt with in this book, as it is quite a separate field of toxicological practice. This book is primarily designed to help the clinician in the diagnosis of causes of poisoning and in their treatment. For this purpose the book is divided into three main parts. All treatment given is described both in Part I where it relates to each system which may be involved, and in Part II, where it is described for each individual toxic agent or group of agents.

The first chapter in the book is an introduction, and here I have given some information and statistics on poisoning. Further information of this kind will also be found under the various toxic agents in other chapters.

Part III consists of two sections which have been especially written for this book by two experts in these subjects. With the information given in these two chapters the ordinary hospital laboratory should be

able to identify and estimate some common toxic substances, and also probably identify some of the more frequently encountered poisonous plants and seeds.

The several parts of the index have been designed expressly to make certain desired information immediately available. The " Treatment Index " should be used whenever emergency treatment of poisoning is required. The page number given in the index here indicates the pages where we give a detailed account of treatment for the condition or intoxication in question. The titles of the other indices are self-explanatory.

In addition to its use as a therapeutic source, we hope that the information which has been collected in this book will make it of value to many non-medically qualified workers whose work overlaps the field of clinical toxicology. We had in view law officers, pharmacologists and pharmacists as well as medical students.

I would like to express my thanks to my collaborators for their excellent contributions, and also for the patience they have shown in awaiting the completed manuscript.

I am most grateful to my secretary, Mrs. E. D. Price, for the enormous amount of laborious typing which she has carried out on the manuscript before it could be completed, to Mr. J. Lumley and Riker Laboratories for their help in drawing so efficiently from my rough sketches all the graphs figured in Chapter I, to Mr. E. A. Sheppard, the photographer of Oldchurch Hospital, Romford, who has taken all the photographs illustrated in this book, and to my collaborator, Dr. W. S. M. Grieve, with whom most of the problems in the laboratory diagnosis of many poisoning cases have been discussed and argued over in detail. I am grateful too to those thousands of clinicians whose labours, both recorded and anonymous, make up the core of medical practice round which this work has been written and who have in essence provided me with much of the material of this book. I am particularly grateful to the police force in this area, as well as all those medical practitioners who have referred their cases of poisoning to me or discussed the treatment of such cases with me. Above all, I am grateful to the large number of doctors, far too numerous to mention individually, who during the past thirteen years have worked with me and for me in this field of clinical work. My thanks are also due to the Editors of *Medicine Illustrated* for allowing me to quote tables and graphs from one of my articles on barbiturate poisoning which appeared in that journal, to the Editor of the *Lancet* for the loan of the block for the illustration showing lens changes in mercury poisoning from my article in the *Lancet* on this subject, and also to the Oxford University Press for allowing me to quote the paragraph which will be found at the head of the ninth chapter from the book written by Adams in 1937 on drug addiction ; to the Council of the Royal Society of Medi-

cine and to the Editors of the *Proceedings* for permission to publish Table XI : 1 (p. 210) from a paper of mine on barbiturate poisoning ; to the Council of the American Medical Association for permission to use the section on picrotoxin in their handbook, " New and Non-Official Remedies, 1956 " ; to Dr. Kent-Jones as senior author of the communication of a panel of analysts of the Royal Institute of Chemistry and the Editor of the *Analyst* for quoting from the article on the determination of alcohol published in the *Analyst* in 1954, and also for the loan of the blocks for the figures reproduced on pp. 646 and 648 ; and to the Council of the British Medical Association for permission to quote from their publications of 1927 and 1954 on the " Recognition of Intoxication " and " Tests for Drunkenness." Other acknowledgements are given fully elsewhere in the text. Finally, and not least of all, I would like to thank my publishers for their encouragement, and great patience over every delay.

S. LOCKET.

KENT.
December, 1956.

TABLE OF CONTENTS

PART III

SPECIAL SECTIONS ON IDENTIFICATION OF POISONS AND POISONOUS PLANTS

CHAPTER I

INTRODUCTION

Some Facts and Figures

THOUGH when compared with sickness and death produced by "natural causes," sickness and death caused by poisoning seems relatively unimportant, we should remember that these latter cases must be considered as preventable. If, however, we were to add to this comparatively small figure the number of cases which occur of "poisoning" due to alcohol in all its wide ramifications and in all its stages, we would get a massive figure. However, estimates of the number of alcoholics based on carefully carried out statistical studies would only seem to be available for Switzerland, where the figure given is 50,000 in 1947, and for the U.S.A., where in 1948 it was stated to be about 952,000 (see Table I : VI). Since the actual extent of alcoholism is almost invariably under-estimated by the health ministries and public health authorities of most countries, most figures given are mere guesswork. It has been estimated that in many countries the number of adult males with alcoholism in need of treatment out-numbers by several hundred per cent those in need of treatment for tuberculosis.

Our figures for cases of "poisoning" have by now reached quite a gigantic size. Were we to now add to this number the cases of opium, hashish or marihuana and other addictions (not forgetting the barbiturate habits of the Occident) we would then be seeing "toxicology" in its more correct relationship to other ills.

Not only are deaths due to poisoning caused by carelessness and ignorance in their widest sense, they are also unfortunately a sign of civilization. Modern times and modern progress makes available to all of us, and unfortunately at all ages, a multitude of simple and effective means of self-destruction. It is more than likely that the annual global injury and number of deaths due to poisoning (excluding alcohol, hashish, opium and other addictions) exceeds by far the destruction which would be caused by an annual atomic bomb explosion in a heavily built-up area. In England and Wales alone in 1953 there were 2,888 suicidal poisoning deaths (2,324 being due to carbon monoxide, coal gas and illuminating gas) and 932 accidental poisoning deaths (635 being due to carbon monoxide, coal gas and illuminating gas).

From information in our possession it would seem that in England, Wales and Scotland hospital admissions for poisoning now make up 0·35%–1·0% of all admissions into the large general non-teaching

hospitals. In rural areas the lower rate applies, whereas urban areas have figures approaching (and on occasions exceeding) the higher rate. Around 2%–4% of medical admissions may be due to this cause, and up to 1% of pediatric admissions.

The persistent problem of this half-century is the ease with which children (particularly between the ages of 1–5 years) can obtain lethal substances. In our personal experience during the last five years, almost 40% of all cases of poisoning (excluding poisoning by the barbiturate group of drugs) accepted for treatment are children under the age of 5 years (see Fig. 6).

In England and Wales in the nine years 1931–39 seventy-four boys and fifty-six girls under 15 years of age died of acute accidental poisoning (other than by toxic gas), and in the following ten years to 1949 another 161 boys and 116 girls. Aspirin poisoning increased fourfold, ferrous sulphate sixfold, and methyl salicylate almost fourfold between these periods. In each period 79% of all child deaths occurred in children aged from 1 to 5 years (Registrar-General, 1954).

Whereas iron preparations in our particular region account for 5% of all admissions for poisoning in children under the age of 5 years

TABLE I : I

Table of Causes of Acute Accidental Deaths of Children by Poisoning, but excluding Deaths caused by Toxic Gases

(Based on the Registrar-General's Returns for the years 1940–49)

Cause	Under 5 Years of Age	5–15 Years of Age
Aspirin and salicylates (22 preparations containing methyl salicylate)	35	2
Iron-containing preparations	21	—
Strychnine preparations	15	—
Quinine	13	—
Caustic soda and caustic potash	13	—
Carbolic, Lysol and " Phenol "	11	2
Phosphorus (including rat poison)	11	—
Corrosive acids (including acetic acid)	11	2
Kerosene, paraffin and petrol	8	1
Opium and morphine	8	—
Barbiturates	7	2
" Liniments " (5 containing camphor)	7	—
Atropine and " nightshades "	6	2
Ammonia	5	1
Nicotine	4	—
Potassium permanganate	4	—
Amanita phalloides and poisonous fungi	1	4
Hemlock (*Conium maculatum*)	1	4
Remainder	64	20

(excluding barbiturates), from the Registrar-General's figures they make up 9·1% of all poisoning deaths in England and Wales under the age of 5 years (excluding barbiturates). Poisoning by ingestion of iron tablets would seem to vary from area to area. In Scotland FRASER and CRAIG (1953) give an incidence of over 10·5% of all admissions for poisoning under 5 years of age.

We note that coal gas is rarely the cause of a " live " admission for poisoning under 5 years of age, whereas it makes up about 25% (32% in 1953, 22% in 1952, 25% in 1951, 13% in 1950, 32% in 1949, 44·4% in 1946, and 35% in 1941) of all poisoning deaths under 5 years of age, i.e., deaths due to toxic gases as well as ingested poisons. (The figures given in Table I : I exclude the toxic gases.)

On the other hand, the group " kerosene, paraffin and petrol " makes up 16% of poisoning cases admitted in our area under the age of 15 years, yet only makes up 3·3% of acute poisoning deaths under the age of 15 years (excluding barbiturates).

Similarly, " Atropine and nightshade plants and berries " as a cause of poisoning make up 15% of cases of poisoning admitted under the age of 5 years (excluding the barbiturates), yet account for only 2·9% of the accidental poisoning deaths of children under 15 years of age (excluding the barbiturates) in the Registrar-General's figures for the years 1940–49, or for 2·4% of the poisoning deaths of children under 5 years of age (excluding barbiturates).

HOLZEL and JAMES (1951) and SWINSCOW (1953) both emphasize the fact that most of the deaths occurring in children between the ages 1–5 are due to medicaments, primarily because children emulate adults rather than because they like the flavour of many of these brightly coloured and often pleasant-coated or flavoured preparations. Nevertheless, in many cases an unpalatable preparation could dissuade a child, whereas with a tablet looking like a " sweet " it might be tempted to taste it, and if it tastes like a sweet it will be readily ingested. SWINSCOW (1953) would also favour the view that the actual number of deaths from poisoning (and presumably therefore incidence of poisoning) is not definitely increasing. The average annual death rate for 1940–49 was 8·7 per million children aged 1–4 years—though 1945 and 1947–49 had rates slightly above the figure. What is in fact occurring is an alteration in the varieties of poisoning in accordance with our current therapeutic and other changes. Thus in the years 1950–51 there were 15 deaths from iron tablets, 14 deaths from antihistaminics, 10 due to strychnine, 6 from aspirin, 5 from methylsalicylate and 2 from Amidone—these already showing a noticeable alteration in drugs ingested from those given in Table I : I for the years ending in 1949. On the other hand, though agreeing with this latter view as to the changing pattern, FRASER and CRAIG (1953) consider that there is a real increase since 1948 in medicinal

agents as a cause of poisoning in children, but not so marked an increase in poisoning by " domestic and household " substances. They point out that in this age group deaths from poisoning fell from 1915 to 1935, but the rise in recent years has resulted in a total figure almost equalling the total in 1915.

Though at all ages coal gas, including carbon monoxide, remains the commonest single cause of *death by poisoning*, it is, however, now far from being the commonest cause of *poisoning*. The honour of holding this eminent place now belongs to the barbiturate group of drugs.

TABLES I : II (A), (B) AND (C)

	(A)	(B)	(C)
	Table of frequency of poisons in common use, based on *live* hospital admissions (excluding the barbiturates) All ages	Table showing relative percentage frequency of admissions of poisoning cases under 5 years of age during 1946–51 in Scotland (After FRASER and CRAIG, 1953)	Showing relative frequency of live admissions of cases of poisoning under 5 years of age General hospitals—outskirts of London)
Aspirin and salicylates	25%	7%	14%
" Coal gas " and carbon monoxide	22·5%	—	—
Atropine and " nightshade " plants	6%	12% *	11% *
Kerosene, paraffin, petrol	7%	6% (+ 6%) †	11% (+ 3%) †
Corrosive acids and alkali	6%	4% ‡	7%
Phenol and lysol	3%	6% §	9%
Amphetamines	3%	—	3%
Ephedrine and adrenalin	3%	—	—
Tab. cod. co.	3%	—	—
Ferrous sulphate and " iron tablets "	2%	10%	3%
Antihistaminics	2%	—	3%
Amidone, morphine, pethidine	2%	—	3%
Camphor	—	5%	3%
Barbiturates	—	15%	15%
Bleach	—	8%	3%
Remainder	15·5%	21%	12%

KEY TO TABLES I : II (B) AND I : II (C)

* Vegetable Group.
† Turpentine.
‡ Ammonia.
§ Disinfectant.

The above Tables I : II (A) and I : II (C) are based on the major poison taken or absorbed. In many adult cases, where suicide is the motive (these make up more than half the cases on which the tables are based), more than one toxic agent is taken (about 10% of cases)—this

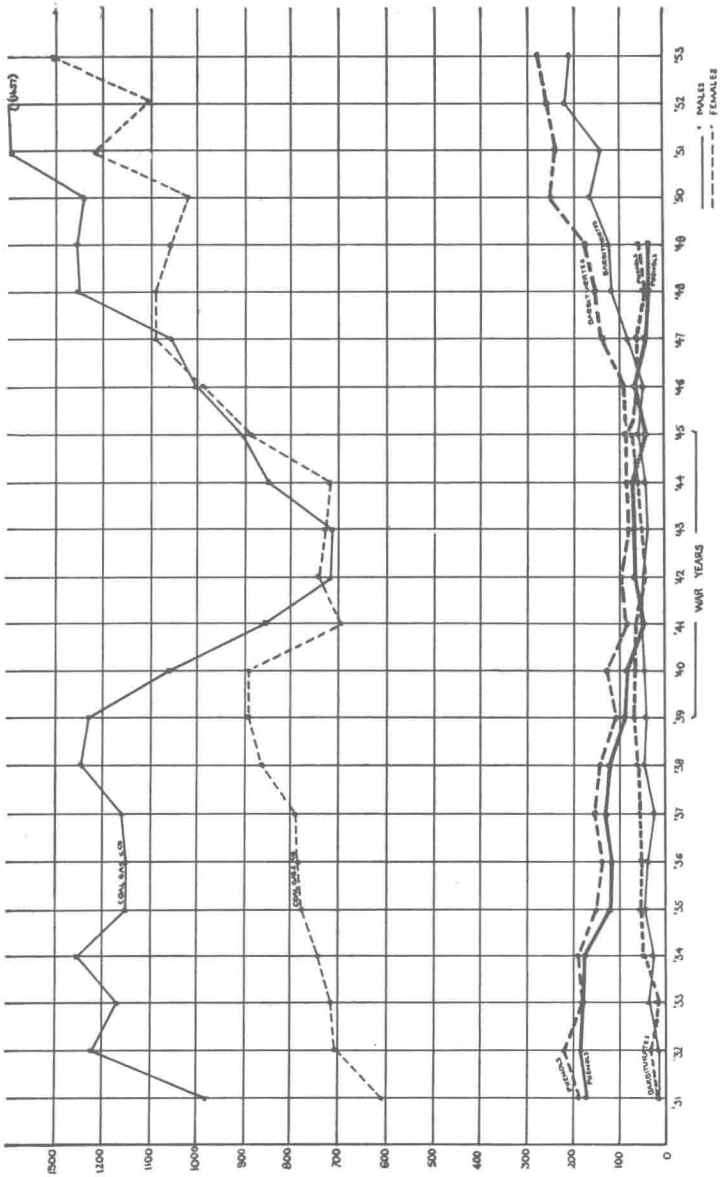

FIG. 1. Annual number of deaths from coal gas, illuminating gas and carbon monoxide, phenols, and barbiturates in England and Wales. (Compiled from Registrar-General's tables.)

is usually in association with aspirin or coal gas or a barbiturate. The Tables I : II (A) and I : II (C) are derived from patients admitted "alive" into a general hospital (since 1947) (OLDCHURCH HOSPITAL, ROMFORD) and do not include alcoholism in any of its manifestations, e.g. acute intoxication or delirium tremens. Many cases of coal-gas poisoning are dead (i.e. die in transit) before arrival at hospital, and therefore would not be included when compiling this

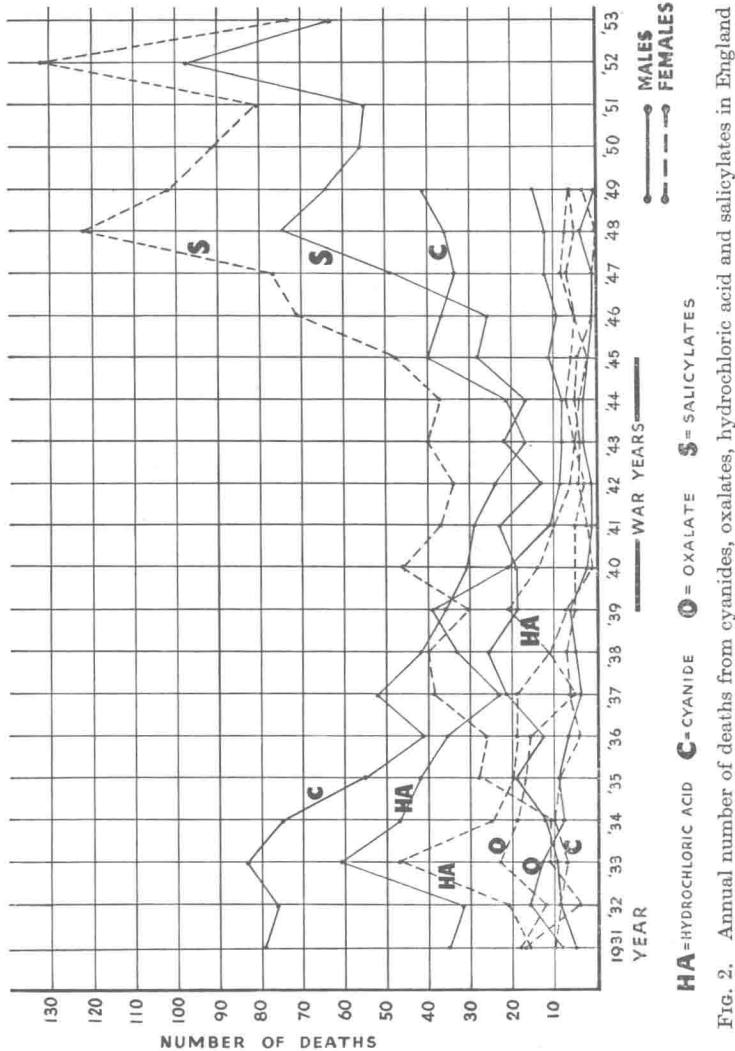

FIG. 2. Annual number of deaths from cyanides, oxalates, hydrochloric acid and salicylates in England and Wales. (Compiled from the Registrar-General's tables.)

table. In our experience these deaths before arrival do not occur with any other agent, i.e. the patient is either dead at home or is alive on entry to hospital.

Table I : II (A) is based on patients who are alive on admission and excludes the barbiturates. If these are taken into consideration, then aspirin makes up 15% (in most general hospitals barbiturates are now about three times as common as salicylates as a cause of poisoning), and coal gas 13%, of cases of poisoning admitted *alive* to hospitals. Table I : II (C) is based on admission under the age of 5 years admitted alive to hospital, but, however, includes barbiturate admission of this age group.

Figs. 1 and 2 give the actual number of deaths in England and Wales since 1931 caused by some of the more common poisons.

Deaths from Poisoning (Accidental and Suicidal) caused by Barbiturates (Veronal, Medinal and Barbitone) in England and Wales prior to 1926

(Registrar-General's Office for England and Wales)

	Males	Females		Males	Females
1907 . . .	1	—	1917 . .	8	7
1908 . . .	4	—	1918 . .	6	6
1909 . . .	6	7	1919 . .	3	3
1910 . . .	9	6	1920 . .	3	2
1911 . . .	8	11	1921 . .	3	4
1912 . . .	12	4	1922 . .	3	3
1913 . . .	14	12	1923 . .	7	1
1914 . . .	12	18	1924 . .	4	3
1915 . . .	14	10	1925 . .	7	14
1916 . . .	5	5			

TOTAL : Males 129
Females 116

Figs. 3A, 3B contrast the age distribution for several years of the deaths due to coal gas (female) with a maximum at 55–65 years of age, and barbiturates (female), with a maximum of 45–55 years of age.

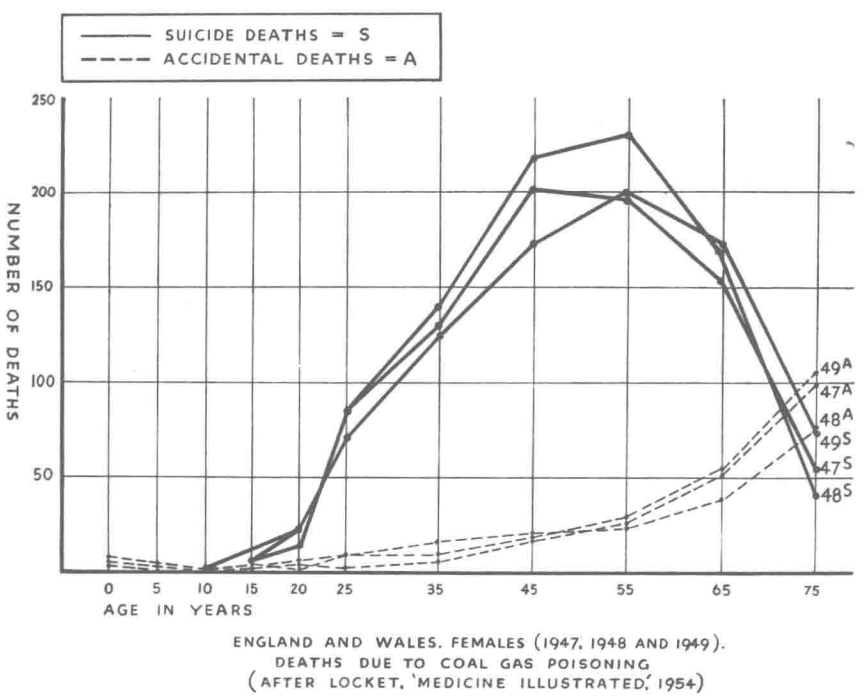

FIG. 3A. Deaths due to coal gas poisoning, to show distribution by age.