

Indian Journal of
Radiology

May - 1962

52
2:4:625m2, N47
N62.16.2
124042

66 26 58 10 858 2-62 MAY, 1962

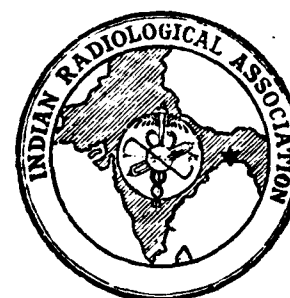
Vol. XVI, No. 2

THE Indian Journal of Radiology

The Official Journal of the Indian Radiological Association

EDITOR

A. N. K. MENON



159
EDITORIAL SECRETARY

L. R. PARTHASARATHY

CONTENTS

Editorial	...	i
Biophysics in Medical Radiology. Prof. BORIS RAJEWSKY (Sir Jagadish Bose Memorial Lecture)	...	65
Transverse Tomography in Diagnosis of Intrathoracic Lesions. S. R. SHARMA & N. G. GADEKAR	...	83
Intra-Cranial Calcification. B. DAYANANDA RAO, M. ANWER HUSSAIN & K. SUBBA RAO	...	95
Angiographic studies on renal circulation with Rauwolfia serpentina. S. P. BASU	...	104
Refresher Column. D. E. PATERSON	...	111
Abstracts	...	127

YEARLY SUBSCRIPTION (4 NUMBERS) Rs. 16/-

SINGLE NUMBER Rs. 4/-

INDEX TO ADVERTISERS

	PAGE
Agfa India Private Limited ...	4th cover
Allied Photographics Limited ...	iv
Central Camera Company Private Ltd. ...	94
Dey's Medical Stores Private Ltd. ...	vi
Escorts Limited ...	v
Glaxo Laboratories (India) Private Ltd. ...	ii
Hind Chemicals Limited ...	xiii
Ilford-Selo (India) Private Ltd. ...	iii
International General Electric Co. (India) Private Ltd. ...	viii
Khatau Valabhdas & Company ...	vii
Kodak Limited ...	104
May & Baker (India) Private Ltd. ...	i
Neo-Pharma (Private). Ltd. ...	xii
Philips India Limited ...	ix
Schering Asia G. m. b. H. Berlin ...	x
Siemens Engineering & Manufacturing Co. of India Ltd. ...	xi

When replying please mention the Indian Journal of Radiology

THE INDIAN JOURNAL OF RADIOLOGY

(QUARTERLY)

The official Journal of the Indian Radiological Association

Editor :

DR. A. N. K. MENON, Madras.

Editorial Board :

DR. L. H. ATHLE, Bombay

DR. Y. SIDIQ, Madras.

DR. O. P. BHARADWAJ, New Delhi.

DR. N. B. ROY, Calcutta.

DR. ASHOKE KUMAR MUKERJI, Calcutta.

Hon. Secretary-in-Charge :

DR. L. R. PARTHASARATHY, Madras.

THE INDIAN JOURNAL OF RADIOLOGY

OFFICIAL ORGAN OF

THE INDIAN RADIOLOGICAL ASSOCIATION

IMPORTANT ANNOUNCEMENT

*All communications to the Secretary-in-Charge,
Indian Journal of Radiology, may kindly be
addressed to :*

Dr. L. R. PARTHASARATHY, M.B.B.S., D.M.R.

63, Fisher Road

PERAMBUR

MADRAS-23

(Phone 61624)

OFFICE BEARERS
Indian Radiological Association
1962

President :

DR. K. B. MATHUR, Lucknow.

Immediate Past President :

DR. L. H. ATHLE, Bombay.

Vice-President :

DR. P. K. HAIDAR, Agra.

Hony. General Secretary :

DR. VED PRAKASH, New Delhi.

Hony. Treasurer :

DR. T. N. SHARMA, New Delhi.

Hon. Joint Secretaries :

DR. S. P. AGGARWAL, New Delhi.

DR. B. N. KHANNA, Kanpur.

Editor :

DR. A. N. K. MENON, Madras.

Secretary-in-Charge :

DR. L. R. PARTHASARATHY, Madras.

Central Council :

Members :

DR. S. P. BASU, New Delhi.

DR. R. C. GOULATIA.

DR. S. R. SAVUK.

DR. V. D. BHARGAVA.

DR. J. P. UDAWAT.

Branch Representatives :

DR. Y. SIDIQ.

DR. ARTHUR DANIEL.

DR. M. G. PURKAYASTHA.

DR. S. LAHIRI.

DR. N. G. GADEKAR.

DR. M. G. DESAI.

DR. G. C. SHARMA

Hony. General Secretary's Address :

Dr. VED PRAKASH,
 48, Hanuman Road, New Delhi-1.

THE
INDIAN JOURNAL OF RADIOLOGY

ADVERTISEMENT RATES

ORDINARY POSITION

159

One Page ... Rs. 100/- per insertion

Half Page ... Rs. 53/- „

★

SPECIAL POSITION

Facing Editorial — }
 Reading Matter and } ... 50% over and above
 Cover Pages 2-3-4 } the Schedule Rates.

★

DISCOUNT

A Series discount of 5% and 10% is allowed on contracts of
 6 and 12 insertions respectively.

★

COMMISSION

An Agency Commission of 15% is allowed on all orders
 booked by Advertising Agencies.

Advertising in The Indian Journal of Radiology will pay the
 Advertisers well. A trial order will prove the above fact.

EDITORIAL NOTICE

Articles offered for publications and other correspondence relating to the Editorial Management and books for review should be sent to the Editor Dr. A. N. K. MENON, "Gitanjali", 35, Albany Layout, Village Road, Nungambakkam, Madras-31. Original Articles are accepted with the understanding that they are contributed solely to the Indian Journal of Radiology.

The acceptance of a paper for publication in the Indian Journal of Radiology is at the discretion of the Editor. It is important to avoid matter, especially illustrations, which is not essential for the understanding of the paper. It is desirable that papers should not exceed 6000 words in length. Papers of exceptional merit which are longer than this may receive special consideration.

The Editorial Committee is not responsible for opinions expressed by authors whose papers are published in the Journal.

Manuscript: A clear and concise style should be adopted. The copy which should be typewritten and double-spaced in good quality paper should be carefully revised before submission. The address given in the title should be the author's present address to which correspondence can be directed, and acknowledgment of the Department or Hospital at which the work was carried out should be made if this is different from the address given in the main heading. Mathematical expressions should be set out clearly, using printed letters rather than script.

Drawings: Diagrams and graphs, including numerals and lettering, should be clearly drawn in Indian Ink on white cardboard. In general they will be so reduced as to have a horizontal dimension of three inches, and their size, thickness of line and lettering should allow for this reduction. The reproduction of graph paper, when used, requires the making of half-tone blocks. Only in exceptional cases will this be permitted. Colour drawings or colour photographs of pathological specimens are not acceptable unless the author is prepared to pay the additional cost of printing these. Legends for diagrams must be supplied.

Radiographs: Half plate prints, or prints of uniform size and scale should be supplied with the manuscript; if the prints are not of sufficiently high standard for reproduction purposes, the author will be required to submit the original radiographs. Hospital illustrators and hospital photographic departments are usually familiar with the type of drawing of print which will give the best reproduction.

References: In the text these should consist of the name and year of publication (in brackets), and the first reference to papers by joint authors should contain all the names; subsequent reference should state both names, where there are two, or the first name followed by et al where there are more than two. In the bibliography, they should be arranged in alphabetical order.

Summaries: Every paper must be accompanied by a summary not exceeding 200 words.

Reprints: Twenty five reprints of each paper are supplied free. Further copies will be charged extra at cost.

Only 6 illustrations per article will be allowed free of cost, and for the remaining the cost will be charged to the contributor.

The Editorial Board reserves the right to make literary corrections.

All exchange copies of Journals, may be kindly sent to the Editor direct.

Correspondence regarding subscriptions, advertisements and other business relating to the Indian Journal of Radiology should be addressed to the "Hony. Secretary-in-Charge"—Dr. L. R. Parthasarathy, 63, Fisher Road, Perambur, Madras-23.

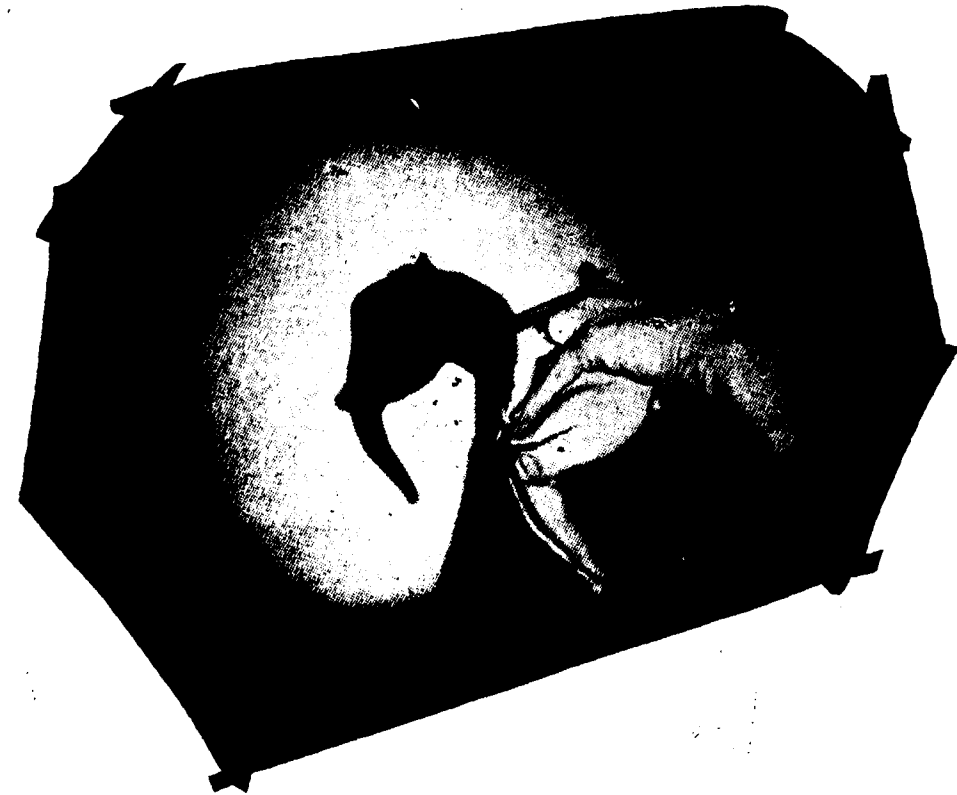
Subscription for India Rs. 16/- per annum; (Reg. Post - Rs. 2 extra).

Single copy Rs. 4/- plus postage.

Foreign subscription £ 1/6 per annum (Registered Post - Extra).

Free to members of the Indian Radiological Association.

Annual subscription for Membership Rs. 20/-.

**DECEPTIVE SHADOWS?**

For shadows that are not misleading, the M&B range of X-ray contrast media is preferable.

'DIAGINOL'

trade mark brand
SODIUM ACETRIZOATE

Water soluble contrast agent for intra-venous or intra-arterial injection and for retrograde pyelography.

'DIAGINOL'

trade mark brand

VISCOUS

SODIUM ACETRIZOATE IN DEXTRAN SOLUTION INDICATED IN HYSTEROSALPINGOGRAPHY

M&B brand Medical Products

'BILIODYL'

trade mark brand
PHENOBUTIODIL

indicated in cholecystography and cholangiography. This preparation which is taken orally, is the latest development for the diagnosis of conditions involving the gall-bladder and biliary tree.

Detailed information is available on request.

MANUFACTURED BY
MAY & BAKER LTD

MAS096/123-233

Distributed by: MAY & BAKER (INDIA) PRIVATE LTD • BOMBAY • CALCUTTA • GAUHATI • MADRAS • NEW DELHI



Rajasthan

SUBTLETIES OF SHADOW

FINE shades and distinctions seldom count so much as in the interpretation of a radiograph...and seldom are they more consistently achieved than with Glaxo radiological contrast media. From this range the preparation best suited to your individual requirements can be nicely selected.



GLAXO LABORATORIES (INDIA) PRIVATE LTD.,
BOMBAY • CALCUTTA • MADRAS • NEW DELHI
Depots: Gauhati • Vijayawada • Srinagar

DIONOSIL AQUEOUS DIONOSIL OILY

(vials of 20 cc.)

DIONOSIL POWDER

(for increasing viscosity of suspensions if desired : bottles of 2 gm.)

For
bronchography

MYODIL

For myelography
and ventriculography
3 cc. ampoules : boxes of 3

PYELECTAN

for intravenous pyelography
and venography
20 cc. ampoules .

PYELECTAN Retrograde

For retrograde pyelography
10 cc. ampoules

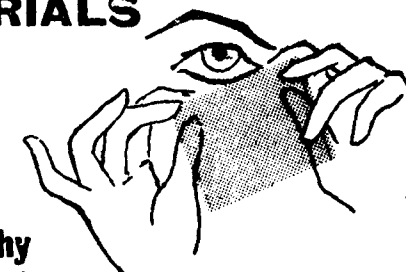
PYELOSIL

'35' and '50'—for excretion pyelography
'70'—for angiocardiology.
All in ampoules of 20 cc.

ILFORD

SENSITIVE MATERIALS

ILFORD
photography
professional
and amateur



ILFORD

X-ray films for
medical and
industrial purposes

ILFORD

plates and film for
the printing industry

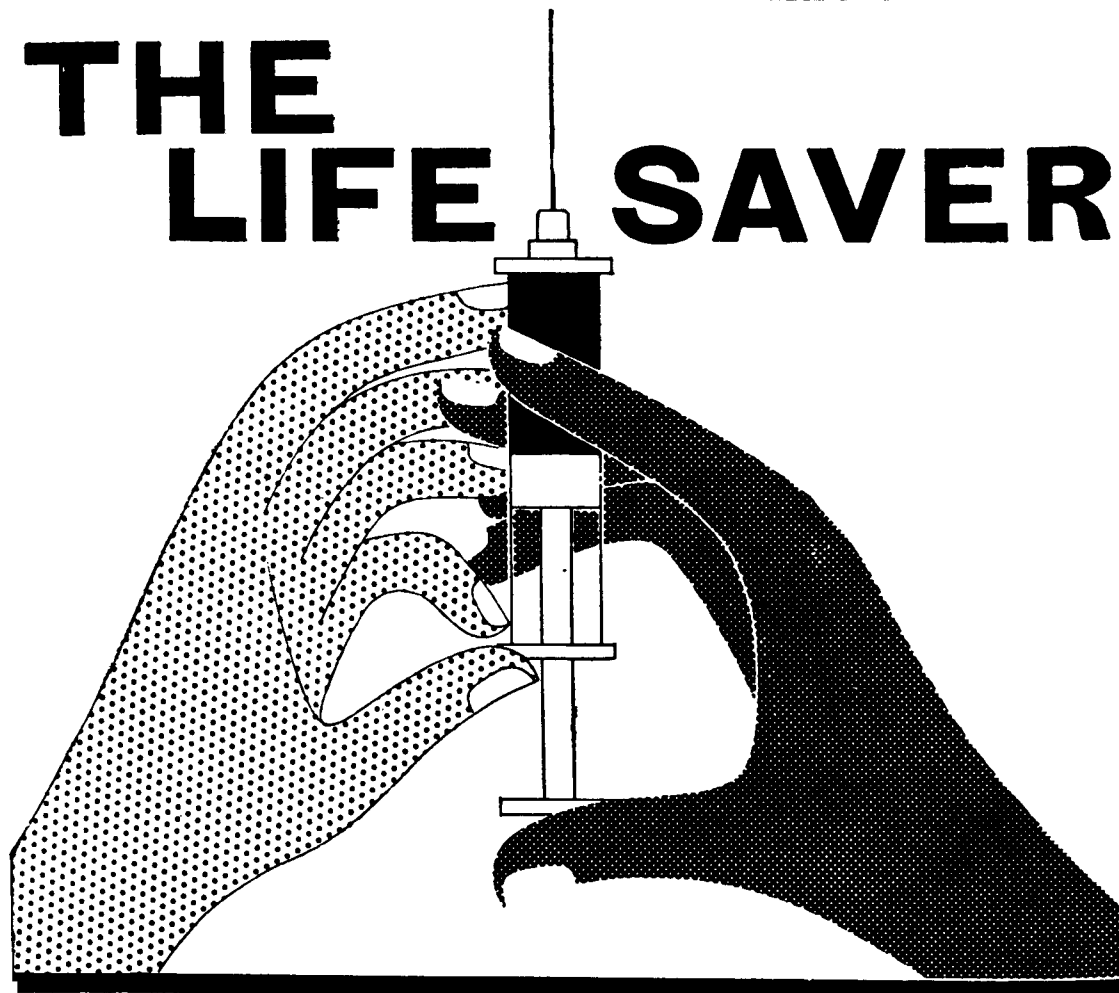
ILFORD

emulsions for
nuclear and other
scientific research

ILFORD SELO (INDIA) PVT. LTD.

Bombay. Calcutta. Madras.

THE LIFE SAVER



By aiding the doctor in making accurate diagnosis, X-Ray has saved many a life. For dependable results, the X-Ray materials he uses should be reliable and accurate. That's why he always prefers Gevaert. For he knows that Gevaert X-Ray films, with their high speed and unmatched clarity, deserve his unreserved confidence.

ALLIED PHOTOGRAPHICS LIMITED

Kasturi Building, Jamshedji Tata Road, Bombay I

GEVAERT

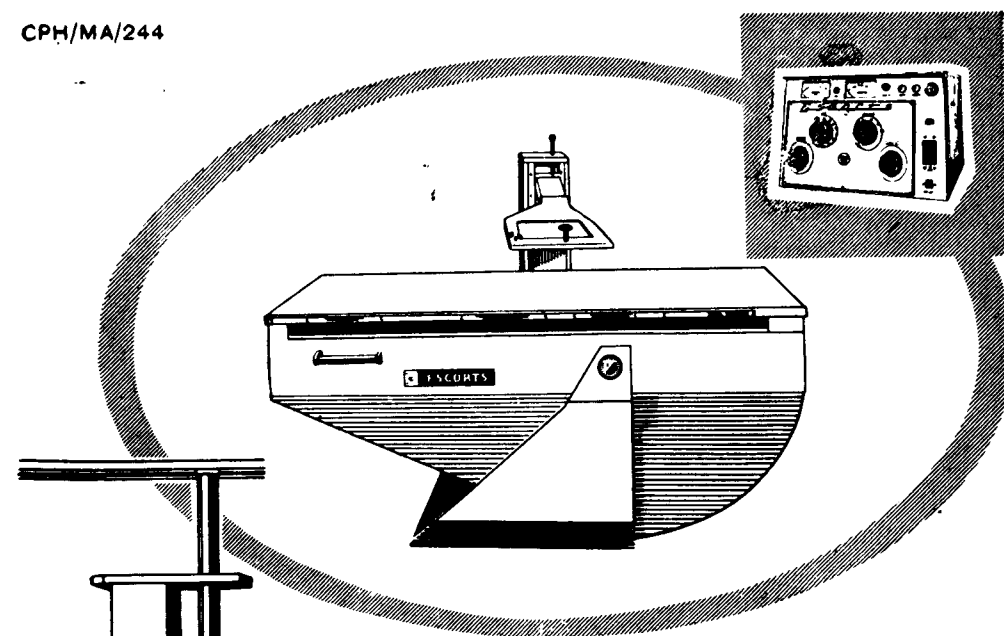
CURIX X-RAY FILM
For medical radiography with intensifying screens. High speed, excellent contrast, and specially hardened emulsion for tropics.

DENTUS SUPER RAPID FILM
Specially made for dental radiography. Film coated on both sides, gives fine image details on light-blue safety base.

SCOPIX FILMS
High speed film giving superb definition for photographing radiographic images on fluorescent screens.

TWO TYPE:
G—for green fluorescent screen.
B—for blue fluorescent screen.

CPH/MA/244



ESCORTS

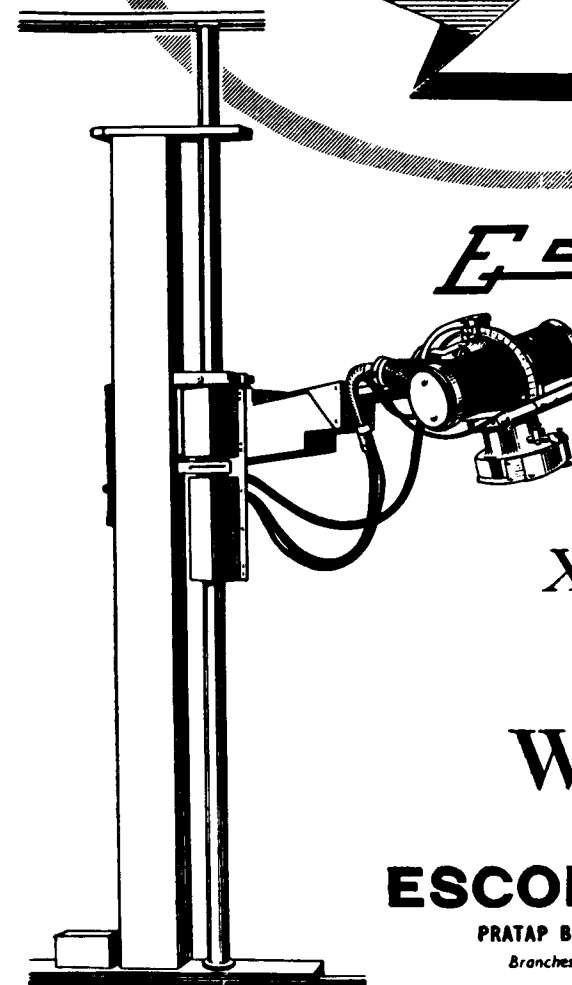
*medical,
therapeutic
and industrial
X-Ray equipment
manufactured in India
under licence of*

Westinghouse

by
ESCORTS LIMITED

PRATAP BUILDINGS, CONNAUGHT CIRCUS, NEW DELHI

Branches: BOMBAY - CALCUTTA - MADRAS - KANPUR - PATNA



ESCORTS X-RAY FACTORY, FARIDABAD

**"There are three main advantages
in the use of TELEPAQUE:**

1. Excellent cholecystograms are readily obtainable.
2. The side reactions are usually minimal, only rarely very disturbing, and often completely absent.
3. In a fairly large percentage of cases, the cystic and the common ducts are quite definitely outlined, and occasionally even the hepatic duct."

Buckstein, Jacob: The Digestive Tract in Roentgenology, ed. 2, Philadelphia, J. B. Lippincott Co., 1953, Vol. 2, p. 1003.



superior oral
cholecystography and
cholangiography

WINTHROP PRODUCTS INC.
NEW YORK U.S.A.

Exclusive Distributors : DEY'S MEDICAL STORES PRIVATE LTD.
CALCUTTA • BOMBAY • DELHI • MADRAS • PATNA • GAUHATI • CUTTACK •

Alubar

WANDER

BARIUM SULPHATE
WETTING AGENT
CORRIGENTS

CONTRAST MEDIUM FOR
RADIOLOGICAL EXAMINATION
OF THE DIGESTIVE TRACT
CONTAINS NO ACTIVE
INGREDIENTS TO STIMULATE
PERISTALSIS.

Aqueous suspensions of ALUBAR are homogeneous, fine-grained and cast a dark shadow. They guarantee sharp and even contrast pictures. They are stable in acid and alkaline media. They can be prepared easily without tedious whisking. ALUBAR is economical in use, has a pleasant flavour and unobtrusive taste.

A PRODUCT OF
DR. A. WANDER S. A., BERNE (SWITZERLAND)

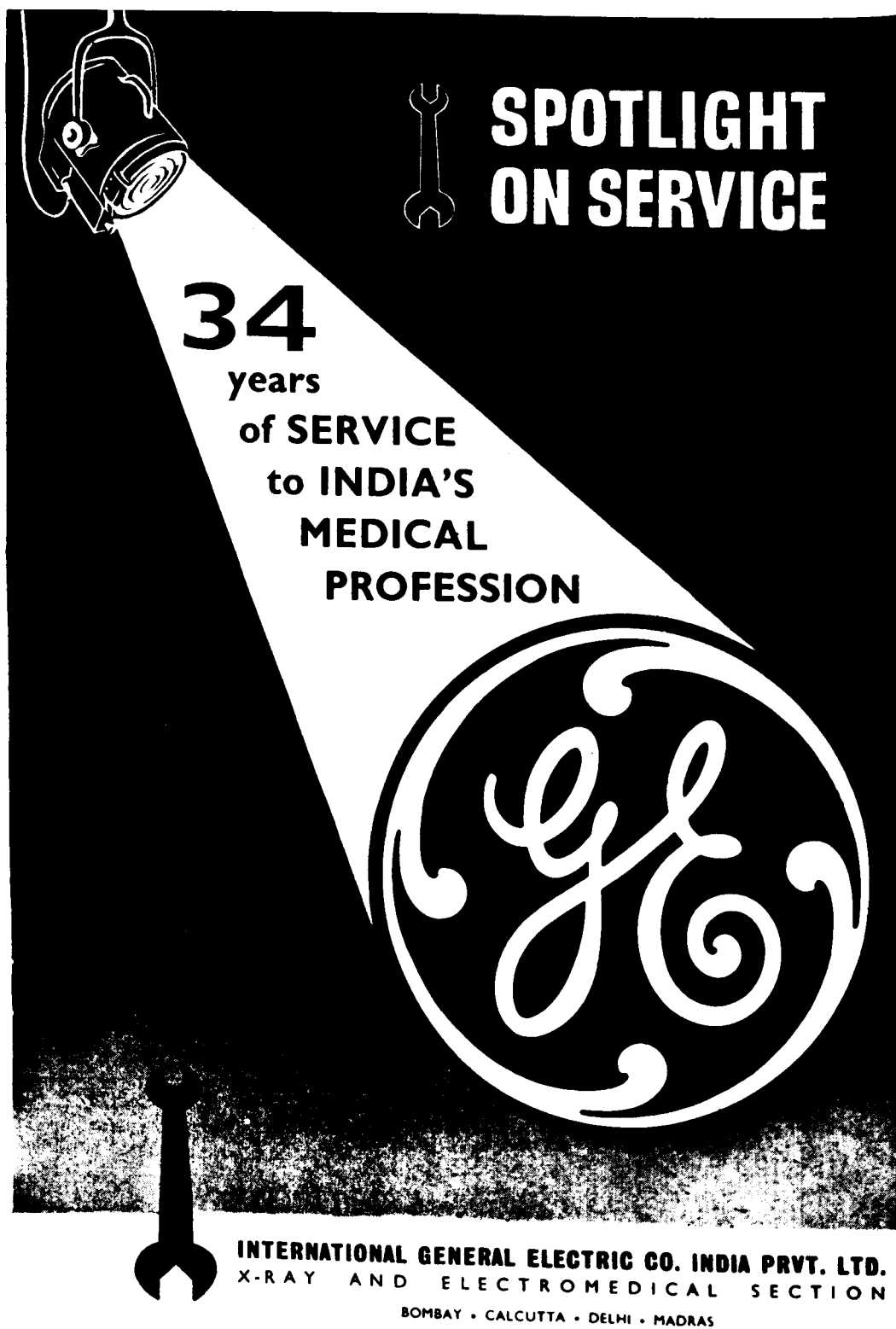
For Medical literature & supplies please contact:

Sole Distributors

KHATAU VALABHDAS & COMPANY

Indian Globe Chambers, Fort Street, BOMBAY-I.
Telephone : 261655 Telegrams "SCARLET"

Packings: Tin of 125
gm. Tin of 5 kg. for
Hospital use.



**SPOTLIGHT
ON SERVICE**

34
years
of **SERVICE**
to **INDIA'S**
MEDICAL
PROFESSION



INTERNATIONAL GENERAL ELECTRIC CO. INDIA PRVT. LTD.
X-RAY AND ELECTROMEDICAL SECTION
BOMBAY • CALCUTTA • DELHI • MADRAS

Editorial

X-RAY EXAMINATION IN THE DIAGNOSIS OF PULMONARY TUBERCULOSIS

Pulmonary Tuberculosis is one of the major scourges which takes a heavy toll of life in our country. About 2.5 million active cases of Tuberculosis exist in the country and about 2,50,000 deaths take place each year from this cause alone. With the discovery of wonder antibiotics and chemotherapeutic agents as Streptomycin, I.N.H., P.A.C., the disease is almost conquered in Western countries. While in other progressive countries, sanatoria are closed due to want of patients and the few cases that are left are under domiciliary treatment in their homes, there is still a very long waiting list of patients in our Tuberculosis Hospitals and Sanatoria. Many of the patients die before their turn of admission to the hospitals actually comes. For 2.5 million open cases of pulmonary tuberculosis, the beds available in the hospitals are less than 20,000?

Perhaps with improvement of living standards of our people as a result of our successive five year plans, the outlook of conquest of this economic disease is bound to improve. But an incessant war against tuberculosis is one of our national duties.

In the fight against tuberculosis, early diagnosis of this disease is one of the most important factors. In few diseases is X-ray examination of more value in diagnosis than in pulmonary tuberculosis. The disease is seen in a radiograph long before it can be heard by a stethoscope. Lesions of 1 mm. in size can be diagnosed by X-ray examination. Routine examination of presumably normal individuals, with or without positive tuberculin skin reactions, often reveals unsuspected tuberculosis. Even in a materially advanced country like U.K. where people seek medical aid at the earliest onset of symptom, about 50 per cent of the cases are symptomless and are diagnosed on their medical check up by mass miniature radiography. Even for X-ray changes to occur a minimum of ten weeks after the onset of infection is necessary. Next to positive sputum characteristic, X-ray finding is the most definite evidence of the presence of tuberculosis. But X-rays signs occur before the patient has any sputum at all. Moreover the positive

sputum does not localise the site of the lesion. "A negative X-ray examination in any circumstance is the most conclusive evidence of absence of tuberculosis of the lungs"—(Rigler).

For the early diagnosis of tuberculosis in our country sufficient X-ray diagnostic machines, X-ray Technicians and Radiologists must be made available in our planned programme. The habit of regular medical check ups must be inculcated among our people along with the rise in living standard. Expansion of the Employees' State Insurance Scheme among industrial and agricultural workers will go a long way in creating facilities for medical check ups. Mass miniature X-ray units service must reach every individual. Tuberculosis detection centres must be established in every group of villages. The habit of supplying fluoroscopic machines before radiographic facilities in our clinics and tuberculosis medical centres must be curbed. Fluoroscopic examination cannot be relied for diagnosis of early tuberculosis even though it may be superior to physical examination in the detection of small lesions. Minimal lesions are spotted in radiographs and not in fluoroscopic screens. The progress can be followed by repeated X-ray studies. Information about the effects of treatment as pneumothorax, thorocoplasty and chemotherapy can be obtained by X-ray examination. Early diagnosis and adequate treatment are the twin prongs in the fight against tuberculosis. Establishment of many more factories like our Pimpri institution for the production of chemotherapeutic agents as Streptomycin in our country will certainly reduce the cost of treatment. Side by side, X-ray diagnostic facilities for the early diagnosis of tuberculosis must be accelerated to make effective treatment possible and feasible. Let us all gird up our loins in the great adventure of building a healthy body with a healthy mind in our dear motherland.

A. N. K. Menon.

Biophysics in Medical Radiology*

BY

Prof. BORIS RAJEWSKY, Dr. phil. nat. Dr. med. h. c. Dr. med. h. c.
*Direktor des Max-Planck-Instituts für Biophysik, Frankfurt a. Main,
Forsthausstrasse 70, Deutschland, Germany.*

SIR JAGADESH BOSE MEMORIAL LECTURER



Professor BORIS RAJEWSKY

Dr. phil. nat. Dr. med. h. c. Dr. med. h. c.

*Direktor des Max-Planck-Instituts für Biophysik, Frankfurt a. Main,
Forsthausstrasse 70, Deutschland, Germany.*

LADIES AND GENTLEMEN!

Please permit me first of all to express my sincerest thanks to the Indian Radiological Association for the great honour in inviting me to deliver the Memorial Bose lecture here, as well as for the kind invitation to visit several cities of your great country. Never having been in India before, I am already most deeply impressed by what I have seen in the few days that have passed since my arrival. In particular I am grateful for the possibility to enter into closer contacts with the Indian colleagues and to spend some time in their midst. It is hard to find the proper words for describing the great kindness and warmth that are encompassing Mrs. Rajewsky and myself here in India from every side; such things one can only feel and express one's thanks for them from the bottom of one's heart. This I should like to do here now. To all of you, therefore, my most heartfelt thanks!

The tradition, observed in a great many countries of the world, of honouring great teachers and scientists by Memorial Lectures is not only a beautiful custom, but at the same time an appeal for a rededication to the true values of the world such as they present themselves in science, culture and religion. Such jointly-experienced hours of rededication to what a great German poet has called "the true, the beautiful and the good" wield a great power in our world—far greater a power than any force of arms, guiding the people as they do, in full freedom and without any coercion, towards a realisation and recognition of the meaningful

beauty of the achievements of the human spirit. They evoke in us a feeling of deep inner satisfaction at the fact that such achievements are possible to man and are, indeed, already in existence. They inspire us with hope and faith in a good future for this world.

In the course of the history of mankind, the memory of great personalities has very often been honoured by monuments of stone and bronze. Yet all such monuments are destined to pass away. The true monuments are those that live on in the deeds of such people. A great Roman poet said of himself: "Exegi monumentum aere perennius". This monument erected by him for all time was his poetry. This poetry we still know and admire to-day, and so will our descendants.

Thus it is also with the great Indian Bose. He, too, has erected, through his work, a monument which is truly "aere perennius", and it is at the feet of this monument that I wish to lay down, as a humble laurel and floral wreath, my present lecture.

To be sure, every nation has a right to say of its great men: "He is ours". Such men as BOSE, however, in truth belong to the entire world. Therefore, it fills me with particular satisfaction and pleasure that I, as a foreigner, as President of the International Society of Radiology and Acting President of the International Congress for Radiology, am able here to deliver the Bose Memorial Lecture.

*Indian Radiological Association Congress, January 1962, Sir Jagadish Bose Memorial Lecture.

As topic for my address I have selected "Biophysics in Medical Radiology", not only because this subject is my favourite occupation and hobby or because I am the Director of one of the oldest biophysical institutes in the world, but for other, deeper reasons. For several decades, namely, I have been occupying myself most intensively with "medical radiology", with its scientific foundations and clinical problems. I am glad to have a great many pupils and co-workers all over the world who, scientifically speaking, have grown up under my advice and who in joint work with me and my staff have become mature scientists or men of the practice. Now they are themselves independent and successful professors and directors of radiological centres, institutes and laboratories. What was started and thought out by them and me together, they are now transforming into deeds. Thus the ideas that originated in those past years live on and continue to develop. More and more knowledge is gathered and experience collected.

Now the important and valuable thing here is that despite the tremendous expansion of fields and directions of work, a spiritual community is always preserved in our work. The large structure of medical radiology which all of us radiologists are striving to build up will never be completed. New wings will continue to be erected or added. Magnificent, long-completed parts of the edifice, large halls, long hallways and labyrinths are deserted or torn down and replaced by new ones, generally simpler, but often also more beautiful of design than the old ones. However, these new structures are based on, or originate from, the insights and experience of the past. Everywhere in the new parts of the structure, the old building elements and styles are clearly discernible.

If I should try now, on the basis of my many years of experience, to characterise present-day medical radiology in scientific terms, I find that medical radiology is a structurally quite complex branch of science. It consists of three component fields which, though in themselves independent, are nevertheless closely interconnected. These fields are: biophysics, radiobiology, and clinical radiology. I am not enumerating these fields in the order of their importance, but rather quite arbitrarily since closer examination will show that it is wholly impossible to prove that any one of these component fields far outranks the others in importance. Perhaps one should rightly mention clinical radiology first, which, after all, constitutes the true goal and the *raison d'être* of the whole of medical radiology whose aims it endeavours to realise concretely.

One thing, however, has been made absolutely certain by all our experience: namely, that the three aforementioned component fields of medical radiology cannot be sharply distinguished from one another since they are closely interwoven and mutually interdependent. Yet each of these component fields at the same time constitutes in itself a complete, well rounded-off, branch of learning.

Thus, *Radiological biophysics* comprises physics, biological chemistry, and, of course, engineering. *Radiobiology* is composed of biology, biochemistry and elements of biophysics. *Clinical radiology* rests on the body of knowledge produced by the two other component fields while furthermore containing the elements of a great many branches of medicine. It is understandable that the development of the two fields of medical radiology mentioned first - that is, of radiological biophysics and of radiobiology - is quite essentially influenced by

the development and requirements of clinical radiology. Indeed, the essence of the overall field of medical radiology consists precisely in the close interrelationship and interdependence of its component fields.

Now what did the historical development look like? That medical radiology could develop at all was a result of the physical discovery of x-rays and radioactivity. The idea of clinical x-ray diagnostics originated with the physicist ROENTGEN who immediately upon his discovery made an x-ray picture of the hand of his medical colleague KOLLIKER. The idea of X-ray therapy was born a few years later as a result of a radiobiological observation by the medical scientist FREUND of loss of hair after exposure of the skin to X-rays. The scope of the entire field of radiology at that time was so small that, within it, the physicist, the biologist and the clinical physician enjoyed unchallenged equality of rights.

In particular, however, the beginner in clinical radiology at that time was able to act as his own biophysicist, radiobiologist and even technician. It is well known that a great many of the biophysical, radiobiological and technical ideas put forward in those years as well as their practical realisation in suitable constructions, originated with the clinical physicians. Such was the way in which the development of the pioneers of medical radiology took place: that of the physicists DESSAUER and FRIEDRICH, the medical scientists and clinicians PERTHES, ALBERS-SCHONBERG, HOLZKNECHT, BECLERE and others.

However, the rapid development of medical radiology and the enormous progress achieved in this process have radically changed the situation that prevailed in those early years. The clinical radiologist no longer was able to oversee the whole field of radiology with expert eyes or to possess expert knowledge and skill in all its

component fields. The enormous growth in clinical radiological practice and the frequency of patients, prevented him from obtaining the required specialised training and from devoting time on his own account to either physical-technical jobs or basic radiological research. In the course of time, therefore, specialised biophysical and radiobiological institutes—or to clinic attached laboratories of the same nature—were set up. It is to these institutes that non-clinical medical radiology, and especially the research part of it, has more and more shifted in the course of time.

This does not mean, of course, that research work as such has entirely slipped from the hands of the clinical radiologist and that his tasks are now confined to radiological diagnostics, the drafting and carrying-out of radiological treatment plans, and the observation of patients' reactions to radiation. Rather, the clinical radiologist has remained in full charge of the extremely important field of "bed-side research" which has so tremendously grown in scope since the early years.

This entire situation has been made even more pronounced by the modern expansion of medical radiology and, in part, by its extension to the fields of, firstly, so-called nuclear medicine (especially radio-isotope treatment) and, secondly, the application of high-energy radiation (X-rays, electron rays, proton and neutron-rays) in the MeV range. This latter development, however, was emphatically welcomed because as bringing about still greater independence of the "theoretical" parts of medical radiology, it made the necessity of close co-operation between medical-radiological "theory" and clinical practice even more evident.

It should be mentioned in this connection also the problem of radiation protection, a

field which only 15 years ago was an almost exclusive domain of the clinical radiologist, who only needed some modest assistance from the physicist and the biologist to cope with it, but which since then has enormously increased in scope, thus likewise underlining the importance of the work of the biophysical and radiobiological institutes. In dealing with this problem, the field of competence of these institutes grew beyond the needs of clinical radiology and eventually included the fields of radiation protection of the entire population, as well as of radiation protection in industry and in engineering. Thus the independence of the aforementioned component fields of radiology was emphasized even more.

This present-day situation in medical radiology has naturally imposed new requirements on the training of medical radiologists. The close interrelationship and interdependence of all, three component fields of medical radiology makes it imperative that all expert personnel for these three component fields shall receive training in the scientific foundations of all fields of learning concerned, and that such training shall extend both to theoretical as well as to experimental (practical) aspects. This basic training is a must for all medical radiologists in order that in their future specialised work they shall be fully aware of the peculiar problems, methodology and practice of the whole of medical radiology. Only upon completion of this basic training should specialised training in one of the three component fields be allowed to begin. The aim of such training is to produce fully-qualified clinical radiologists, likewise fully-qualified radiobiologists, and radiologic biophysicists who have a thorough overall familiarity with the two other component fields.

Radiologic biophysics and radiobiology lie very close together and even overlap

partly. A combination of both fields of learning is, therefore, entirely possible and for many problems even necessary.

It seems to me that it is in this direction—which, after all, is only a natural consequence of the present situation in radiology—that teaching, research and practice in medical radiology will develop in the future. The quest for greater and greater progress both in technology and research, and thus in science in general, undoubtedly will force even the most conservative-minded radiologic circles to proceed along this course.

Ladies and Gentlemen! It is in the thoughts I have just outlined that you must look for the deeper reasons of which I spoke at the beginning of my address—the reasons that prompted me to select this subject as topic for my lecture. In view of the discussion which took place two years ago at the 9th International Congress for Radiology in Munich and at subsequent radiologic conferences, I believe that these considerations are of great topical interest at the present time.

Now please permit me to explain the specific tasks of radiologic biophysics and its research work. The tasks of biophysics within the overall scope of medical radiology are so numerous that it is of course impossible to dwell on all of them within the framework of a lecture. I must therefore confine myself to a few selected examples. I furthermore ask for your forbearance if, in so doing, I seem to be lacking in courtesy towards other authors these selected examples are taken from papers written by myself. This simplifies my task in so far as I now am under no obligation to lavish praise on these papers.

First of all I should like to turn to the ancient problem of medical radiology which even now has not yet been fully clarified—the problem, namely, of what are the primary physical, chemical and physiological reactions produced in living tissue by X-radiation. In other words, I have set myself the far-from-modest goal of sketching a picture of what happens in living tissue during and after irradiation and of presenting this picture to you. I am fully aware that this is a risky undertaking.

The starting point of the development concerned was Max PLANCK's discovery in the first year of our century on the nature and structure of radiant energy. According to this discovery, electromagnetic radiations possess corpuscular properties and, when interacting with matter, behave themselves as energy corpuscles, or quanta as PLANCK called them. Seen thus, a ray is a flow of individual quanta, energy particles, flooding the irradiated material in steadily varying numbers and in disorderly arrangement.

This new discovery brought about a most fundamental change in the concepts valid at that time regarding the physical processes taking place in irradiated matter. These concepts were based, naturally, on such information as had previously been available on those radiation. According to these concepts, radiant energy as carried by electromagnetic waves was continuously and uniformly propagated in all directions with the speed of light, and its effect on the irradiated material was likewise continuous in nature.

The new concept is a totally different one. According to it, the radiation corpuscles—or quanta—penetrate quite irregularly into the material, where they collide haphazardly with the electrons, atoms and

molecules of this material. In these collisions, which are irregularly and haphazardly distributed over the material, the energy of the quanta is consumed, or rather, transformed into other forms of energy. Thus, for instance, photo-electrons and (Scattering)-Compton-electrons are liberated, atoms or molecules are ionised and excited pairs of one positive and one negative electron each may be formed, or still other processes may occur.

Since the number of incident quanta is generally smaller than the number of electrons, atoms and molecules of the irradiated material, these "radiation effects" do not take place everywhere, nor is their intensity the same at all those points where they do occur; rather, they are confined to certain points that are distributed in a discontinuous and haphazard manner. The magnitude of the short-lived stores of energy thus formed inside the material varies likewise and is likewise distributed in a haphazard fashion.

Thus, what is actually going on in a matter-filled, irradiated volume of space amounts to an enormous, haphazardly constituted diversity of elementary energy transformation-processes. Since these processes go practically hand in hand with chemical changes of the irradiated molecules, we are faced, from a chemical point of view, with a chaos of all kinds of chemical reactions within the irradiated volume of matter, provided of course that there is a sufficient variety of types of molecules available.

Now for a satisfactory understanding of the various radiation effects within the irradiated material, particularly within the living substance, the living tissue and the living organisms in which we are interested, this concept was obviously unsatisfactory

since it seemed more natural to assume that the specific biological radiation effects observed were attributable to specific, rather than haphazard, chemical reactions. Radiobiological and biophysical research found itself therefore forced to seek new information about the processes described. Such information was, indeed, obtained. But before describing it to you I should like to show you three pictures of the primary physical processes, particularly the ionisations, in irradiated matter, so that you may be able to form a visual idea of what I am going to tell you.

In *Fig. 1* you see a picture, taken under special conditions, of the ionisation effects produced in a gas by irradiation. The beam of X-rays is directed from the left to the right and produces, as you can see, individual

pairs of ions which are made visible by illuminating the droplets of condensation moisture formed around the ions (both the positive and negative ones). The individual pairs of ions stand out very clearly. However, they are not evenly distributed but rather form single pairs as well as little clusters of pairs made up of varying numbers of such pairs. The haphazard nature of ion formation is thus clearly demonstrated. The x-rays used contained relatively few radiation quanta.

Fig. 2, on the other hand, shows the formation of ions by more powerful X-radiation. Here, the ion pairs are very numerous and lie very close together. In any event they form clusters of ions and at various points even coagulate into tracks that have an appearance of continuity. On the

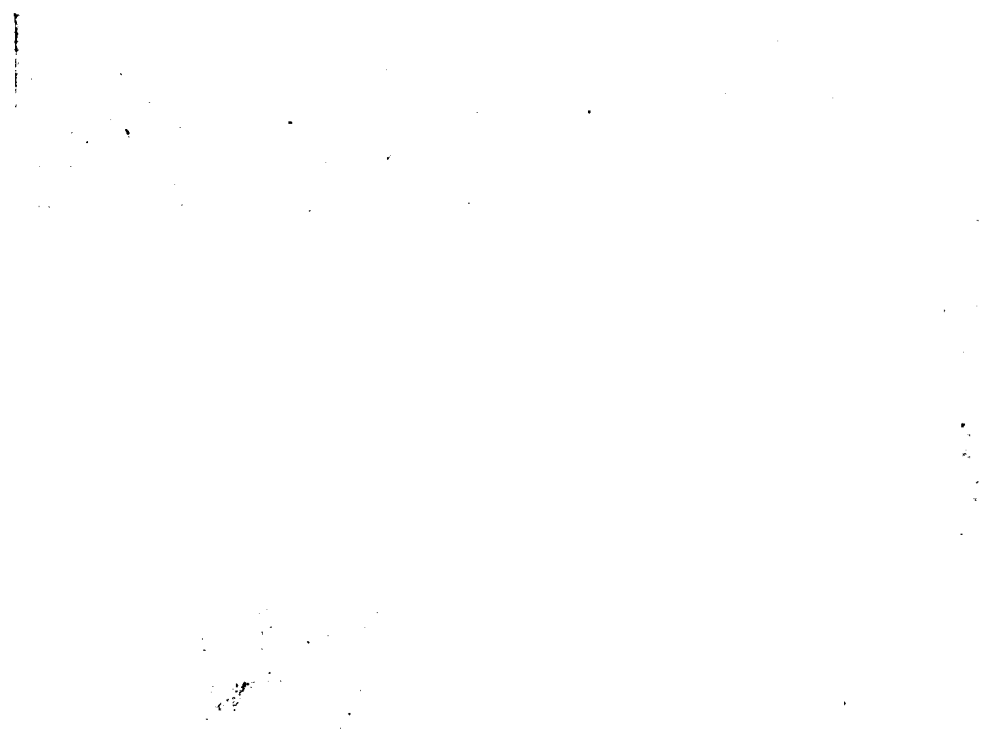


Fig. 1

Track of a 1 MeV B-particle (Gray, 1947)

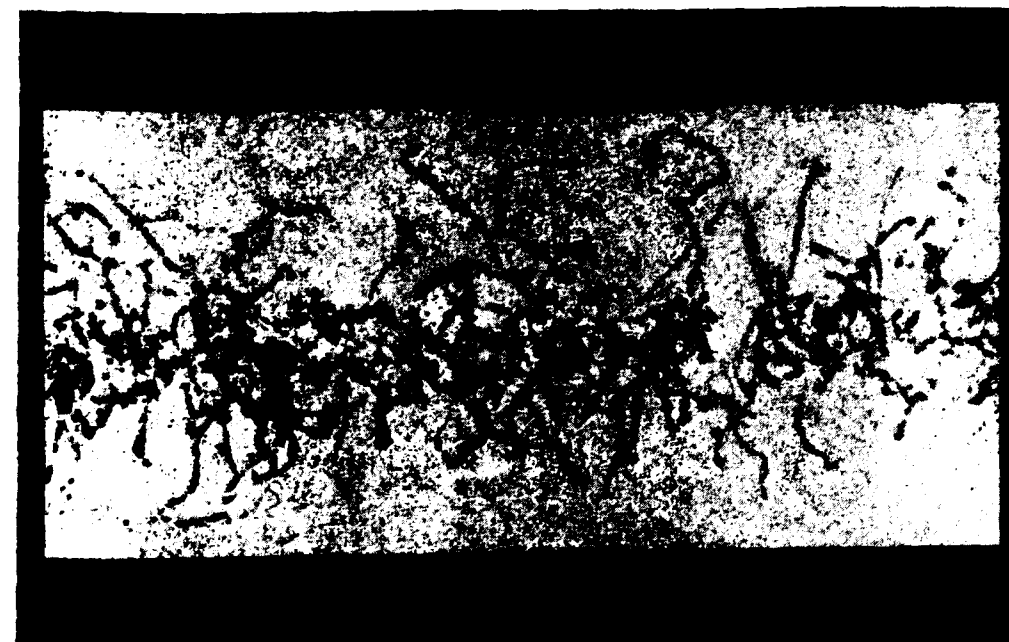


Fig. 2

Electron tracks formed by x-ray absorption in air.

whole, this is indeed a veritable jumble of physical energy transformation processes. One might object, however, that here we are looking at processes in a gas, whereas in a biological medium the matter is in a liquid-solid state.

Fig. 3 therefore shows a similar picture taken in a liquid, namely in a bubble chamber. As you see, we obtain the same picture here, too. In order to generalise these concepts of the primary physical processes in irradiated matter even further, rapid electrons (namely particles of matter) of 24, 1 : MeV energy were used here instead of X-rays.

You see, the overall picture presented by these processes is indeed a chaotic one and should, presumably produce equally chaotic chemical reactions. Thus, biophysical research had arrived at an

alarming dead end. How is it possible that these chaotic processes gave rise to wholly specific biological radiation effects? The only effect that seemed to make sense would be a general destruction of the living substances.

Together with G. PETER and Th. WIELAND, I irradiated the aqueous solutions of various biologically important substances. The products thus obtained were studied by means of paper chromatography and electrophoresis.

Fig. 4 shows the results obtained with lysin. As you see, irradiation of lysin does not produce a chaos of chemical changes, but rather a quite specific range of radiation products, all but one of which could be identified.

The chemical reactions corresponding to these products are schematically shown in

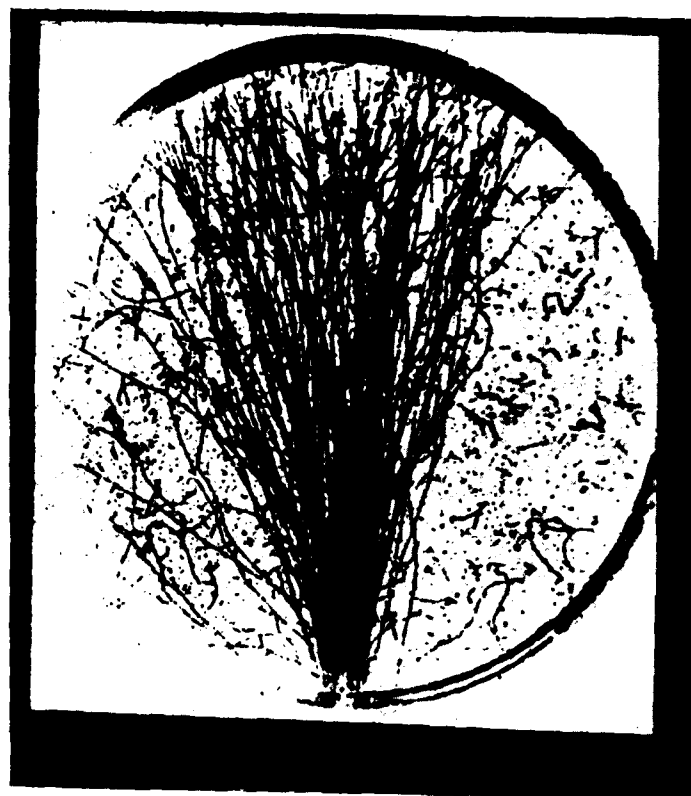


Fig. 3

Electron tracks in the bubble chamber (24, 1 MeV Water).

Fig. 5. We encounter here both reactions by which chemical compounds are built up and reactions by which they are broken down. Hence, the effects of irradiation are not always of a destructive nature, as it was believed formerly. Together with K. Dose and K. ETTRE I therefore gave some further study to the possibility of the synthesis of compounds by irradiation and found additional evidence of it.

A few of the results obtained are shown here. Fig. 6 shows the manner in which glycine formation as a result of irradiation of a 70% aqueous solution of ammonium acetate at 20°C (degrees centigrade) varies with the radiation dose. Fig. 7 illustrates

the effects of varying doses of irradiation in formation of pyruvic acid from a 0.5 molar solution each of acetaldehyde and sodium bicarbonate at 20°C, while Fig. 8 shows the variation of glycine and beta-alanine formation depending on the concentrations of the ammonium acetate solutions in the case of exposure to X-rays of 18, kr and at 20°C.

I could go on to show you a whole series of similar results, but I believe that these examples shown will suffice to warrant the conclusion: it is absolutely possible to achieve directionally controlled chemical reactions in irradiating aqueous solutions of biological substances with x-rays. These

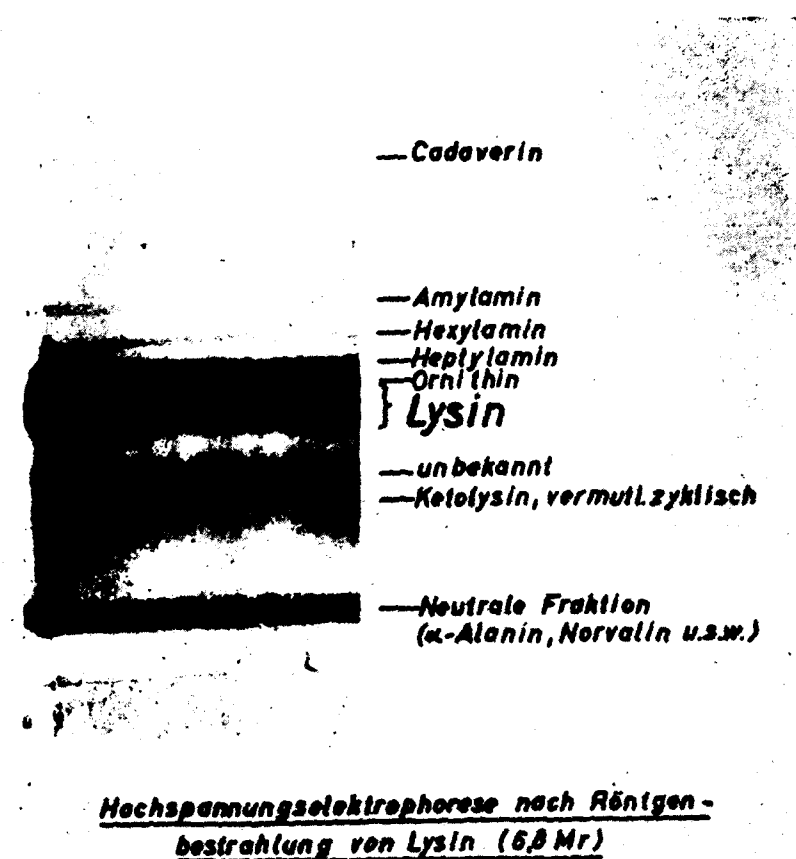


Fig. 4

reactions may take place both in the direction of a synthesis and in that of a disintegration of chemical compounds. This also establishes the possibility of the formation of active radicals. You will recall that an assumption of this effect had been supported until then by various other experimental data, which had thus been satisfactorily substantiated.

By means of these examples I have shown to you how biophysical research has been instrumental in bringing about a

far-reaching change in certain basic concepts of medical radiology.

I should like to follow this up with a 2nd example which penetrates even more deeply into the fundamental problems of medical radiology. Some 20 years after PLANCK's discovery had very changed the field of radiation-physics, a new concept was formulated concerning the interpretation of radiation effects in living tissue. This concept was developed by my teacher Friedrich DESSAUER.

Spaltungs- und Anlagerungsprozesse bei Röntgenbestrahlung von Aminosäuren. Dosis: $60 \cdot 10^6$ r; Konzentration: 0.1% (nach Peter, 1953)		
Ausgangszustand	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & H & H & H & H & NH_2 & O-H \end{array}$	Lysin
Decarboxylierung	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & H & H & H & H & NH_2 & O-H \end{array}$	Cadaverin
Spaltung der C-C-Kette und Desaminierung	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & H & H & H & H & NH_2 & O-H \end{array}$	Ornithin
oxydative C-C-Kettenverkürzung	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ HOOC - H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & H & H & H & H & NH_2 & O-H \end{array}$	Asparaginsäure
	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ HOOC - H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & H & H & H & H & NH_2 & O-H \end{array}$	Glutaminsäure
Substitution der H-Atome der C-C-Kette durch OH-Gruppen (Hydroxylierung) u. Decarboxylierung	$\begin{array}{ccccccc} & H & H & H & H & H & O \\ & & & & & & \\ H_2N - & C - & C - & C - & C - & C - & C \\ & & & & & & \\ & OH & OH & OH & OH & NH_2 & O-H \end{array}$	Polyhydroxyamine

Fig. 5

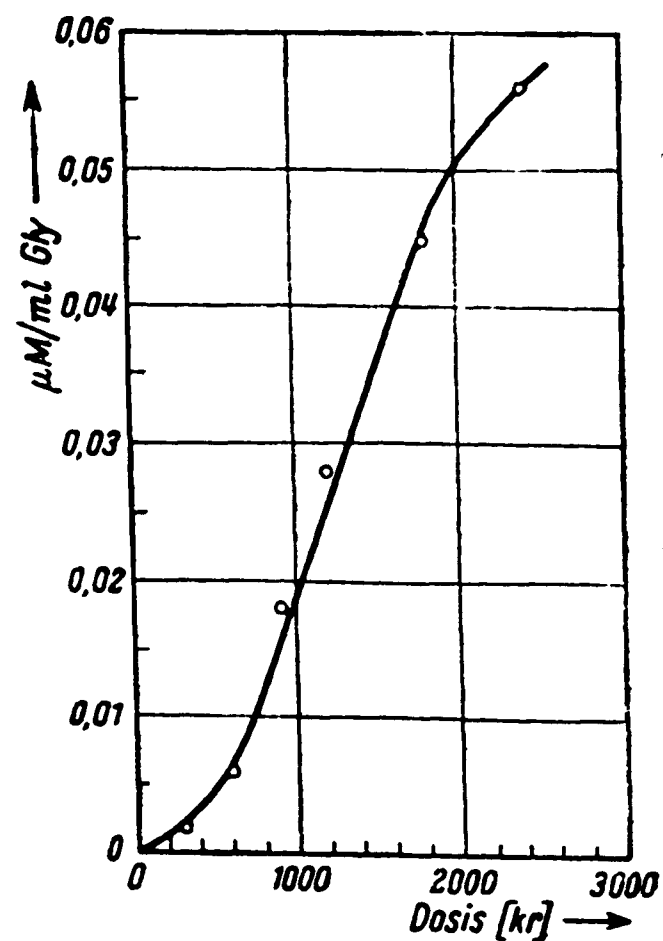


Fig. 6

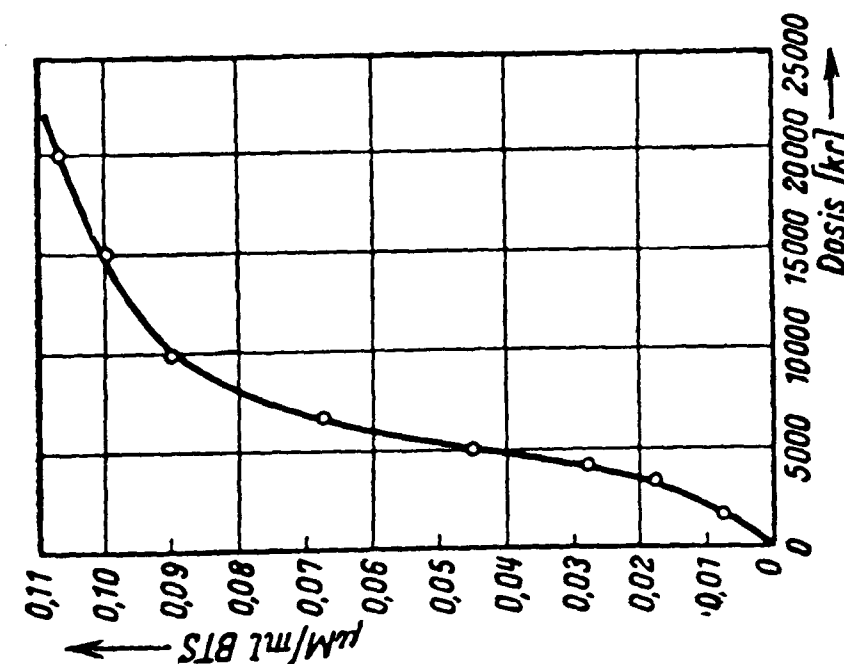


Fig. 8

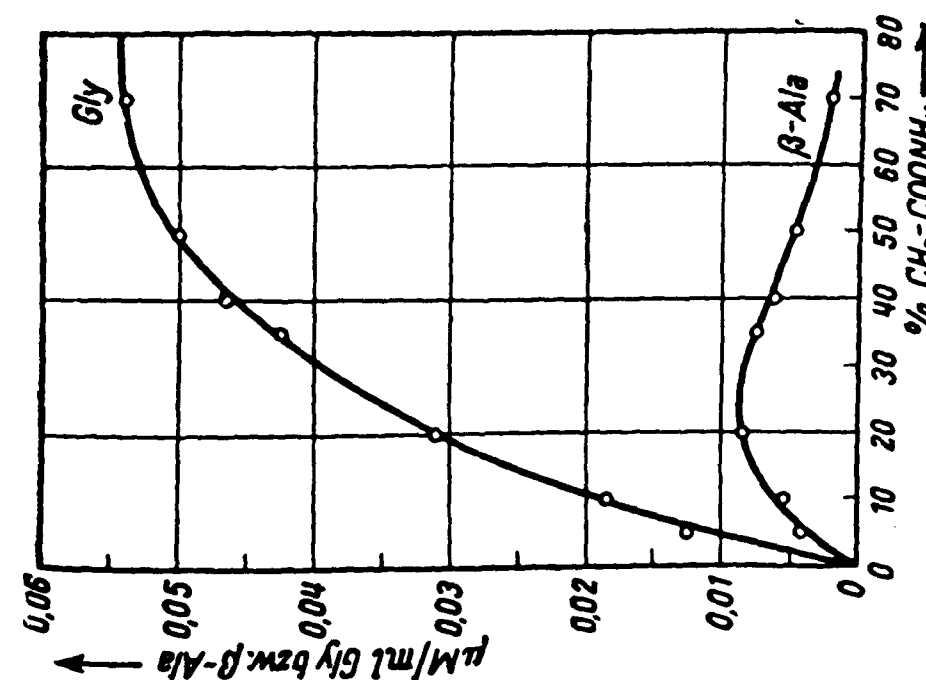


Fig. 7

While pondering about the ideas of M. PLANCK on the physical interaction of radiation and matter, which, as I mentioned previously is of a haphazard and discontinuous nature, it occurred to DESSAUER that living tissue, too, and particularly its component parts, are likewise discontinuous in structure and organisation, for they constitute complexes of conglomerates of numerous units and sub-units. From these physical and biological data, DESSAUER concluded that the biophysical processes in irradiated tissue must likewise take place in a discontinuous and haphazard manner and therefore must obey the laws of probability. Not all of the stores of energy, the energy depots, left behind by radiation in living tissue are effective, but rather only those of adequate magnitude—the “hits”. Similarly, not all structural elements and organisa-

tional units of living tissue are equally sensitive. For different “sensitive areas” of living tissue, hits of different magnitude and nature are required. The observable radiation effects are, then, the result of the haphazard interplay of these factors.

It is conceivable that for different radiation effects specific “hits” and specific “sensitive areas” are decisive. It was thus that the well-known “hit theory” of radiation effects came into existence.

Slightly over 20 years ago I gave a schematic explanation—which was correct however as to scale,—of the state of affairs such as the hit theory presents it. This explanation is shown in the following Fig. 9.

Fig. 9 shows 2 tissue sections with added projections, correct as to scale, of ionisation



Elektronenbahnen im menschlichen Epithel-Gewebe (Photomontage). Röntgenstrahlen von unten.
Links: Übergangsepithel vom Nierenbecken, rechts: Epidermis mit Interzellularbrücken

tracks. One can readily recognise the haphazard distribution of ionisations and the variations in the supply of energy to the various structural elements of the cells. When this schematic representation was published it was criticised on the grounds

that the ionisation tracks had been taken from experiments in gases. At that time it was not yet wholly certain that similar conditions prevail also in liquids. However, older experiments by BRASCH, GLOCKER and LANGENDORFF, as well as newer ones with bubble chambers have since proved that this manner of presentation is justified. From it, it can be seen that the hits, indicated by the ion pairs and ion clusters, are differently localised and that the various cellular areas are exposed to varying intensities of radiation energy load. We distinguish here between single-hit effects and multiple-hit effects. They produce injury curves of different shape for various cells. Examples of the single-hit and multiple-hit curves are shown in Figs. 10 and 11.

By means of the hit theory it was possible correctly to interpret a whole series of radiation effects on biological material. It was in the selection—or in the determination by means of the hit theory—of

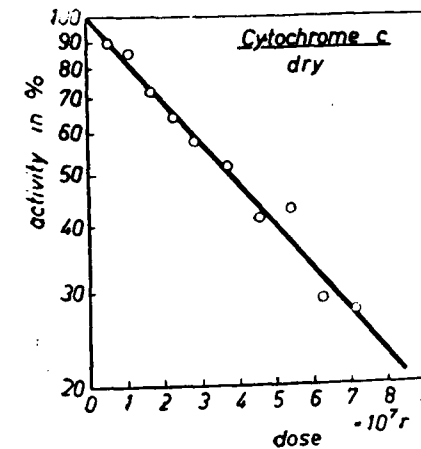
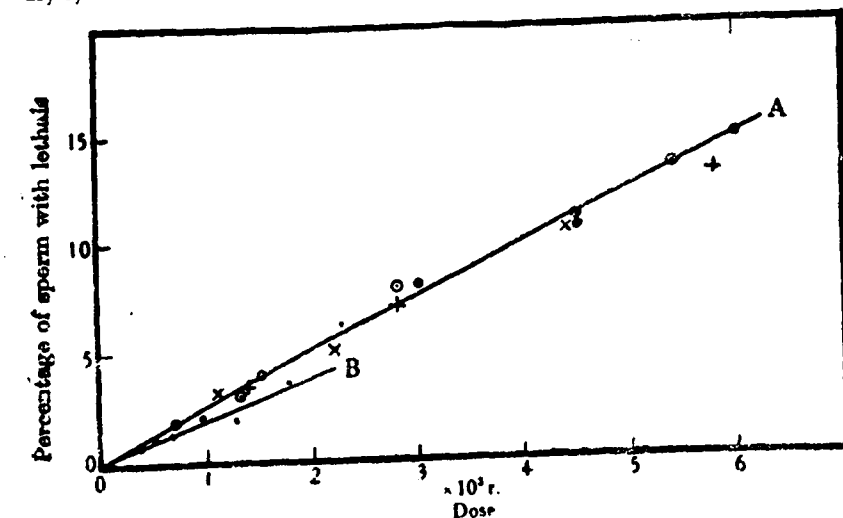


Fig. 10-a

Single-hit dose effect curve for inactivation of dry cytochrome c. 45 kV-x rays.



Induction of sex-linked recessive lethals by different radiations (Timoféeff-Ressovsky & Zimmer). Curve A: ● X-rays; × soft X-rays; ⊙ γ-rays; + β-rays. Curve B: • neutrons.

Fig. 10-b

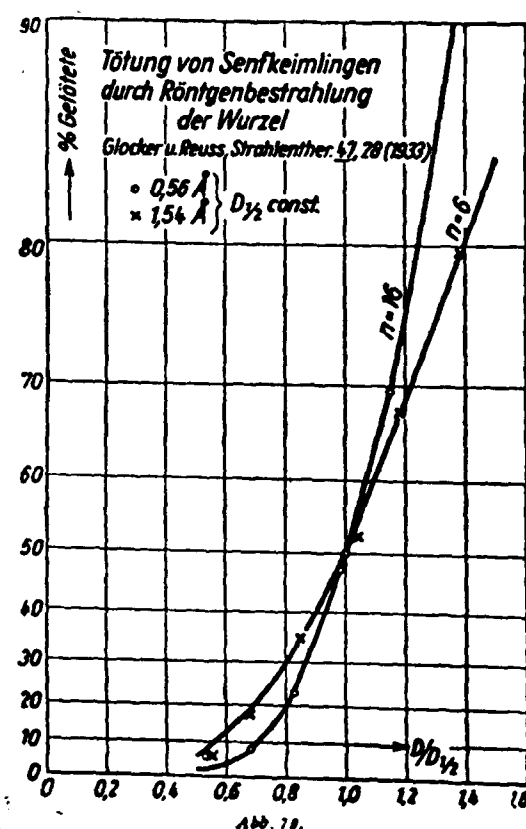


Fig. 11

the "sensitive areas" and the "hit areas" that difficulties occurred. With these "hit areas" we mean the areas within which a hit produces effects. According to the concepts of the classical hit theory, both areas should coincide. Experimental data seemed to indicate, however, that the "hit area" may be considerably larger than the "sensitive area".

This newly-obtained information, as well as certain theoretical considerations, prompted me as far back as in 1931 to abandon the concept of a direct "physical hit" within the sensitive area and instead to assume the possibility of a migration of the physical or chemical energy carrier from

the large "hit area" into the sensitive area. Thus the concept of an "indirect hit" was introduced. The pertinent mechanism may consist in energy migration processes or in the diffusion of the active radicals produced by the radiation.

Together with my co-workers E. SIX, E. REINHOLZ, H. PAULY and K. DOSE, I set out to collect information on this indirect radiation effect. Such information we obtained indeed. The results of experiments on vegetable seeds and pollens conducted at my suggestion by E. REINHOLZ were communicated by me in the course of a lecture 1948. A few examples from these lecture results are shown in Figs. 12 and 13.

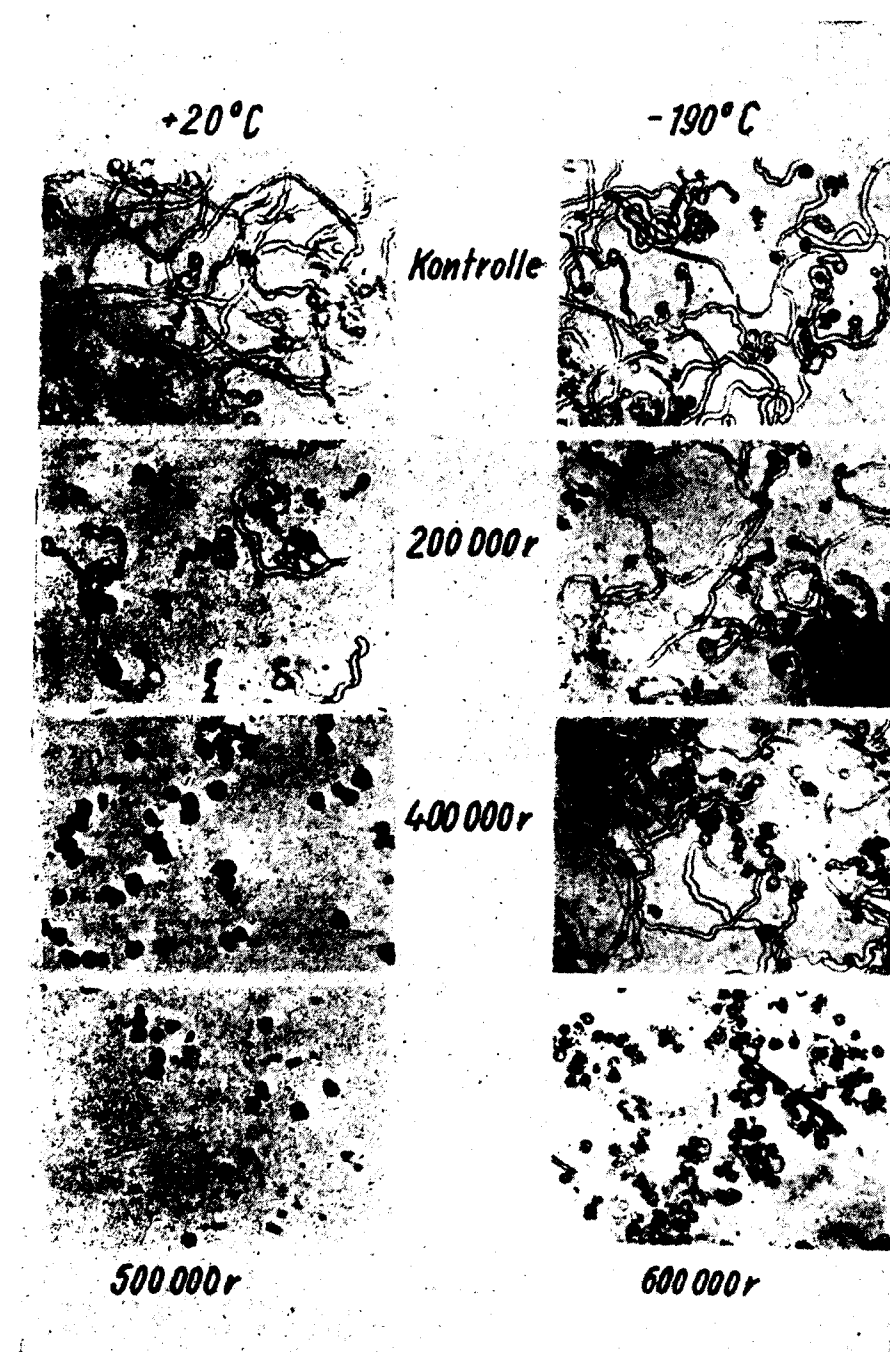


Fig. 12

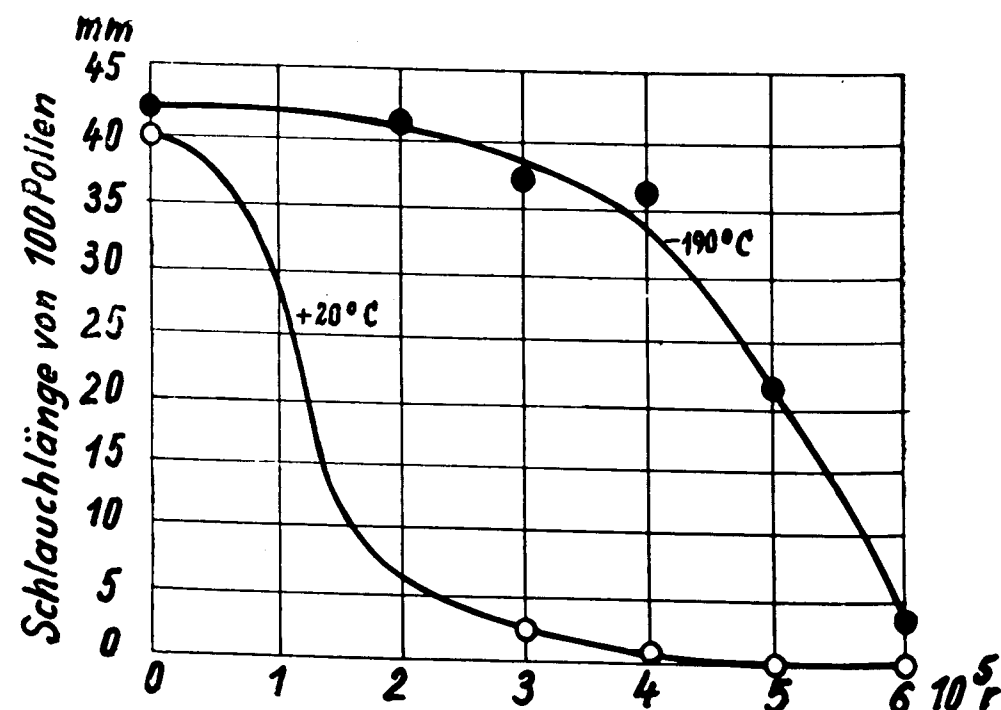


Fig. 13

Growth of *Digitalis purpurea* pollen as function of dose.

● irradiation at the liquid air temperature.

○ irradiation at room temperature (RAJEWSKY AND REINHOLZ).

You will note the variety of irradiated objects exposed to one and the same dose of X-rays at room temperature and at temperature of liquid air. By the low temperature, a large proportion (up to 80%) of the radiation effect is eliminated. It seems quite natural to assume that the diffusion of the energy carriers, probably of the active radicals, is prevented by the low temperature. The remaining effect of 20% can be presumably attributed to the direct hits.

Similar results were yielded by the experiments jointly conducted with H.

PAULY on metabolism in various surviving tissues. The situation of the elementary processes revealed by these experiments is shown in Fig. 14.

As you see, determination of the hit area by means of hit theory analysis yields a volume which leads to the assumption of molecular far too high weight of the substance concerned. If, on the other hand, the diffusion area computed by E. SIX is used as basis, one arrives at the correct order of magnitude for the molecular weight. In this case, too, the occurrence of indirect hits appears probable.

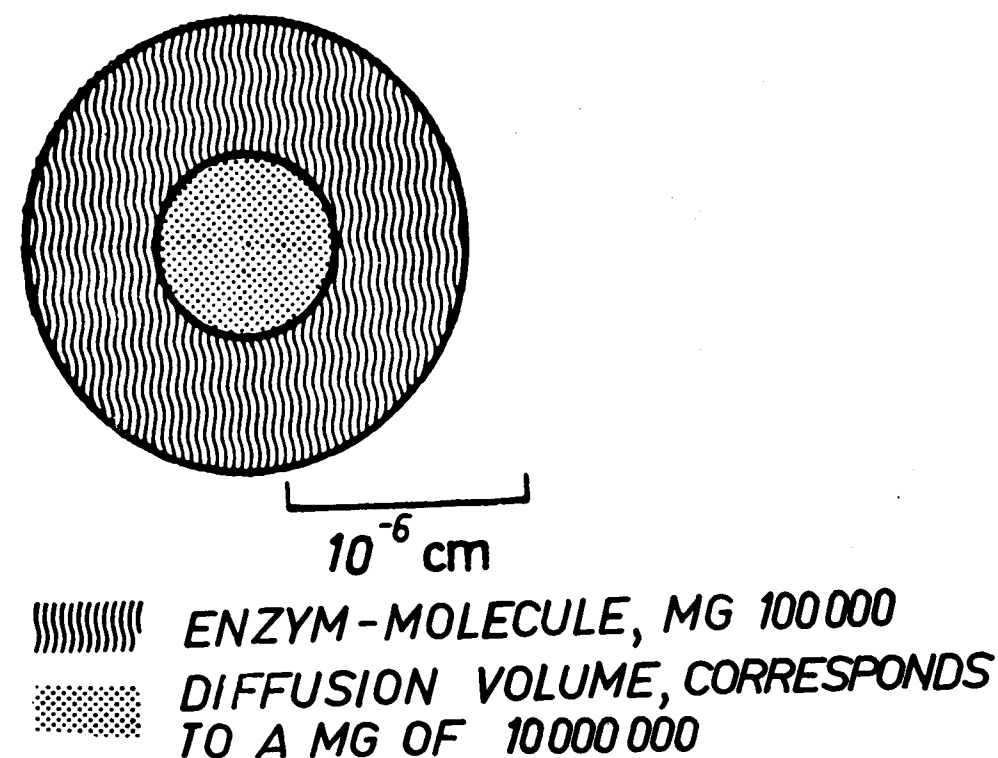


Fig. 14

These new concepts were supported in an even more interesting way by the experiments conducted by my co-worker H. PAULY on cytochrome.

Fig. 15 shows the manner in which, according to H. PAULY, radiation effects on cytochrome vary with concentration. The hit areas calculated from the dose vs. effect curve have been indicated at 2 points. What we notice right away is the surprising fact of a small hit

area at high concentration values. This means at the same time a greater sensitivity of cytochrome to radiation at smaller concentrations. This effect may be explained by the larger free paths in the diffusion area of the radicals.

Ladies and Gentlemen! I have described you the changes which have taken place in certain basic concepts of utmost importance for medical radiology, the concepts, namely of the nature of the

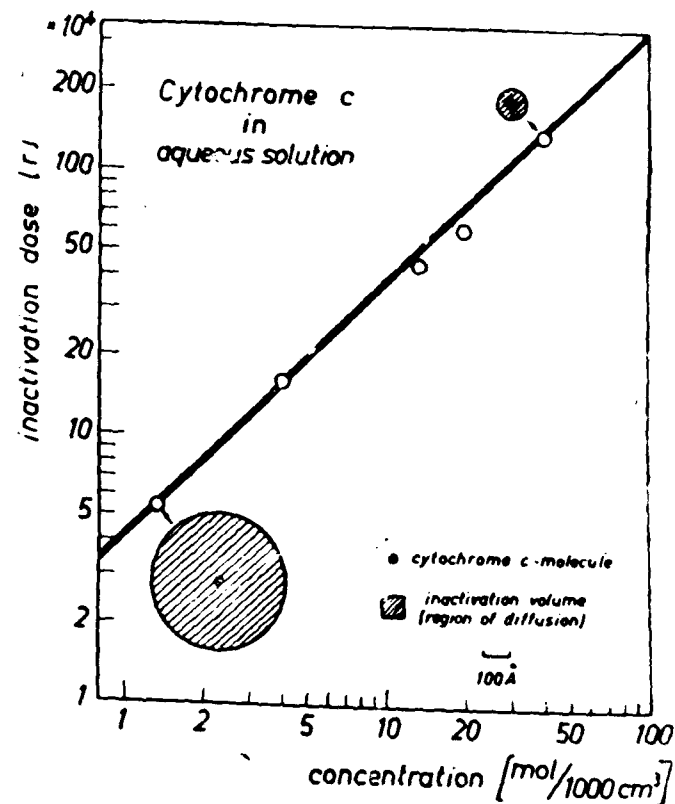


Fig. 15

physical processes and chemical reactions going on in irradiated tissue. Many of the concepts out of which medical radiology has come forth and developed have been replaced by new ones. As a result, the radiobiological picture of these processes and reactions has been widened. Many things have become clearer and more certain. The new concepts permit faster

and greater progress in the development of radiobiology. All the more rapidly will they themselves, too, be replaced in their turn by new, still better concepts. Such is the eternal march of science. The usufructs of this development are enjoyed by medical radiology—and hence by suffering mankind.

—★—

Transverse Tomography in Diagnosis of Intrathoracic Lesions*

BY

S. R. SHARMA and N. G. GADEKAR,

From the Department of Radiology, All India Institute of Medical Sciences, New Delhi.

Watson in 1937 described the procedure of transverse tomography. The technical difficulties encountered in this procedure were overcome by the modification introduced by Vallebona (1948). It has been found to be helpful in localising and assessing the exact dimensions of lesions when radiotherapy or surgical removal is contemplated. The technique has been widely adapted by radiologists in Europe and U.S.A. Results in these investigations have been sufficiently encouraging to warrant the use of this technique as a routine diagnostic aid. To our knowledge, there is no published report on this subject in this country. It is the object of the present communication to discuss our experiences with the technique in a series of cases with intrathoracic lesions.

Principle

Tomography in general has three main components (i) The tube, (ii) The patient and (iii) The film. Out of these, any two are kept in motion with one remaining stationary. In conventional tomography, the tube and the cassette move in opposite directions, whereas in transverse tomography, the patient and the cassette rotate in the same direction with a uniform speed and the tube remains in a fixed position. Thus the points in the selected plane remain identical on the film producing a

sharp image, whereas the points above and below the selected planes, become blurred producing an uneven image. In this procedure, as the patient-cassette distance is more, as when compared to conventional tomography the image produced is magnified. It should be kept in mind that due to the divergence of the rays, the projections on the cassette of the points in the plane to be projected sharply are not identical, so that a certain degree of distortion and blurring is produced. Hence it is necessary to keep the tube as far as possible so that the rays between the body of the patient and the cassette will be approximately parallel.

Technique

The equipment supplied by Philips India Ltd. for this procedure (shown in figure 1) consists of a rotatable seat and cassette-plate, both of which can be rotated by a motor below the seat with a mechanism to complete one rotation during the exposure time.

Selection of the plane.—A number of metal wires are fixed on a piece of cardboard at different heights and a scale is prepared. This scale is attached to the anterior chest wall of the patient and a routine chest film is exposed. The tip of the particular wire nearest to, or at the lesion will give the idea of the plane to be subjected to sectioning

* Paper read at the 15th Indian Congress of Radiology, 1961, New Delhi.

Alternately, a thin strip of an adhesive plaster can be directly affixed to the body of the patient at the level of the lesion, with the help of fluoroscopy.

Alignment of the patient and cassette.—Exact alignment of the patient and the cassette to the tube is achieved by the use of an optical system, which is a simple device consisting of a light source and a lens on which is

marked a circle with a cross. The plane to be sectioned is marked off on a vertical scale at the patient's back. The image of the horizontal line of the cross is first obtained on this mark without the patient on the seat. The vertical line of the cross will naturally coincide with the patient's spine. The cassette is next brought to position by focusing the centre of the circle and the cross on its centre. The patient is seated

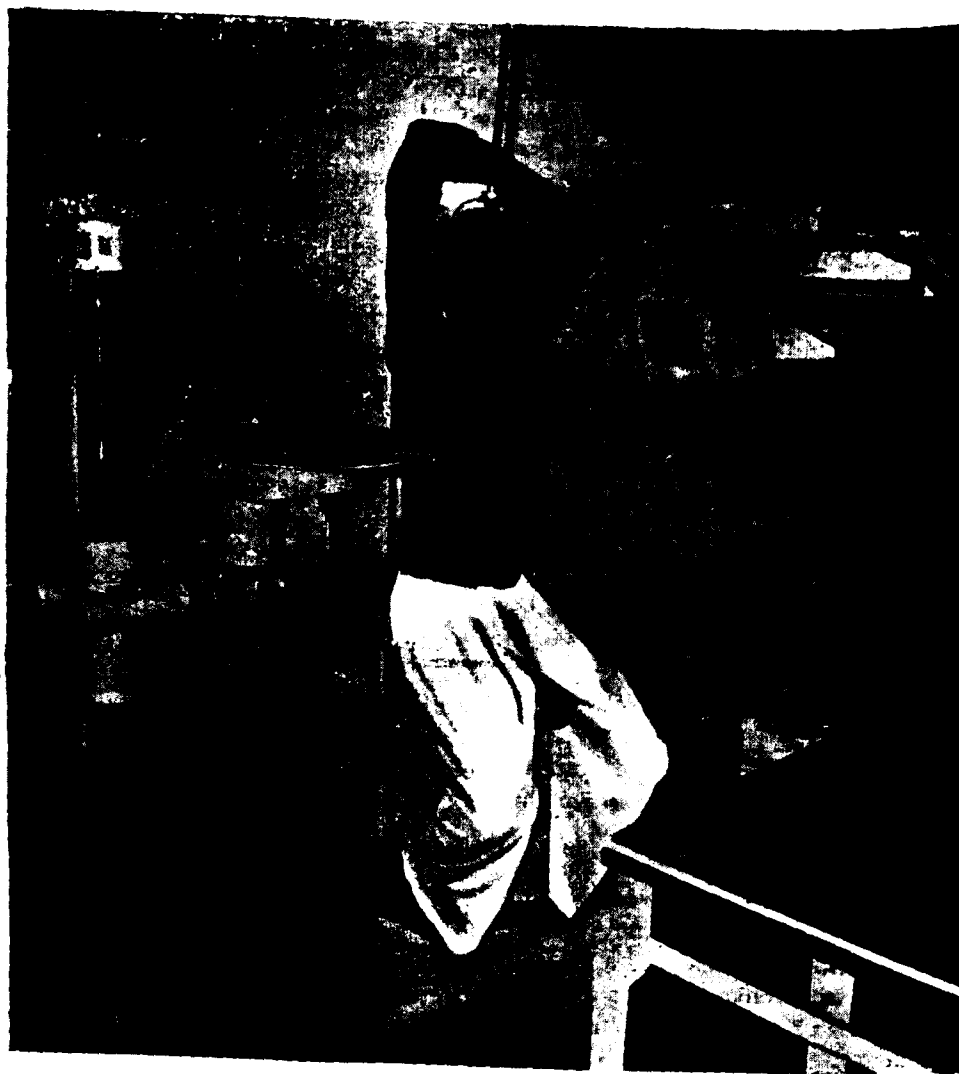


Fig. 1

and totally immobilised with the help of rubber pads and belts.

By varying the angle of the tube-head from 15° to 40° , the thickness of the sectioned plane can be varied and can be calculated with the help of Vieten's formula

$$D = 0.3 \cdot x \cdot \text{tg. } a \cdot \sin a \quad \text{where } D \text{ is the } \frac{x+y}{x+y}$$

thickness of the plane, a is the angle of incidence, x is the tube-object distance and y is the object-film distance. It is also our experience that the tomogram taken with 25° angle of the tube-head is quite satisfactory for interpretation. The exposure is now made with 110 to 120 MA and 90 to 95 KV. A typical exposure requires 2.5 seconds.

The chief difficulty as expressed by Bernard Roswit has been the inadequacy of the standard $14' \times 14'$ film to take in the entire area of transthoracic section. In our hands, however, this film has been found to be quite adequate, provided the various steps of the procedure, particularly the alignment of the three components, are meticulously followed.

Transverse tomography of the chest in two normal individuals and six cases with different intrathoracic lesions have been illustrated in this communication. In these cases the information gained by this technique is of more than academic value, and has been helpful in localising the exact site of the lesion. Also it is obvious from the study of these cases, that the technique will provide a correct three dimensional appraisal of tumours not only in the thoracic cavity, but in other regions like the intracranial cavity where other routine radiological procedure are likely to be of limited utility. In cases where radium needle implants are to be used, this technique will provide the correct anatomical knowledge and the exact position of the radium needle implants. Hence it is needless to reiterate the importance of adoption of this procedure in cases selected for surgery and radiotherapy.

We wish to record our appreciation of the technical guidance extended by Philips India Ltd. and of the technical staff of this department. Thanks are due to Dr. B. B. Dixit, Director for granting the permission to publish this work.

REFERENCES

1. Amisano, P.: "Three Dimensional Stratigraphic Examination, Axial Transverse Stratigraphy, Part II, Am. J. Roentgenol. 71: 777-790, November, 1955
2. Roswit, B., Sol M. Unger, Joseph Stein, Stanley, J. Malsky and Cyprian, B. Reid: "Transverse Laminography: The Third Dimension In Body Section Roentgenography: Application In Radiation Therapy", Am. J. Roentgenol, 81: 130-139, January 1959.
3. Roswit, B. and Sol M. Unger: "Tumour Localization with Transverse Tomography, Diagnostic and Therapeutic Applications", Radiology, 74: 705-719, May 1960.
4. Vallebona: "A Three Dimensional Stratigraphic Examination: Axial Transverse Stratigraphy Part I", Am. J. Roentgenol. 74: 769-776, November 1955.
5. Wilk Stefan, P.: "Axial Transverse Tomography of the Chest", Radiology, 72: 42-50, January 1959.
6. Vieten: quoted in Mediocror, X-Ray Manual, Volume I: 172, Budapest 1957.

Illustrative Cases

Case No. 1



Transverse tomogram in a normal individual at the level of seventh dorsal vertebra, showing the heart anteriorly, the vertebra posteriorly and the pulmonary vessels in between.

Case No. 2



Transverse tomogram in a normal individual at the level of eleventh dorsal vertebra showing the domes of the diaphragm surrounded by the costophrenic sulci. The translucency of stomach bubble is seen in the density of the left dome of the diaphragm.

Case No. 3



(a)

(a) Chest skiagram of 30 years old female, clinically diagnosed as a case of acute respiratory-infection, showing multiple encysted effusions with subsegmental pneumonia.



(b)

(b) Transverse tomogram of the same patient showing encysted costoparietal effusions, one on the left and two on the right side with subsegmental pneumonia.

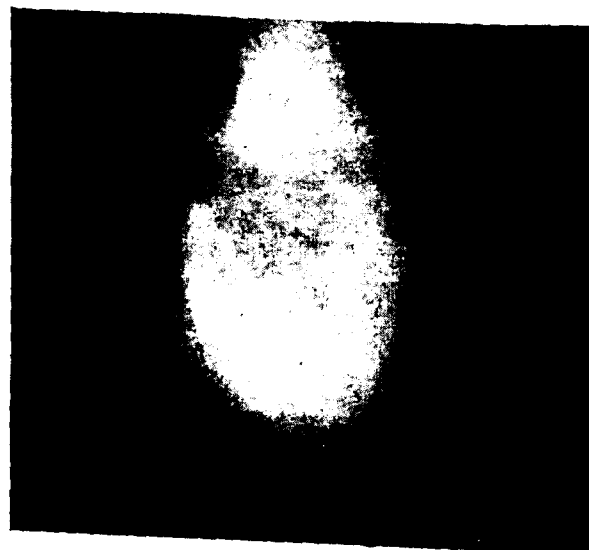
Case No. 4



(a)

(b)

- (a) Chest skiagram of 39 years old male clinically diagnosed as a case of aortic aneurysm, showing the aneurysm of aorta and the calcification in it.
 (b) Left lateral skiagram of the same patient showing the aneurysm of aorta.



(c)

- (c) Transverse tomogram of the same patient showing the aneurysm on the left side of the heart and calcification in it marked by an arrow.

Case No. 5



(a)

(b)

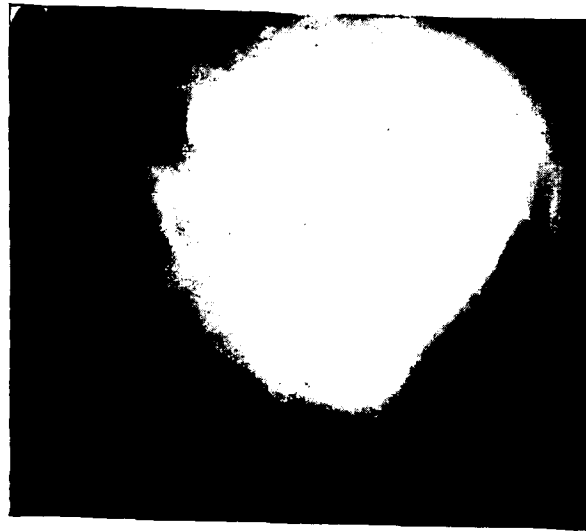
- (a) Chest skiagram of 45 years old male clinically diagnosed as a case of mediastinal tumour, showing a mediastinal mass on the left.
 (b) Barium swallow skiagram of the same patient showing the anterior displacement of the oesophagus by the mass. The mass was nonpulsatile on fluoroscopic examination.



(c)

(d)

- (c) Intravenous aortogram showing the lateral displacement of aorta by the mass, in the same patient.
 (d) Bronchogram showing a complete block of the left main bronchus due to acute bend in it.



(e)

(e) Transverse tomogram of the same patient showing the mass on the left side in relation to posterior mediastinum.

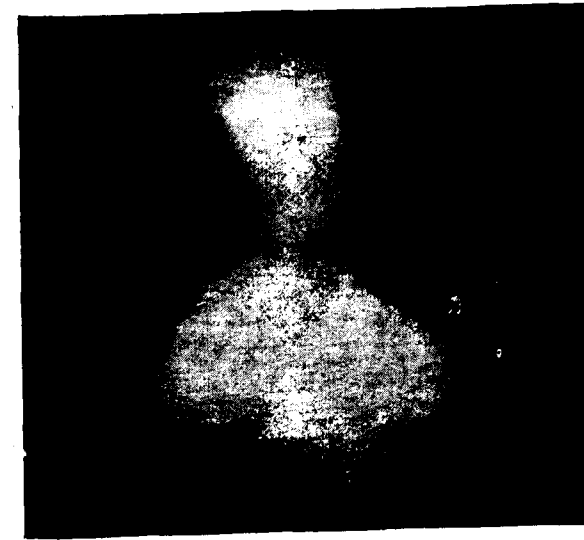
Case No. 6



(a)

(b)

(b) Chest skiagrams of 48 years old male clinically diagnosed as a case of superior vena-cava obstruction syndrome, showing atelectasis of right upper lobe. Conventional tomography showed a block in the right upper lobe bronchus.



(c)

(c) Transverse tomogram showing a mass on the right side of the heart which represents the atelectetic lobe.

Case No. 7



(a) Chest skiagram of 46 years old male clinically diagnosed as a case of pulmonary tuberculosis showing a right mediastinal mass, which was nonpulsatile on fluoroscopic examination. The dye of bronchography which was done in some other hospital is seen in the right lung field.

(b) Lateral skiagram of the chest of the same patient showing the mass related to anterior mediastinum.



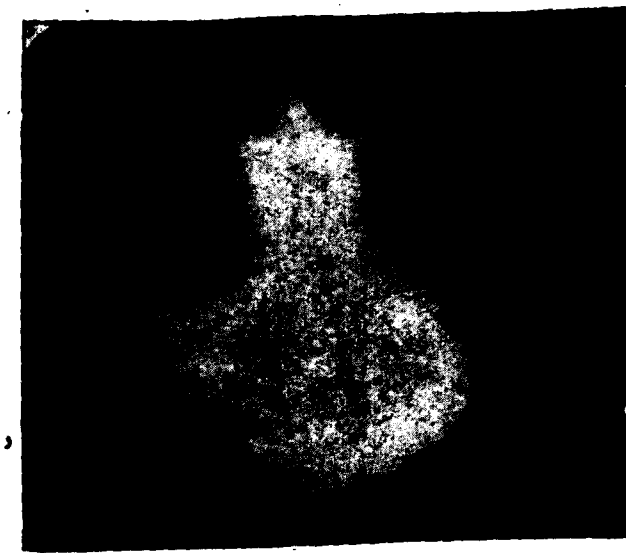
(c)

- (c) Transverse tomogram of the same patient showing the mass on the right side, related to anterior mediastinum. Sputum showed presence of malignant cells.

Case No. 8



- (a) Chest skiagram of 43 years old male, clinically diagnosed as a case of pulmonary tuberculosis showing a diffused haziness in the right lower zone.
 (b) Right lateral chest skiagram of the same patient showing encysted interlobar effusion.



(c)

- (c) Transverse tomogram of the same patient showing encysted interlobar effusion.

FOR
DIAGNOSIS
IN
DEPTH...



Modern medical practice doesn't go by surface symptoms alone. The diagnostician delves deeper—to the inside story that Radiographs tell. And what better aid to diagnosis than Radiographs obtained on Deko Supervidox X-Ray Film, produced to stand up to the rigorous standards of modern medicine?



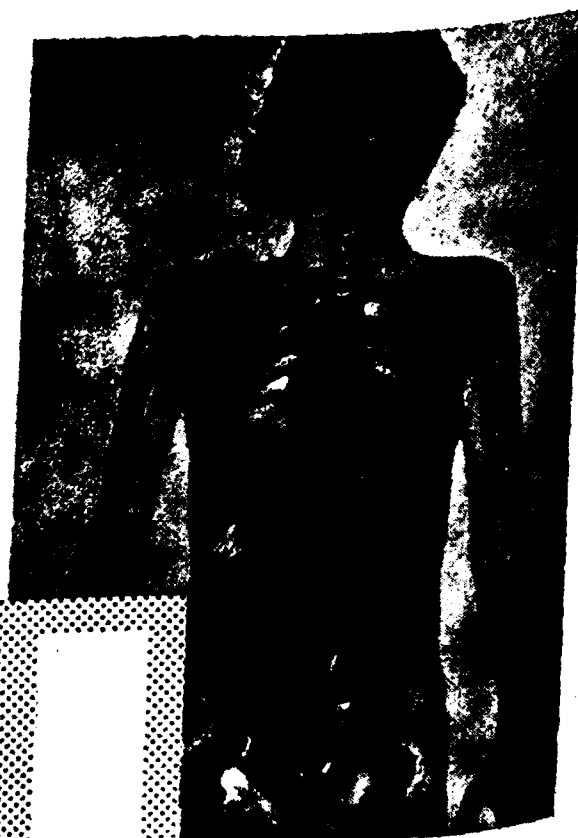
deko
SUPERVIDOX
X-RAY FILMS

Manufactured by AGF FOTOCHEMISCHE WERKE BERLIN-WAGNERWERK G.P.

Sole Authorised Importers

CENTRAL CAMERA COMPANY PRIVATE LTD.

195, Dr. D. Naoroji Rd., 44B, Sandhurst Rd., 11, Govt. Place East, 35/4, Mount Rd., 22A, Asafali Rd.,
BOMBAY-1. BOMBAY-4. CALCUTTA-1. MADRAS-2. NEW DELHI



Intra-Cranial Calcification

(A Report of Three Cases)

BY

B. DAYANANDA RAO, Dept. of Neuro-surgery

M. ANWER HUSSAIN, Dept. of Radiology

K. SUBBA RAO, Dept. of Radiology

Osmania General Hospital, Hyderabad, A. P.

Intra-cerebral calcification, pathological or otherwise, has been studied in some detail and frequently commented upon in literature. The importance of such calcification is obvious because of its significance in not only the anatomical but also the pathological diagnosis of the basic lesion. The incidence of calcification in intra-cranial tumours has been variously appraised from 3 to 40% (Camp 1930). In our series of 96 space occupying lesions eight cases showed demonstrable intra-cerebral calcifications; one out of the three meningiomas, two out of the fifteen tuberculomas, all the three craniopharyngiomas, one brain calculus and one epidermoid. In only four of these eight cases was the calcification considered gross or massive. One of the craniopharyngiomas showed dense calcification but not really unusual for the lesion (Fig. 1). The purpose of this paper is to briefly record three cases whose clinical interest is not, however, entirely confined to the presence of dense and extensive calcification. Two of these cases were epileptogenic.

Case 1.—A male aged about twenty years with a history of epileptic fits for over fifteen years. At first these fits were right sided but since three years tend to occur on the left side invariably. They always start in the lower limb and spread to the upper limb and face with loss of consciousness for over

fifteen to twenty minutes. The intervals between the fits ranged from two to three weeks. There was no other physical disability beyond these fits but of late developed weakness and spasticity of the upper as well as lower limbs on the right side and three years back as the fits switched over from the right to the left side, the weakness and spasticity also was noted in the left lower limb also; a state of what may be well described as "triplegia".

His general condition was excellent and there was nothing relevant in his family or

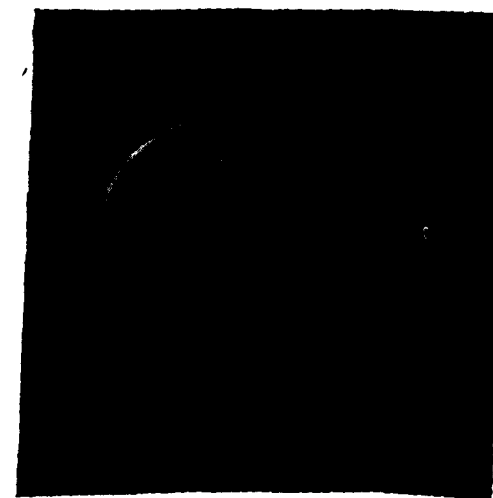


Fig. 1

Supra-cellular Calcification in craniopharyngioma.

previous history. His mental state was definitely below par. All his cranial nerves were intact as well as the ocular fundi, visual acuity and fields. Apart from the state of "triplegia", the only positive finding was a blunting of touch and pain sensation all over the right side of his body and the loss of vibration and muscle joint sense in all the limbs except the left upper one. Blood wasserman was negative and E. S. R. normal. Routine X-ray of the skull showed irregular wooly type of dense calcification in both the parietal regions and that on the right side was bilobed and in the lateral view the calcifications on either side were superimposed. The calcifications were placed on either side of the midline deep to the surface (Figs. 2 & 3).

He was operated on 20-12-1958. Through a left parietal craniotomy the brain was exposed. The gyri and sulci were not well defined but flattened and the cortex on gentle palpation felt tough and unhealthy, but not under tension. The main calcified mass which was located at a depth of about an inch from the surface was uncapped and removed. It was now clear that the process

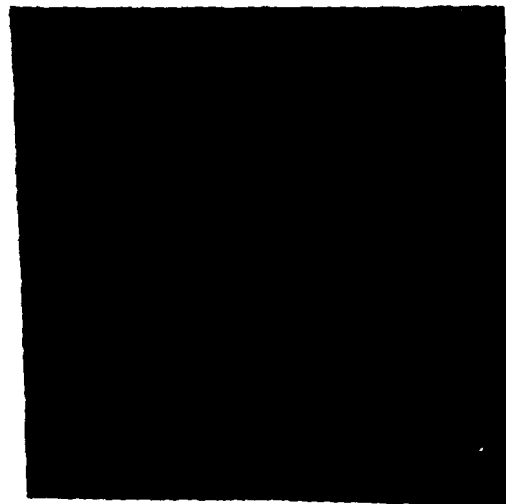


Fig. 2

of calcification had spread beyond the middle line. The brain substance immediately surrounding the 'calculus' was removed for histological examination. Post-operative course was smooth and the patient was discharged after three weeks with an advice to take regularly anti-convulsent drugs as prescribed. When seen on 17-2-1959 and subsequently he was found to be in good physical and mental state but still getting left sided epileptic fits with loss of consciousness though much less severely and less frequently. A suggestion of re-operation to remove the rest of the calcified mass was made to him but not accepted.

Post-operative x-ray of the skull showed the extent of the calcification still left behind (Fig. 4).

Pathological report

The calcified mass was bony hard, rough and irregular in shape with spiky edges all round measuring $1\frac{1}{2} \times 1$ inch and weighed 16.5 Gms. X-Ray of the specimen showed dense calculus with spongy type of radio-lucent areas in between the calcified portions. The calcification in certain areas is ring like

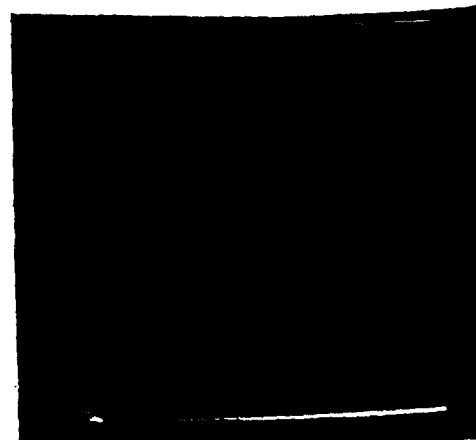
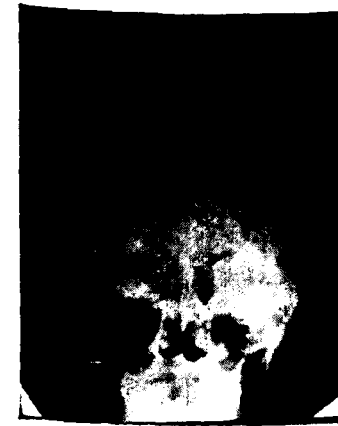
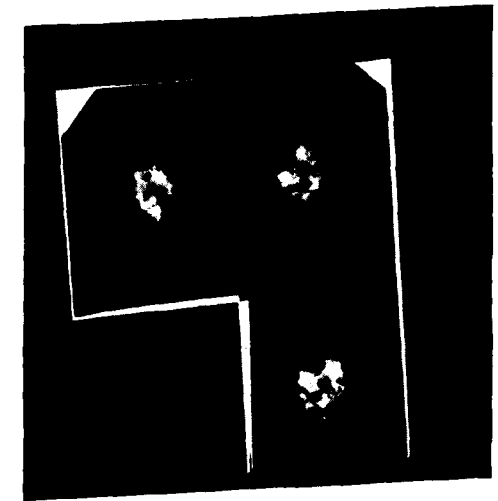


Fig. 3

Fig. 4
Post-operative.Fig. 5
X-Ray of the "Brain Calculus".

in distribution (Fig. 5). Chemical analysis of the stone showed organic material 72% and inorganic 28% as follows.

Organic material 72%	
Proteins	66 Gms. %
Cholesterol	0.73 Gms. %
Cystine	Nil.
Inorganic material 28%	
Phosphates	12 Gms. %
Carbonates	3.6 Gms. %
Calcium	12 Gms. %

Histological examination showed an area of gliosis with normal adjacent vasculature in the tissue immediately surrounding the calculus. There are plaques of recent and old calcification in the zone of gliosis without any relation to the vascular supply (Fig. 6)

Comment

The history of this very interesting case was progressive; an irritative lesion first on the left side with right sided fits and later as this focus settled down and established itself as a paralytic one, an irritative lesion

developed on the right side with contralateral fits. The march of the paralytic symptoms was also from the right lower to the right upper limb and then to the left lower limb, the only limb to be spared being the left upper one. In retrospect one feels that the right side should have been operated first in spite of the greater mass of the calcification being on the opposite side because it is the right side that was actually giving rise to symptoms of epilepsy.

The problem in this case is one of establishing the pathological nature of the lesion so densely calcified. Though lesions like oligodendroglioma and tuberculoma were suggested, yet it is more reasonable to consider the basic process as degenerative rather than neoplastic in view of the long history and bilateral and symmetrical distribution. The association of intracerebral calcification and epilepsy has been extensively studied in recent years. Geyelin and Penfield (1929) described a condition similar to the present one which they called "endarteritis calcificans" occurring in a family affecting the father and the four sons. In the one son operated the histological



Fig. 6

Case 1.—Shows walls of normal small arterioles in the top left, and a zone of calcification towards the right hand corner. This is to impress the association of calcification with normal vasculature.

features found were suggestive of a primary affection of the arteries which first got calcified and their lumen occluded resulting in a necrotic area in the brain which secondarily got calcified. Calcium was found round about the larger vessels. Alexander (1953) reported a case which supported this concept of pathogenesis. But in the present case the basic pathological process appears to be totally different. Histologically the vessels are quite normal and showed no evidence of calcification. Our own impression is that it is a calcified blood clot probably the result of an injury either at birth or infancy, though no such history is actually available. Otherwise it is rather difficult to explain the bilateral and symmetrical distribution of the lesion. Cairns and Jupe (1939) also describe a condition which they vaguely call "brain calculus" "Multiple or single patches of calcification may occur in the brain substance usually in the form of circular or triangular areas of uniform density with sharp margins. They are usually associated with epilepsy and mental deficiency and sometimes with hemiplegia. Sometimes

there is a history of injury when the calculi are probably the result of old intracerebral haemorrhage often at birth or infancy". The present case is one which may truly be termed a "brain Calculus".

Case 2.—A boy aged eighteen years with a history of epilepsy since his eight year and with increasing severity and frequency for the last three years. The fits always start in the left leg and spread to the left arm and then get generalised with loss of consciousness lasting for over twenty to thirty minutes. He had been getting these fits even twice or thrice a day and often at night during sleep. His general condition was good and nothing relevant in the family history. His mental state was well below normal and was prone to be unruly, stubborn and often violent. The only positive physical finding in the C. N. S. on repeated examination was left sided pyramidal signs with weakness, spasticity and exaggerated tendon jerks etc. There was absolutely no evidence of any intracranial hypertension.

Routine X-ray of the skull showed a rounded, uniformly dense opacity about 2 inches in diameter with a clear cut margin occupying the right parietal region well away from the surface (Figs. 7 and 8). He was operated on 23-10-1959. Through a right parietal craniotomy the brain was exposed. The dura and brain were not tense but the cortex appeared shrunk and atrophic in general with a large collection of subarachnoid C. S. F. The tumour was uncapped and during dissection it was found that it was intimately connected to the lateral wall of the lateral ventricle which had to be opened into to effect a total excision of the tumour. Post-operative course was rather stormy for two main reasons. He developed severe aseptic meningitis with a temperature ranging from



Fig. 7

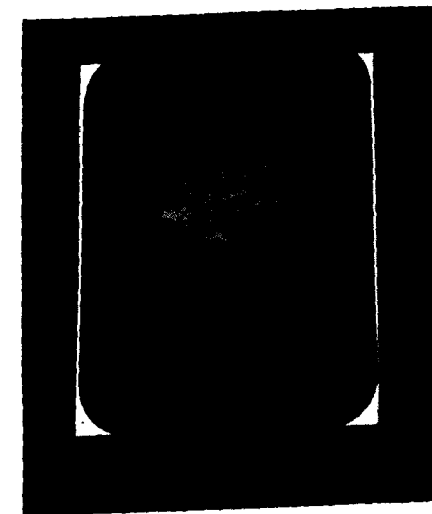


Fig. 8

100° to 103°F. the C.S.F. remaining sterile on culture all the while. Repeated C.S.F. taps were necessary during this period. Secondly the patient became a most difficult nursing problem on account of his stubbornness, violence and continued epileptic fits. The course was further complicated by an accidental fall from the cot during one of the fits on the fourteenth day when the scalp wound gave way completely exposing the brain. This required a facialata

graft to close the dural gap and careful re-suture of the scalp. However, he was discharged after two months of hospital stay when he was afebrile and the fits completely under control with anti-convulsant therapy. His mental condition was also better.

Pathology Report

The gross specimen measured 2 inches to 2½ inches in diameter and had a well

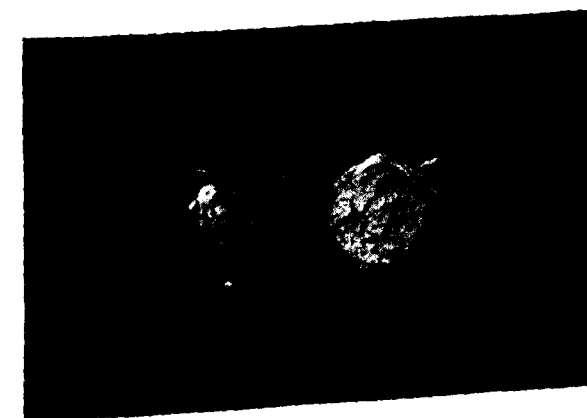


Fig. 9



Fig. 10

Case 2.—Sections from cyst showed thick hyalinised eosinophilic lamellated wall infiltrated here and there by inflammatory cells. In certain areas lozenge shaped clefts due to cholesterol can be seen. Outside the cyst is a condensed zone of glial tissue mainly.

formed and tough capsule on incising which the contents were seen as a vascular cheesy material. The typical pearly appearance was not present (Fig. 9).

Histological examination showed thick hyalinised eosinophilic lamellated wall infiltrated here and there by inflammatory cells. In certain areas lozenge shaped clefts due to cholesterol can be seen. Outside the cyst is a condensed zone of glial tissue. (Fig. 10).

Comment

Epidermoids and dermoids of the central nervous system are rare but benign tumours and hence of supreme importance to the surgeon. Cushing (1932) encountered 15 epidermoid tumours in his collection of 2023 brain tumours; Grant and Austin (1950) reported 22 epidermoids operated upon over a period of 20 years; Tytus and Pennybacker (1956) reported 41 cases of epidermoids of which seven were intra-cerebral; and Fleming and Botterell (1959) reviewed the subject and reported 27 personal cases of which nine were dermoids 18 epidermoids. The only notable Indian contribution seem to be that of Bende and

Dayagude (1947). It is generally agreed that these tumours arise from inclusions of epiblast during development. Clinically they are slow growing and hence do not give rise to symptoms of intra-cranial hypertension. Epilepsy is the commonest presenting symptom. Biggart (1949) mentions that these tumours are occasionally met with during routine post-mortems where no cerebral pathology was suspected during life. Radiologically the two important features are the rather pathognomonic ventriculographic appearances and the incidence of calcification. The ventriculographic appearances are determined by the fact that these tumours are as a rule in intimate relationship with the ventricular system or the subarachnoid space. Though unfortunately in the present case ventriculography could not be performed, yet the close relationship to the lateral ventricle was well demonstrated during the actual operation.

The occurrence of calcification in dermoids and epidermoids is frequently commented upon but the actual experience appears to be otherwise. None of the cases

either Tytus and Pennybacker (1956) or Fleming and Botterell (1959) showed any evidence of calcification. Indeed the latter even remark that "calcification sufficient to be radiologically visible is a rare occurrence".

In view of their benignity the obvious treatment is total excision of the tumour but this is not always an easy procedure as often they may be so inaccessibly placed or so extensively spread that only a piece-meal and intracapsular removal may be the only possible procedure with safety. Tytus and Pennybacker (1956) mention two possible operative and post-operative complications, firstly a tendency to recur when partially removed, and secondly the onset of post-operative aseptic meningitis as observed in ten out of his 41 cases.

Case 3.—A male child of five years was admitted on 28th September 1957 under the care of Dr. S. Balaparameswara Rao, Neuro-Surgeon, King George Hospital, Visakhapatnam, for inability to walk or stand steadily since five months. There was no antecedent history suggestive of meningitis or encephalitis. The parents first noticed a gradually increasing size of the child's head and inability to walk or stand. On admission the child was quite cheerful, co-operative, afebrile but could walk only a few steps with support. Except for exaggerated tendon jerks on either side there were no significant signs in the central nervous system. The head circumference was 21". Ocular fundi showed definite papilloedema. X-Ray of the chest revealed a focus in the left lung. X-Ray of the skull was normal except for some separation of the sutures. A little air was introduced into the lateral ventricles through the separated sutures and this showed gross dilatation of the ventricles (Fig. 11). Mantoux test was positive and the ESR. markedly raised.



Fig. 11

On the presumptive diagnosis of a tuberculoma of the brain possibly posterior fossa, the child was treated with streptomycin and INH. with remarkable improvement. The child was finally discharged after five months of stay when he was able to walk briskly, the ocular fundi returned to normal and the head circumference stationary. The child was being followed up. When he reported last on 12-10-1959, he was re-x-rayed. The X-ray of the chest now showed a calcified spot in the left lung mid zone and also calcified hilar glands. ESR. was 35 mm. 1st hr. Optic discs were pale but with normal visual acuity and fields. There were no demonstrable signs in the central nervous system and no operative procedure was therefore considered necessary. But the most remarkable finding was the radiological demonstration of multiple, bilateral, intra-cerebral discrete rounded opacities with somewhat irregular margins of about 1" to 1½" in diameter (Figs. 12 and 13). X-ray of rest of the body did not show any evidence of cysticercosis.



Fig. 12

Comment

The diagnosis of this case is obviously one of multiple intracerebral tuberculomata. The points of interest are, indeed, several.

1. The paucity of definite and persistent neurological signs inspite of multiple and extensive lesions in the brain.

2. The occurrence of calcification which was absent in 1957 and which is so well marked in 1959. Calcification in tuberculomata is admittedly uncommon but not so rare as statistical data in literature indicate. Several such cases do not reach the clinician or are not likely to be firmly diagnosed as such. Arseni (1959) in a series of 201 tuberculomata surgically treated found calcification in 5.5% of the cases. Time and again we come across calcified spots of all sorts of shapes and sizes in routine X-Rays of skulls of epileptics and undoubtedly a good many of them must be tubercular atleast in our country. Purdon Martin (1937) remarks "cerebral tuberculomata are common and although in only a small proportion of cases

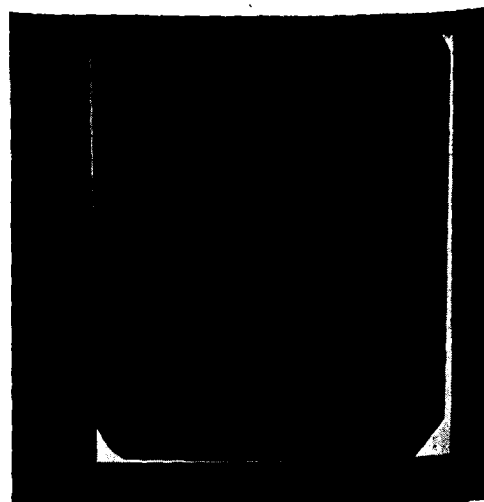


Fig. 13

do the patients survive the acute stage of the lesion, the accumulation of survivors may eventually produce an actual number of patients that is by no means negligible". Now with the modern advances in treatment more and more cases are crossing into the chronic phase and hence one is bound to come across more and more intracerebral calcifications, otherwise so puzzling.

3. There are few conditions which give rise to multiple intracranial calcifications and hence multiplicity by itself is of great diagnostic significance.

Summary

1. Radiologically demonstrable intracerebral calcification was found in eight cases in a series of 96 space occupying lesions of the brain. In four of them such calcification was considered to be massive.

2. Three cases of such calcification, a 'brain calculus', an epidermoid and a case of multiple tuberculomata are described in some detail with relevant comments.

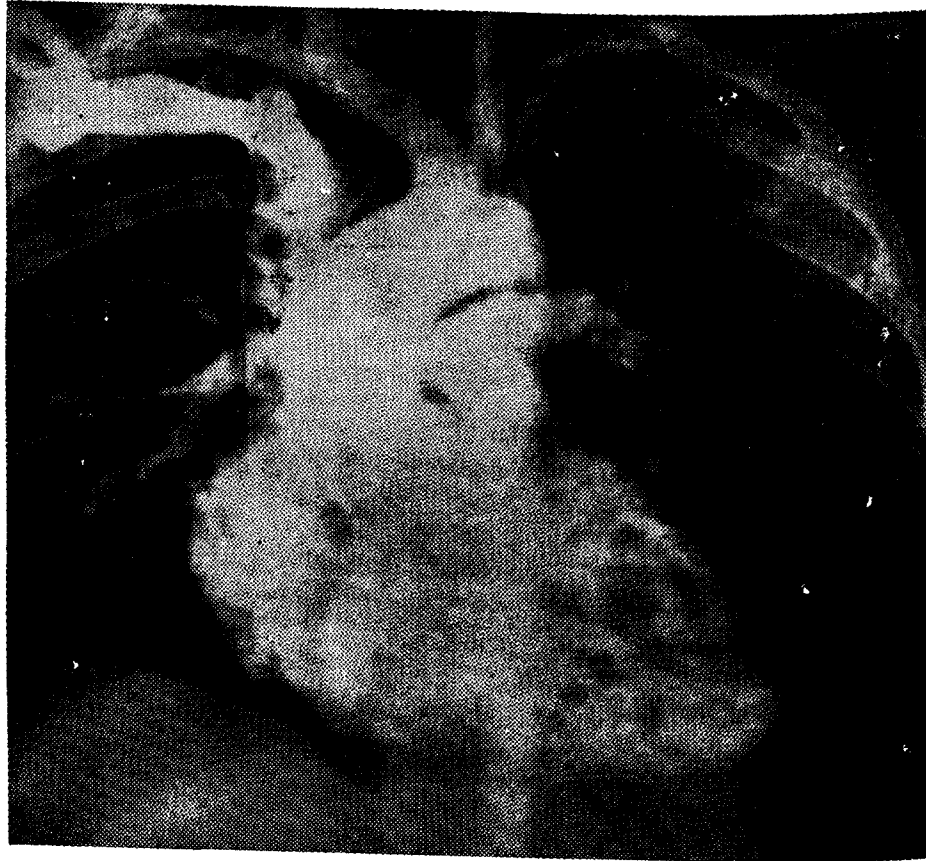
Acknowledgements

Our thanks are due to Dr. M. Bahadur Khan and Dr. V. S. Raghunathan, the Superintendents of Osmania General Hospital, Hyderabad and King George Hospital, Visakhapatnam, for allowing us to use the clinical records and to Dr. S. Balaparameswara Rao, Neuro-Surgeon, King George

Hospital now on deputation to England, for permitting us to make use of his case notes regarding case 3. We are also indebted to Prof. V. Gopal Rao, Professor D. Govinda Reddy and Dr. D. Sundarasiva Rao for the pathological data and Dr. T. R. Seshagiri Rao for radiological help. We are thankful to Dr. Gyan Prakash for the clinical photographs.

REFERENCES

1. Alexander, W. Stewart: Cerebral calcification epilepsy. A report of a case caused by calcified haematoma, *J. of Neurosurg.* 10, 69-74, Jan. 1953.
2. Arseni, C.: Two hundred and one cases of tuberculoma treated surgically, *J. Nuer. Neurosurg. Psychiat.* 21, 308-311, November, 1958.
3. Bende and Dayagude: *Archives of Pathology*, 43, 1947.
4. Big art, Henry, J.: *Pathology of Nervous System*, page 321, Livingston & Co., London 1949.
5. Cairns, Hugh and Jupe, M. H.: *A Text Book of X-Ray Diagnosis by British Authors* H. K. Lewis & Co., London, page 64-65, 1939.
6. Camp, D.: Intracranial calcification and its Roentgenologic Significance *Am. J. Roentgenol.* 23, 615, 1930.
7. Cushing, Harvey: *Intracranial tumours*, Notes upon a series of 2000 verified cases. Springfield, Charles Thomas, 1932.
8. Felming, Ross, J. F. and Botterell, E. H.: Cranial dermoid and epidermoid tumours. *Surg. Gyn. Obst.*, 109, 403-411, 1959.
9. Geyelin, H. R. and Penfield, W.: Cerebral Calcification epilepsy. *Endarteritis calcificans cerebri.* *Arch. Neurol. Psychiat.* 21, 1020-43, 1929.
10. Grant, F. C. and Austin, G. M.: Epidermoids; Clinical evaluation and surgical results, *J. of Neurosurg.* 7, 190-98, 1950.
11. Martin Purdon, J.: Calcified intracranial tuberculomata. *Brit. J. Radiology*, 10, 5-18, 1937.
12. Tytus, J. S. and Pennybacker, J.: A report upon pearly tumours in relation to the central nervous system, *J. Neur. Neurosurg. Psychiat.* 19, 241-259, 1956.



The heart of the problem— exposed

Unmistakably clear on radiographs taken on 'Kodak' X-ray Film, rich in detail, sure in contrast—a clear and reliable guide to correct diagnosis.

The reliability of 'Kodak' X-ray materials is constant because they are manufactured with the finest materials and stored under ideal conditions—despatched to hospitals and radiographers, factory fresh.

'Kodak' X-ray film processed in 'Kodak' Tested Chemicals will give you radiographs of the finest diagnostic value.

Kodak

Limited (Incorporated in England with Limited Liability)
Bombay · Calcutta · Delhi · Madras

SWF-K.1971

Angiographic studies on renal circulation with *Rauwolfia serpentina*

BY

S. P. BASU,

Radiologist, School of Tropical Medicine, Calcutta.

In most cases of essential hypertension the raised blood pressure is attributed to increased peripheral resistance, because the other two factors, *viz.*, the cardiac output and viscosity of blood remain usually unaltered. It has been shown that this increased resistance occurs chiefly in the arterioles, the renal ones in particular. This is in the form of vasoconstriction specially in the earlier phase rather than organic narrowing of the blood vessels, which, however, may occur in course of time.

In animals it has been shown that experimental production of renal ischaemia by partial occlusion of the renal arteries results in elevation of blood pressure. This is considered to be due to the liberation into the circulation of a pressure substance of an enzyme, the so-called renin, formed in the damaged kidney. In essential hypertension of man the haemodynamic effects are practically the same as in experimental renal hypertension. In any case, the exact pathogenesis of the clinical condition is not clear in spite of the extensive experimental work carried out in different parts of the world. Consequently the treatment of hypertension is yet unsatisfactory because there is no specific remedy.

A number of anti-hypertensive drugs are used in treatment of essential hypertension, and of these *Rauwolfia* is an important one of plant origin. Siddiqui and Siddiqui¹ in India isolated certain alkaloids from *Rauwolfia serpentina*. Chopra *et al*² demonstrated

the physiological effects of the alkaloids and scientifically established their anti-hypertensive action at the Calcutta School of Tropical Medicine. Chakraborty and his colleagues³ showed that most of the alkaloids are produced in the root bark and not in the woody portion. It was also observed in this institution by Gupta and his collaborators⁴ with acid insoluble *Rauwolfia* resin, obtained from alcoholic extract of the root of *Rauwolfia serpentina* by repeated treatment with aqueous acids, possesses marked anti-hypertensive action. Following this line of work Mueller, Schlittler and Bein⁵ isolated reserpine from this resin fraction.

Since the pioneering work of Chopra *et al* extensive pharmacological studies on *Rauwolfia serpentina* have been carried out by different workers. Das Gupta *et al*⁶ while working in this institution showed that *Rauwolfia* alkaloids depress the sympathetic nervous system by their action on the central mechanism regulating the blood pressure *i.e.* on the hypothalamus and reticular formation. They have further shown that these alkaloids also depress the peripheral and sympathetic tone by releasing catecholamines.⁷

In view of the fact that renal vasoconstriction in essential hypertension might be due to neurogenic stimuli *i.e.* increased sympathetic tone and that *Rauwolfia serpentina* might act by depressing it leading

to vasodilatation, it was considered worthwhile in visualising the effect of the drug on renal circulation by the angiographic technique. The preliminary reports were reported previously by us.⁸

In the present investigation 15 cats (3.3-5 kg.) were divided into three groups. Under chloralose anaesthesia (70 mg/kg., intravenously without ether induction) a catheter was introduced through the femoral artery of each until its tip reached about the point where the renal arteries branch off from the aorta. Diodone solution (2 ml. of 70 per cent solution) was rapidly injected through the catheter under approximately constant pressure and x-ray picture was taken immediately after the completion of the injection, the time relation of the exposure to the injection being more or less constant each time. No apparent fall of blood pressure was noticed as a result of the administration of the radiopaque dye. No apparent change

was also noticed in the calibre of the aorta. No attempt was made in the present study to observe the effect of the drug administration on the other peripheral blood vessels.

One group of animals X-rayed in this way served as the control for comparison, while the second group was again X-rayed, after bleeding (15 to 20 ml. of blood/kg. body weight) and the third group was X-rayed similarly after the haemorrhage and again 5-20 minutes later after an intravenous administration of *Rauwolfia serpentina*. The preparation used was the alcoholic extract of the root (Dehra Dun variety) in a dose of 0.025 ml./kg. body weight corresponding to 250 mg./kg. of total alkaloids.

The observations are illustrated by the skiagrams. In the control group of animals, the renal vascular network was well visualised in all (Fig. 1), the shadow of the contrast

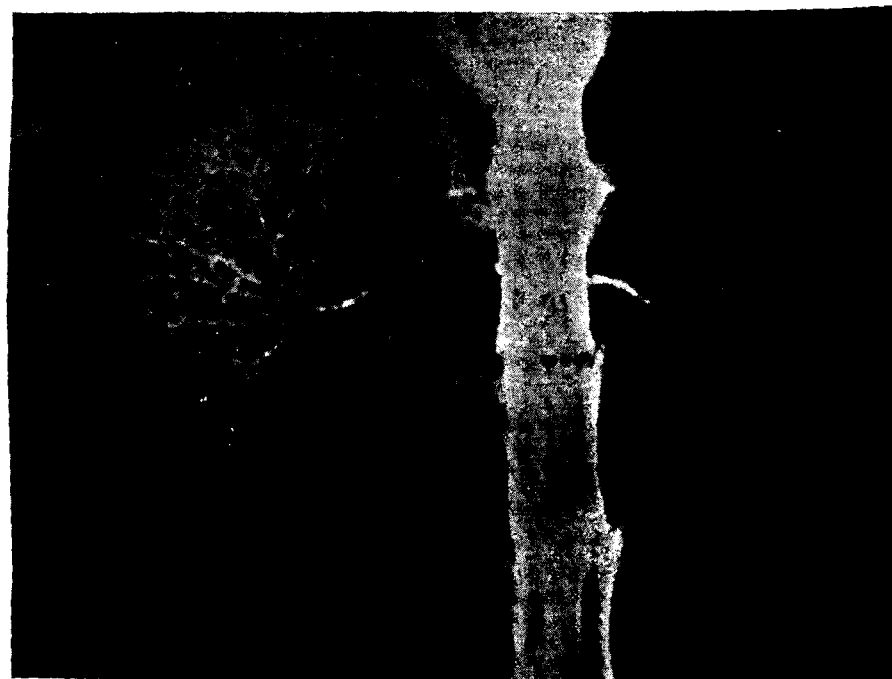


Fig. 1

Angiography showing normal renal artery and its branches after injection of Diodone.

Discussion

media being seen practically upto the outer region of the cortex. In the group of animals subjected to haemorrhage a relative ischaemia of the cortex was observed in all as evidenced by the absence of opacified blood vessels in that area (Fig. 2). A completely different vascular pattern was however seen after the subsequent drug administration as compared to the pictures obtained after the bleeding but before giving *Rauwolfia* (Fig. 3). A dense vascular network was seen, reaching with its finest branches upto the margin of the kidney shadow whereas before the drug administration only the central parts of the medullary vessels were visible due to their content of the radiopaque fluid.

The angiographic technique permits a direct visual impression of blood circulation in the kidney and of the degree of constriction or dilatation of the renal blood vessels, following intravenous administration of a small amount of radiopaque fluid, the distribution of which within the organ being recorded on X-ray films. Using this technique, Pricard and Daniel⁹ could confirm the earlier claims of Trueta *et al*¹⁰ of the existence of an ischaemia of the renal cortex under certain conditions, irrespective of the blood flow through the medulla. It was shown that normally as the contrast medium circulated



Fig. 2

Angiography showing a reduction of calibre of renal artery caused by bleeding after 5 minutes.

Note.—Constriction of vessels causing cortical ischaemia as shown by absence of opacified blood vessels in the cortex.

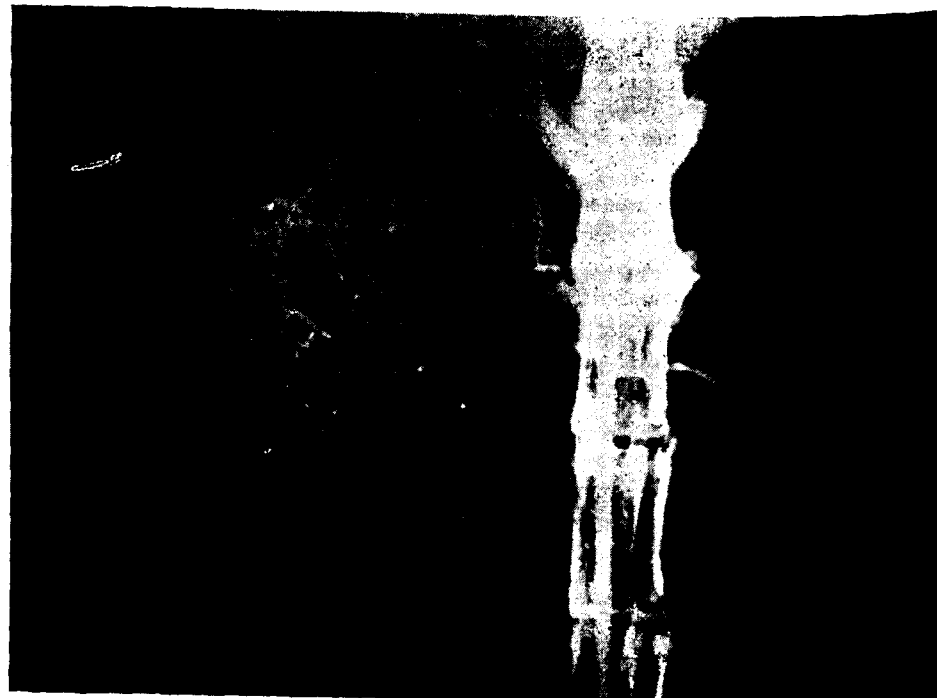


Fig. 3

Angiography showing a dilatation of renal artery and its branches after 5 minutes following an intravenous injection of R. S.

Note — Presence of opacified blood vessels in the cortex indicating vasodilatation.

through the kidney, its shadow is seen to extent almost to the extreme margins of the organ. In cortical ischaemia with a maintained medullary blood flow, the peripheral zone of the kidney remains partially or entirely devoid of shadow and the latter is seen only in the more central parts of the organ.

In the present experiments, the angiographic technique was utilised to demonstrate the action of *Rauwolfia serpentina* on renal

blood vessels. It appears that the *Rauwolfia* alkaloids combated the vasoconstriction in the renal vascular bed induced by haemorrhage. The demonstration of the renal vasodilator action of the drug may be of interest to the clinicians in view of the therapeutic effect of *Rauwolfia serpentina* in the treatment of hypertensive disease in man. Further, the present radiological observations in experimental animals tend to confirm the views of the pharmacologists on the renal vasodilator action of *Rauwolfia serpentina* and offer an aid to our clinical colleagues in the rational use of the drug.

REFERENCES

1. Siddiqui, S. and Siddiqui, R. H. : J. Indian Chem. Soc., 9, 539, 1932.
2. Chopra, R. N., Gupta, J. C., Bose, B. C. and Chopra, I. C. : Indian J. Med. Res., 31, 71, 1943.
3. Chakravarty, N. K., Rai Chaudhuri, M. N. and Chaudhuri, R. N. : Indian Med. Gaz., 86, 348, 1951.
4. Gupta, J. C., Kahali, B. S. and Dutta, A. : Ibid., 32, 183, 1944.
5. Mueller, J. M., Schlittler, E. and Bein, H. J. : Experimentia, 8, 338, 1952.
6. Das Gupta, S. R., Ray, G. K. and Werner, G. : Indian J. Med. Sci., 7, 597, 1953.
7. Das Gupta, S. R., Ray, G. K., Roy, P. K. and Werner, G. : Indian J. Med. Sci., 7, 229, 1953-A.
8. Chakravarty, N. K., Basu, S. P. and Werner, G. : Bull. Calcutta School Trop. Med., 2, 1, 1954.
9. Pricard, M. N. L. and Daniel, P. M. : Giba Symposium on Visceral Circulation, pp. 60, Little, Brown & Co., Boston, 1953.
10. Trueta, J., Barclay, A. E., Daniel, P. M., Franklin, K. S. and Pricard, M. N. L. : Studies on Renal Circulation, pp. 20, Blackwell Scientific Publications, Oxford, 1947.

Refresher Column

BY

D. E. PATERSON, M.D., M.Rad., D.M.R.D.

The Christian Medical College, Vellore.

RECENT ADVANCES IN RADIOLOGY OF THE ALIMENTARY TRACT

General

In hot countries dust, heat, flies, spiced foods, irregular small, or infrequent large meals and general physical fatigue, all play their part in throwing additional strain upon the alimentary tract. Careful fluoroscopic and film examinations with standardised barium preparations will reveal all the conditions described in standard western text books of radiology, but in our experience there is a higher incidence of oesophageal hiatal disorder, of post bulbar duodenal ulcer, and of small intestine disorder in South India than in the West. In this series special emphasis will be laid on these conditions.

Method of Examination

Owing to pressure of work and to financial considerations there is a temptation to restrict the barium meal procedure to rapid examination of only one part of the intestinal tract. If the clinician merely wants a radiological confirmation of a diagnosis he has already made by clinical means, an expensive and time consuming radiological examination may not be necessary at all. If as is usually the case, the patient is referred to the radiologist because of vague dyspepsia or atypical symptoms, then a thorough examination of the entire alimentary tract is essential in every case. Even patients with typical peptic ulcer symptoms may have an associated hiatus hernia or tuberculous terminal ileum.

Opaque Medium

Non-flocculating Barium.—Because of the need to show gastric and intestinal mucosal patterns even in the presence of mucous secretions, a non-flocculating colloidal suspension of barium is essential. New barium suspensions should be tested for flocculation by mixing 1 c.c. of 100% W/V Barium suspension with 10 c.c. water and 2 c.c. Saliva and/or intestinal juice in a petrie dish and comparison should be made with a control suspension in water (Paterson 1958, Astley and French, 1951). Flavouring with Vanilla is usually appreciated. Aromatic flavours may be preferred. There are now available preparations such as "Micropaque" that resists flocculation to a moderate degree, and "Raybar" that is an almost non-floccuable suspension (Laws and Pitman 1960). Small intestine studies may be hastened by intubation methods (Scott Harden 1960) or by "ramming" a small barium meal down with a pint of jel. (Prepacol).

Measured Quantity and quality.—In order to compare transit times and peristalsis in the oesophagus and small intestine, measured quantities of standard preparations should be used. Four standard preparations are needed:—

1. 100% W/V Standard mixture.—For each patient expected on one day four ounces of Colloidal barium powder made up to four fluid ounces with boiled water should be

carefully mixed into a even creamy suspension with a sterile pestle and mortar or with a sterile whisk mixer. This mixture should be kept in a sterile bottle for not more than 24 hours. A few extra doses should be kept ready in a separate bottle for patients who need 8 ozs.

2. *Dilute mixture.*—A bottle of boiled water is kept ready along with a sterile measuring jug so as to be able to measure out equal quantities of the 100% mixture and water.

3. *Oesophageal paste.*—Two ounces of boiled water should be gradually added to four ounces of powder in a sterile pestle and mortar. This mixture should be kept in a sterile cup and measured into a patients' spoon by a sterile teaspoon (or "Micro-trast" can be used).

4. *Solid Barium.*—Can be given in the form of the largest size of gelatine capsules filled with powder. A bottle full of these can be kept ready. Barium lozenges that do not melt may be preferable.

A set of boiled stainless steel or plastic cups should be kept ready on a tray. Some patients can only drink by pouring fluid into their mouths from a cup with an everted lip. Some need a feeding cup.

A set of sterile rubber tubes for sucking barium out of cups should be kept in a sterile bowl.

X-ray Apparatus and Technique.—In taking films of any part of the alimentary tract a short exposure time is the most important factor. Referral to technique in terms of M.A.S. is not good enough. 120 K.V. at 300 M.A. are desirable in order to get an exposure time of less than 1/10th second in fat patients. Short distance (30") and compression where possible may enable exposure time to be reduced. A rotating anode

tube with fine focal spot (1.5 or 2 mm.) will increase the detail and definition of the radiograph only if the factor of movement is reduced by the patient holding his breath and the short exposure time. Scattered rays need to be cut out by a moving radiographic grid, and by keeping the tube aperture down to the minimum. Overcouch bucky pictures may show better detail.

A tilting table with fluoroscopic screen and spot film device are essential as patients need to be examined in erect, in lying, and in trendlenburg positions. A reliable mechanical device for tilting the table is conducive to thorough examination of the patient with small and large quantities of barium in standing and in lying positions. In remote places however, the fewer the mechanical devices (that are liable to go wrong, or be sensitive to mains voltage drop) the better. The mains voltage compensator needs to work on the voltage applied to all relays and motors as well as to the K.V.

Requisition and recording system.—In a busy hospital it is not always possible for the case records to be sent along with every patient for barium meal examination. It is however, desirable that a brief history, clinical signs, and early laboratory findings should be recorded on the requisition. The requisition form may also contain space on which the radiographer can record techniques and number of films taken. A separate form on which the radiologist records details of history and fluoroscopic findings is also useful. The requisition, fluoroscopy form, and copy of the final radiologists report should be filed in the department of radiology for ready reference next time the patient comes. A disease index copy of the final report may be filed for research purposes.

Preparation of the Patient.—Even for examinations of the oesophagus it is desirable

that the patient shall come in the morning with empty stomach. Nothing to eat or drink since 6 p.m. the previous evening should be allowed. Patients need to be given a printed slip in their own language or have this matter carefully explained to them the day before the examination. Nice (1960) has pointed out that an empty caecum may hasten transit of barium to the terminal ileum and so a laxative jel preparation or an enema may prove helpful.

THE OESOPHAGUS

Anatomy and Physiology

Musculature.—The muscularity and power of the oesophagus are not usually appreciated in man because of his erect posture. Details of oesophageal peristalsis and pathology are best seen in the more primitive horizontal or head down positions.

The musculature of the oesophagus consists of circular and longitudinal serous and mucosal layers. There is striated voluntary muscle in the upper third, and involuntary muscle in the middle and lower third. These mixed types of muscles propel food from pharynx to stomach in accordance with control by the vagus (parasympathetic Auerbach's) plexus and by sympathetic fibres that reach the oesophagus from the aortic plexus. In some persons muscle slips may pass from the oesophagus to the aorta and left bronchus (Cooper 1959). Anatomists disagree on the presence of thickening of circular muscle at the lower end of the oesophagus, Cooper in Madras found definite thickening. There is certainly a physiological cardio-oesophageal sphincter. (Berridge and others 1961).

Peristalsis.—Normal Oesophageal contractions are of two types: (1) Primary peristaltic waves (that are initiated by the act of swallowing) pass down from the pharynx to

the phrenic ampulla. The ampulla contracts in one piece with contraction of the supra-ampullary oesophageal ring (Templeton 1958) and relaxation of the infra-ampullary or cardiac sphincter. (2) Secondary peristaltic waves starting from the region of the aortic arch carry the remainder of the bolus to the phrenic ampulla. Abnormal contractions of several different types have been described (Johnson et al 1961). Ripple contractions and tertiary contractions are quite common. Lower oesophageal spasm may be associated with peptic oesophagitis due to reflux of gastric juices in hiatal incompetence or primarily to vagal over activity (Johnstone 1960).

The effect of drugs on oesophageal contractions may be a diagnostic aid. Hyosine hydrobromide 1/100 gr. intramuscularly (a parasympathetic blocking agent) has been seen in many patients to prolong the oesophageal transit time to inhibit peristalsis and to relax tertiary contractions and to close the cardiac sphincter. (Johnson and Northover 1960). Schinz (1954) details the action of other drugs.

Diaphragmatic contraction: in full inspiration has a partial pinchcock action on the lower end of oesophagus. Normally this pinching is at a lower level than the cardiac sphincter (see under Hiatus Hernia below).

Mucosa.—The oesophagus is usually lined throughout by squamous epithelium. The junction between this squamous epithelium and gastric columnar epithelium is in cadavers found to be 4–6 mm. below the external cardio-oesophageal junction (Cooper 1959), but in life various authors (Eddy Palmér 1954 and Johnston 1955) have demonstrated by means of silver clips that this junction may slide up and down in the lower end of oesophagus. There are usually nine to fourteen thin regularly

arranged longitudinal mucosal folds in middle third of the oesophagus, and five to seven of these pass to the cardio-oesophageal junction (Cooper). At the junction very large cylindrical masses of gastric mucosa form a star shaped mucosal valve at cardiac orifice of the stomach (Botha, 1959).

Anchorage.—The oesophagus is retained in position by : (1) the surrounding fascial bed, (2) the mediastinal layers of pleura and the para-oesophageal fascia, (3) the phreno-oesophageal membrane, (4) muscular slips to the aorta and bronchus, (5) the stomach is retained in the abdomen by the peritoneum, the gastro-phrenic ligament, the mesentery and the vessels. Further details of the lower anchorage will be discussed under hiatus hernia.

Radiological Examination

1. *Iodised oil.*—In Children, and in suspected obstruction of fistula of the upper oesophagus 10-20 c.c. iodised oil should be used. Iodised oil should be slowly introduced into the upper oesophagus through a catheter under screen control or otherwise it will be difficult to tell whether the opaque medium has entered the trachea through a fistula or by "spill over" through the layrnx. Spot films should be taken under screen control with very short exposure time.

2. *Standard barium swallow.*—Where there is no question of fistula one ounce of Colloidal barium 100% standard mixture should be given at first. The transit time of this one ounce to the stomach in erect position is counted in seconds. Cross deviations or obstructions, emptying of the phrenic ampulla, and action of the diaphragmatic pinchcock in inspiration are observed.

Where details of the oesophageal and gastric mucosal pattern and oesophageal varices : re to be seen, the patient is now told that

he is going to be tilted into the lying position (a hand on his shoulder will reassure him) and then the table is moved. One more mouthful of standard barium is poured into the patient's mouth and he swallows it only when told to do so. In this way the upper oesophagus is better seen. Transit time to the stomach is counted. After the bolus has passed down, and there is relaxation there may be minimal reflux from the phrenic ampulla. Three long thin spot films are taken on a 10 × 12" film.

The radiologist may at this stage go on to examine the gastric mucosa with only one ounce of barium in the stomach as often "the more the barium the less we see".

3. *Barium meal.*—Where *hiatus hernia*, ulceration, motor disorder or diverticula are suspected, the patient is asked to turn on the face and a bolster is placed under the abdomen. The head is turned to the left and a rubber tube is placed with one end in the patient's mouth and the other in a cup of barium. The patient is now instructed to suck the barium quickly up the tube. Peristalsis is observed during the act of swallowing and long spot films are to be taken. The patient is now turned on the back and is asked to keep his legs straight and raise them (to increase intra abdominal pressure) and to take deep breaths in and out. In expiration the diaphragmatic pinchcock may be relaxed, and a sliding type of hernia revealed, or reflux from the stomach may be seen. Reflux is more often seen actually during the act of turning.

4. *Barium Paste.*—In every case of *minimal dysphagia* where no obstruction can be detected by standard 100% barium cream, two teaspoonfuls of the *oesophageal paste* (microtrast) should be given and the passage of this thick bolus should be observed in the supine position with right side raised. After

such a bolus has passed when the oesophagus is in a relaxed phase, a better "White-washing" of mucosal folds may be obtained, and varices or ulcer crater better seen (Evans 1959).

5. *Solid Barium.*—If still no obstruction is seen, a solid barium capsule or lozenge should be given (Templeton 1958). Even with all these measures a small lesion may be undetected, *oesophagoscopy* is indicated in every case of dysphagia that cannot be diagnosed by the above methods.

Electrocardiograph may reveal a depressed ST segment in some cases. Tertiary contractions of the oesophagus may be associated with myocardial infarction or hiatus hernia.

Pathology

Dysphagia is the most important symptom relating to the oesophagus. No case of minimal dysphagia should be passed as normal until the full routine above has been completed, and even then oesophagoscopy may be needed. Causes of dysphagia may be classified as follows:—

Congenital.—Atresia, vascular ring.

Inflammatory.—Acute-Reflux oesophagitis. Chronic - Syphilis, tuberculous, sarcoid (rare).

Traumatic.—Foreign bodies, Corrosive strictures.

Neoplastic.—Benign, Malignant.

Motor.—Cardiospasm; diffuse spasm; tertiary; sideropenic.

Gastric.—Leather bottle stomach.

Thoracic.—Aorta; glands; Tumours.

Congenital Anomalies

Double oesophagus is very rare (Ansell and Edwards 1958).

Atresia.—There may be vomiting of food (from the upper oesophagus) since birth. The commonest type is where the upper third of the oesophagus blind, and the lower third communicates with the trachea or a bronchus. Where there is a fistulous connection to a bronchus, there will be gas in the gut.

Vascular anomalies of the great vessels may lead to a "ring" that obstructs the upper oesophagus.

Oesophagitis non specific.

Acute.—Reflux of acid juices from the stomach may take place in children and more rarely in adults (under anaesthesia with pregnancy etc). These acid juices cause inflammation and possibly ulceration of the mucosa with resultant spasm and irregular narrowing of the lumen (Johnstone 1960).

Oesophageal moniliasis was described by Kaufman and Levene (1958).

Foreign Bodies

Opaque and non-opaque foreign bodies are just as liable to be swallowed in the tropics as elsewhere. Flat opaque bodies are seen "face on" in the upper oesophagus and "end on" in the trachea. Small non-opaque bodies such as fish bones may be detected by the above mucosal studies or by swallowing a piece of cotton wool soaked in barium. Large lumps of meat may be struck at the site of spasm or old partial stricture in the lower third of the oesophagus (Betts 1953). One man who had swallowed his denture six year earlier developed an oesophago-bronchial fistula. The cause of obstruction in another patient was found to be a whole goat's eye (Thomas T. 1960).

Corrosive Burns

If a barium swallow reveals a long narrow stricture then the patient may need to be cross examined carefully to elicit a history of swallowing a corrosive substance. In all such cases an attempt should be made to get diluted barium meal into the stomach (Thick barium may temporarily block the lumen). The entire length of the stricture in the oesophagus must be demonstrated for the benefit of the thoracic surgeon and a further stricture in the stomach must be excluded.

Benign Tumour and Cysts

Of these rare tumours, Leiomyomata are reported to be the commonest (Terrocol and Sweet 1958) Bronchial cysts and enterogenous cysts in the oesophagus are described (Barlow 1957). One gastric type of cyst seen here presented radiographically as a rounded opacity at the right base (Betts 1953). Intra-Mural tumours show a clear cut filling defect with a crescent of barium, extra mural tumours give filling defects that are smaller than their soft tissue mass, and such defects do not move on swallowing.

Carcinoma of the Oesophagus

Clinical and Pathological features in India.—In 1959 as many as eighty-eight cases of carcinoma of the oesophagus were admitted for treatment at Vellore. In a review of 300 cases of primary carcinoma of the oesophagus, treated here in 12 years period (Thomas Sathé and Gault, 1960) (adenocarcinoma extreme lower end excluded) all were squamous cell except two. The gross types of tumours seen were: Ulcerative 59%, infiltrating 20%, Fungating 11%, Polypoid 1%, infiltrating and ulcerating 8%. The sites of the tumours were:—upper third 14% middle third 55%, lower third 30%, 60-70% of the tumours at all sites were found to be of grade IV malignancy

(anaplastic squamous carcinoma with very little differentiation). The sex incidence was 80 females and 216 males. The average age was 49.3 years. Symptoms in order of frequency were (1) dysphagia (2) pain in the retro-sternal region, back, upper abdomen, left arm, or shoulder (3) dyspepsia, (4) anorexia, (5) vomiting (6) regurgitation (7) salivation (8) weight loss, (9) heart burn, (10) weakness. The average duration of symptoms was 7.4 months. After palliative operations such as gastrostomy some patients survived as long as 2—3 years. After a radical resection a limited follow up of 30% cases has revealed at least 12 patients who are alive after 3½ years. Terracol and Sweet (1958) report a 32% five year survival rate in "curative resection" of favourable cases in the lower third.

Radiological signs.—The short duration of symptoms, the high mortality, and the high degree of malignancy in this disease indicate a very special need for careful radiological examination of the oesophagus. After the above radiographic technique was introduced, we have found it possible to detect carcinoma of the oesophagus at a much earlier stage than formerly.

Minimal ulcerative or infiltrating growths: anaplastic squamous in the middle third, or adenocarcinoma extending from or to the cardiac end of stomach may show the following radiological signs:—

1. *Minimal gradual narrowing of the oesophagus without mucosal defects.*—(Schinz 1954). At these minimal narrowings there may be marked slowing down of the passage of barium lozenges or of thick paste. Such areas are due to infiltrating Scirrhus carcinoma. Oesophagoscopy must be performed. Syphilis must be excluded.

2. *Tertiary contractions above and below the lesions may occur.*

3. *Upset of the mechanism of swallowing* may be seen in the upper oesophageal tumours.

4. Minimal irregular thickening of the longitudinal mucosal folds at the lower end.

5. A serrated outline in a rigid area may indicate superficial ulceration.

6. Thick mucosal folds in the cardiac end of stomach.

Scirrhus infiltrating growths at the lower end may be difficult to differentiate from cardiospasm. The points in favour of carcinoma are:—

1. Peristaltic movements in the middle third pass normally to the upper margin of the growth.

2. The oesophagus tends to taper move abruptly to the narrow area which may have parallel walls.

3. A soft tissue mass may be seen associated with the narrow area of the oesophagus.

4. A gastric air bubble is more frequently seen in carcinoma than in cardiospasm.

Proliferative and bulky growths of varying histological type are those more usually seen in hospital practice. Even these may give rise to few symptoms until the lumen is almost occluded. Radiological signs are:

1. Filling defect in the oesophageal lumen with irregular outline.

2. Irregular narrowing of the lumen with delay in the passage of thick barium paste.

3. Almost complete obstruction of the lumen.

Extent of lesion.—In all such cases a diluted barium mixture should be given first so as to get some barium into the

stomach and to outline the lower border of the lesion. The surgeon must be informed as to the exact length and site of the lesion, and any extension from the lower end of the oesophagus into the cardiac end of stomach must be detected. Long films (15 × 6") in lying prone and supine positions are needed.

Complications.—An oesophago-bronchial fistula may develop in advanced cases. If such a condition is suspected iodised oil swallowed, or through a tube, should first be given in lying supine and then prone positions.

Associated lesions.—Smithers (1955) and Pattinson et al (1956) pointed to the frequent association of hiatus hernia with adenocarcinoma of lower end of oesophagus. Watson and Goodner (1957) have reported 16 cases of carcinoma of the oesophagus with other associated but independent malignant conditions, 14 of these were intra oral carcinomas. In the 300 Vellore cases mentioned above, only one had an associated diverticulum of the mid oesophagus, one had carcinoma of the mouth, thrice had cirrhosis of the liver, and four had adenomas of the thyroid.

Post Operative Oesophageal Radiology

Three major surgical procedures have recently been employed for relief of oesophageal obstruction they are:—

1. *Cervical oesophago-jejunostomy* the Robertson Sargent operation. In this procedure a substernal extra pleural passage is made for loops of jejunum so that even extensive high oesophageal strictures can be by-passed.

In a review of nine such operations at Vellore, the most frequent complication was a temporary salivary fistula at the upper site of anastomosis. Such leaks can be

investigated radiologically by lipoidol swallow lying supine, and if possible in prone position also. The disadvantage of this operation is that the blood supply to the lower mobilised segment may be inadequate (Betts, Thomas and Gopinath 1955).

2. *Oesophago-gastrostomy*.—For strictures and carcinoma of the middle and lower third of the oesophagus, the stomach can be mobilised ante-thoracically and anastomosed even to the cervical oesophagus (Nakoyama 1959). Post operative examination is again by lipoidol swallow to see if there is stenosis or leak at the upper stoma. Later a barium meal is needed to check the emptying of the stomach.

3. *Colon transplant*.—In the search for something more viable than jejunum, in Vellore the right colon was used in twelve cases and the left in four (Betts, Thomas and Gopinath 1960). Lipoidol swallow or barium meal and follow through are used to check the results.

Mega-oesophagus or Achalasia of the Cardia

The etiology of this condition is not yet proved but fluoroscopic observations and pressure readings show it to be associated with a motor disorder of the oesophagus with failure of passage of secondary peristaltic waves down the lower half of the oesophagus (Hurst 1930 and Templeton 1958, Creamer et al 1957).

At operation there is no evidence of hypertrophic muscle or "Cardiospasm." On the contrary the lower segment is thin and atrophic and the upper segment is hypertrophied. Histologically, inflammatory changes have been described in the plexuses of Auerback and Meissner with degeneration of ganglion cells, but these changes

are not localized to a segment (as in Mega-colon) they may involve the entire oesophagus (Terracol and Sweet 1958, 206). It may be that this condition starts as cardiospasm and later the muscle degenerates as does the Crico-pharyngeus (see below).

In an analysis of 22 cases treated surgically in Vellore, the commonest age groups were found to be 20-40 years, the commonest complaints were dysphagia, vomiting, retro-sternal pain, and loss of weight (Gopinath, Betts & Thomas 1956).

Three stages of the diseases are described :—

1. (a) Minimal sensation of retrosternal blockage of food.
- (b) Barium swallow shows hyperactive peristalsis with
- (c) Occasional delay of food near the cardia.
2. (a) Increasing dysphagia, heaviness in the chest, and retrosternal pain.
- (b) The first few morsels of barium enter the stomach easily.
- (c) Then there is a hold up above the level of the diaphragm where
- (d) the oesophageal wall gradually tapers to a point.
- (e) Primary peristaltic wave do not pass beyond the aortic arch, infrequent, uncoordinated muscular contraction may be seen in the lower third.
- (f) There may be a fluid level in the middle third of a dilated oesophagus. Barium sinks to the bottom of the fluid.
- (g) Ripple contraction may be seen.

- (h) Hot water may cause relaxation of the cardia.
- (i) The gastric air bubble may be absent.
- (j) There may be some "milking action" by the diaphragmatic pinchcock.
3. (a) Food no longer induces peristalsis.
- (b) The oesophagus elongates and becomes tortuous.
- (c) The lower end prolapses into the abdominal cavity.
- (d) There may be a fluid level at the thoracic inlet and bulging of the superior mediastinal shadow.

The choice of treatment depends to some extent on the above staging. Hellers oesophagomyotomy is most successful in stage 2, bougies and drugs may be tried in stage I, in stage three the narrow portion may need to be elongated by longitudinal incision and transverse closure (Terracol and Sweet 1958).

Associated lesions.—Such as hiatus hernia, and carcinoma of the lower end of the oesophagus are difficult to detect radiologically. An attempt should be made to get barium into the stomach. Bronchiectasis and broncho-pneumonia may result from spill over into the trachea.

Oesophagospasm

Terracol and Sweet (1958) describe seven types of spasm as follows :

1. *Transitax and acute oesophagospasm*: due to eating or drinking with insufficient mastication etc., psychic origin, metabolic disorders, toxins, or oesophagitis.
2. *Pharyngo-oesophageal spasm*.—Neurotic patients who complaint of inability to swallow.
3. *Lower segment or cardio-spasm*.—Due to inflammation, foreign body, or emotional

turmoil, there may be a violent spasm of the cardia with hyperperistalsis, vomiting and retro-sternal pain.

4. *Curling or corkscrew oesophagus* rare condition usually in old age.

5. *Segmental oesophagospasm*.—Barseny-Te-chendor Syndrome (1927-28) see below.

6. *Persistent spasm and later degeneration (Abel) of the cricopharyngeus*.—Painless progressive dysphagia in old age.

7. *Persistent spasm of the lower oesophagus*.—(Giant muscular hypertrophy) rare-seen in old age. This last condition appears to correspond with the idiopathic diffuse spasm with inflammatory cells, described by Johnstone (1960).

In the course of 2629 consecutive barium meals at Vellore 103 cases of tertiary contractions or segmental oesophagospasm have been seen 202 had ripple contractions only, 80 were of the corkscrew type, and 201 shows tortuosity of the low end, 342 of such cases were associated with hiatus hernia and 779 were associated with duodenal ulcer (Johnson et al 1960). In 12 cases there were seen to be persistent oesophageal diverticula. The symptoms in these various conditions ranged from mild dyspepsia to an angina-like retro-sternal pain. In these cases an electro-cardiogram frequently showed a depressed S.T. segment (possible vagovagal reflux or associated myocardial infarction).

Subcutaneous atropine (0.5 mg.) has been found within one hour to cause elimination of the contractions (Terracol and Sweet). We found that Hyocine Hydrobromide has less side effects and acts more quickly.

Radiologically tertiary contractions are seen as persistent narrow areas. In milder cases the spasm may be present one day and not the next. In more severe cases there may be the beading effect of Teschendorf, sometimes associated with hiatus hernia, and sometimes with peptic ulcer.

Occasionally the corkscrew pattern is seen. This may be associated with or mistaken for tortuosity of the lower end of oesophagus in the sliding type of hiatus hernia.

Sideropenic Dysphagia

In iron deficiency anaemia and sometimes after gastrectomy (Brunton 1960) degenerative changes may occur in the mucosa and submucosa of the upper oesophagus. Small fibrous webs or mucosal haustriations and local spasm of the circular muscle opposite the fifth cervical vertebra may be seen. Malignant change may take place. Murray (1958) has advocated cine radiography for differential diagnosis of pharyngeal disorders. Brunton (1960) advocates timed spot film in A.P. and lateral views with thick barium paste.

Myasthenia Gravis

In this condition there is inability to close the upper pharynx and fauces and to form a bolus. It is dangerous to use oesophageal paste in the cases, but barium swallow with cine radiography is worthwhile (Murray 1958). Prostigmine 1.5 mg. subcutaneously with atropine 1/100 gr. should be given as a diagnostic test. After thirty minutes the act of swallowing should be possible.

Oesophageal Diverticula

Diverticula of the oesophagus may be of three types—pulsion, Traction, and ulcer-diverticula.

Pulsion type (92%) are usually situated above a sphincter (crico-pharyngeus or cardia) or above a constant tertiary contraction.

The traction type (8%) or pseudo-diverticula are usually localized distortions or bulgings of the wall of the oesophagus produced by adherent T.B. bronchial lymph nodes (Terracol and Sweet).

Ulcer diverticula are small pockets or large ulcer craters seen usually at the lower end of oesophagus.

In the series of 2629 barium mentioned above 11 cases showed the presence of oesophageal diverticula in the middle third and one in the lower third.

Other causes of Dysphagia

Other causes of dilatation and obstruction of the oesophagus may be "leather bottle" carcinoma of the stomach, tortuosity of an atherosclerotic aorta and compression by enlarged adherent mediastinal glands.

Mediastinal tumours and aneurysms may displace the oesophagus, but not obstruct it.

Oesophageal Varices - Portal Hypertension

Cirrhosis of the liver and hepato-splenomegaly are common in tropical countries. 50% of cases of portal hypertension are associated with dilated and varicose submucous oesophageal veins, which may endanger life (Evans 1959). Dilated peri-oesophageal and submucous veins may be seen on spleno-portal venography, but only the submucous variety may be detected radiographically. Barium swallow may fail to show oesophageal varices in 56% cases (Steiner, Sherlock and Turner 1957).

It is important to examine such cases in the lying position with standard cream or oesophageal paste (microtrast) and to take spot films when the oesophagus is in a relaxed stage just after passage of a bolus, and when the mucosa alone, is just coated with barium. Atropine sulphate 1 mgm. subcutaneously 30 min. before examination may help (Nelson 1957).

Minimal varices are seen as irregularities and thickening of the normal mucosal folds

(differentiate from air bubbles). Cross varices appear like a "bag of worms" in the oesophagus and there may be dilatation of the lumen due to degeneration.

Hiatus Hernia and Gastro-oesophageal Incompetence

The folly of routine examination of the oesophagus alone, or the stomach and duodenum alone, is seen in a study of hiatus hernia. Before we started to look carefully for hiatus hernia we found only three or four cases a year. Recently in a series of 2,235 barium meals, we found definite evidence of an intra thoracic portion of the stomach in 5% cases and evidence of hiatal disorder or incompetence in 23% cases. (Johnson et al 1961 (2). Sparks (1958) in Britain states that herniation of the stomach through the diaphragm is now found more frequently than any other oesophageal or gastric abnormality.

Cardio-oesophageal valve mechanism and Hiatus Hernia

The factors that are concerned with the mechanism of hiatus hernia have recently been discussed in a symposium (Brit. J. Radiol. 1961 - 471).

1. *The lower oesophageal sphincter.*—This sphincter or high pressure zone contracts in "cardiospasm" and fails to relax in achalasia (Creamer et al 1957) but in infants and in some adults this sphincter apparently does not exist. Such cases may be termed 'Chalasia' of the cardia (Neuhauer and Berenberg 1947) or 'Patulous cardia' (Johnstone 1948), or gastro-oesophageal incompetence (Astley 1956).

Infants frequently take some time to gain control of the cardia, and reflux small vomits after feeds are frequent. Some adults are more prone to belching and

'heart burn' than others. Contraction or relaxation of this involuntary muscle cannot be controlled by will, but belching and hawking which are common practice in South India may cause such relaxation.

Chalasia of the cardia may allow reflux of acid juices into the lower end of oesophagus which may be unnoticed in sleep, or may cause retrosternal pain when abdominal pressure is increased on exertion (Donnelly 1953).

2. *The Hiatus.*—Efficient surgical repair of the hiatus abolishes reflux even if there is no sphincter (Millstein 1961).

3. *Infra Diaphragmatic gullet.*—Creamer Harvian and Pierce (1959) demonstrated by manometric and cine radiography that the pressure differences above and below the diaphragms cause a flap valve effect on the infra diaphragmatic portion of oesophagus.

4. *The mucosal valve:* as stated above big cylindrical gastric mucosal folds form a rosette at the cardiac orifice, and no doubt these folds do have some sort of valve effect in preventing reflux from stomach into oesophagus (Botha 1961 & Berridge 1961). When this gastric mucosa is pulled up by longitudinal muscularis mucosae, the valve may no longer act.

5. *The longitudinal muscle-Traction.*—Peptic oesophagitis due to reflux may cause contraction of the longitudinal muscle of the oesophagus. First the muscularis mucosae may pull up the gastric mucosa into the lower end of the oesophagus. Later contraction of the serous longitudinal muscle may pull the cardiac end of the stomach up through the diaphragm and the hiatus may gradually become widened by a sort of bougie action. Contraction of this longitudinal muscle may also occur due to any

stimulation of the vagus nerve by the vago-vagal reflex mechanism (Rabin 1958, Johnston 1960).

6. *Congenital*.—In other cases there may be a congenital short oesophagus and intra thoracic stomach, or a congenitally wide hiatus.

7. *Degeneration - Pulsion*.—In older age groups degenerative changes and weakness of the diaphragm increased abdominal pressure, etc., may cause a pulsion type of hiatus hernia that may slide in and out through the wide hiatus. Peptic oesophagitis may change the sliding pulsion type into a traction type.

8. *The Diaphragmatic Pinchcock*.—In full inspiration the diaphragm is contracted and the oesophagus is pinched between the shortened fibres of the right crus. Such pinching causes a temporary hold up of descending barium in the Phrenic ampulla in normal patients, and when the ampulla relaxes there is reflux from the ampulla into the oesophagus. When there is a traction hiatus hernia this pinchcock action still may be quite marked, and so the intra-thoracic stomach becomes pinched and it looks like the phrenic ampulla. Pressure studies (Atkinson et al 1957) however, revealed no evidence of increased pressure due to contraction of the diaphragm.

9. *The angle of entry* of the oesophagus into the stomach is normally oblique. This may have some valve action which is destroyed in traction hiatus hernia.

10. *The sling of muscle fibres* that pass from the lesser curvature of the stomach up round the cardia may have some effect (Botha 1959).

11. *The anchorage of the intra abdominal oesophagus* and cardiac end of stomach is mainly by peritoneum and the gastro-phrenic ligament or mesentery.

12. *The phreno-oesophageal membrane* is a translucent membrane filling up the gap between the diaphragm and the oesophagus at the hiatus. The superior layer can be traced up the oesophagus to the level of the seventh thoracic vertebra. The inferior layer invests in a collar like manner the abdominal portion of the oesophagus (Terracel and Sweet 1958).

Classification of Hiatus Hernia and Gastro-oesophageal incompetence

After considering the above factors, previous classifications (Harrington 1940) seem inadequate, we suggest the following:— (Johnson, Paterson and Scudder 1961).

1. *Hiatal disorder*.—Cases where definite evidence of intra-thoracic stomach is not seen, but where there is evidence of patulous cardia, lax hiatus or reflux (incompetence) only.

2. *Reducible or Sliding Types*:—

(a) Congenital-wide hiatus (rare)

(b) Acquired:

(i) Traction:

reflux oesophagitis and contraction of longitudinal muscle

or

reflex vagal contraction of longitudinal muscle.

(ii) Pulsion-Wide hiatus (degenerative or senile).

or

Raised intra abdominal pressure (Pregnancy etc.)

3. *Irreducible*:—

(a) Congenital-short oesophagus and intra thoracic stomach (rare)

(b) Acquired:

(i) Traction-oesophageal fibrosis.

(ii) Pulsion-para-oesophageal (wide hiatus)

or - incarcerated.

Radiological Signs of Hiatus Hernia

The diagnosis of hiatus hernia depends on the radiographic demonstration of an intra thoracic portion of stomach. The difficulty is one of distinguishing between the normal phrenic ampulla, and the small portion of intra-thoracic stomach that may be pulled up above the narrowing that is caused by the diaphragmatic pinchcock. A good definition of Hiatus Hernia is given by Edwards 1961.

In large or irreducible hernias there may be definite or direct radiographic signs such as:—

1. A short straight oesophagus and large intra thoracic stomach (suggests the congenital type).

2. A tortuous oesophagus with an intra thoracic portion of stomach (suggests the pulsion type).

3. An oesophagus passing normally through the diaphragm but with stomach pushed up alongside the lower oesophagus (the para-oesophageal type).

4. A gastric air bubble in the chest or filling of the right cardio-phrenic angle may be the first indication of such gross types of hiatus hernia.

In sliding or small traction hernias there may be less obvious or intermittent signs such as:—

1. *Elevation of the phrenic ampulla and of the cardiac or inferior ampullary sphincter*.—On careful screening examination as described above, peristalsis can be seen to pass regularly down to the phrenic ampulla. Below the dilatation of the ampulla (if any), the cardiac sphincter is seen at first closed. The ampulla can be distinguished from an intra thoracic stomach by the fact that it contracts all in one piece (as does the prepyloric antrum of the stomach) and empties a bolus into the stomach.

2. *The intra thoracic portion of the stomach* may be seen as a separate second dilatation above the diaphragmatic pinchcock. This stomach dilatation however, does not contract at the end of the peristaltic wave, and may remain partly filled when the oesophagus is empty.

In the supine position with straight leg raising in inspiration and in expiration, these details may be more clearly seen.

3. *Tortuosity of the oesophagus above the intra thoracic stomach* is strongly in favour of hiatus hernia. Tortuosity due to tertiary contractions and "corkscrew" type of oesophagus must be distinguished from that due to intra thoracic stomach.

4. *The Gastro-oesophageal ring*.—In 98 out of 450 cases of Hiatal disorder bilateral small deep notches, or a thin transverse ring were seen. In 97 of these cases this ring was definitely below an elevated cardiac sphincter in the upper part of an intra thoracic portion of stomach.

We consider (Johnson et al 1961) that this ring is due to a contraction of circular muscularis mucosa, and that this contraction is at the site of the junction of gastric and oesophageal mucosa. This mucosal junction anatomically is usually found just within the stomach (Cooper 1959) but by the silver clip method it has been found to slide up and down (Palmer E 1953) within the area of a lax cardiac sphincter (see below).

Gastro-oesophageal incompetence or Hiatal Disorder

Even if the above more definite signs of intra-thoracic stomach are not seen, the following signs provide indirect evidence of gastro-oesophageal incompetence or disorder. A sliding intra-thoracic stomach may be seen at one examination and not at another.

1. *Thick gastric mucosal folds in a wide lower end of oesophagus.*—In normal cases only three or four oesophageal mucosal folds can be seen to pass through the cardiac sphincter, and these folds are only about one sixteenth of an inch thick. In hiatal disorder thick gastric mucosal folds may be seen in a wide hiatal portion of the alimentary canal. These gastric folds may be seen in a wide hiatal portion of the alimentary canal. These gastric folds may be up to one third of an inch thick and they are seen to be continuous with these in the stomach. They, therefore, provide supportive evidence of the presence of an intra-thoracic portion of stomach.

Where the diaphragmatic pinchcock pinches below these folds, they may form a mushroom or scalloped filling defect in the lower end of oesophagus.

2. *Wide lower end of gullet or lax cardia and wide hiatus.*—Parallel walls passing from oesophagus to stomach, or gradually increasing calibre from oesophagus to stomach, may be a sign of sliding or traction types of hernia.

3. *Regurgitation.*—If regurgitation is seen on fluoroscopy to be a reflux from below the diaphragm, and not just reflux from the phrenic ampulla, such reflux is strong evidence of Chalasias of the cardia or inefficient valve mechanism and may provide indirect evidence of a sliding or intermittent type of hernia. Reflux of acid juices may later cause a hernia. Reflux may be seen in the act of turning rather than on straining or leg raising.

4. *Tenting or formation of a triangular peak at the cardiac orifice of the stomach* may be an early sign of chalasias of the cardiac sphincter and traction of the gastric mucosa into the lower end of oesophagus.

5. *Motor disorder of the oesophagus* such as persistent tertiary contractions; hypomotility of the upper oesophagus and hyperactivity of the cardiac sphincter and delay in emptying rate of oesophagus (with standard mixture) beyond 14 seconds may all be associated with hiatus hernia.

Clinical significance of Hiatus Hernia.—An intra thoracic portion of stomach may be present and there may be no reflux and no clinical signs provided that the valve like mechanism of the cardia is in working order (Milstein 1961). But even if there is no intra thoracic portion of stomach there may be reflux oesophagitis. Demonstration of a genuine reflux of barium from the abdominal portion of stomach into the intrathoracic gullet would thus appear to be more important than the demonstration of a Hiatus Hernia. Cine radiography may be indicated in order to demonstrate minimal momentary involuntary reflex. Other Lesions associated with hiatus hernia are very commonly found (Johnson et al 1961). The demonstration of a hiatus hernia should therefore make the radiologist more diligent in his search for a peptic ulcer, a small intestinal disorder, carcinoma of oesophagus or stomach, cholecystitis etc.

Conclusion

To sum up therefore it seems that a partial intra thoracic portion of stomach is quite common, and is in fact probably within normal limits in many people. If associated with this intra thoracic stomach, or with the less obvious signs of hiatal disorder described above, there are clinical signs of retro-sternal pain coming on in bed at night and possibly of choking sensations at night, than if postural and peptic ulcer type of treatment has failed; operative repair of the diaphragmatic hiatus is indicated.

Diaphragmatic Hernia and Eventration

Anatomical defects in the diaphragm may be classified into congenital and acquired, traumatic and non traumatic types (Rabin 1958). An analysis of 18 cases of diaphragmatic defects admitted to the department of thoracic surgery at Vellore in a ten year period revealed the following incidence of various types—(Prusty 1958). (i) Eventration - Left 2 cases, right 5 cases. (ii) Hiatus Hernia, sliding - 3 cases, traction 1 case, para oesophageal 1 case, congenital wide hiatus 1 case. (iii) Congenital absence of right posterior dome - 3 cases. (iv) Double right (anterior and posterior) defects - 1 case. (v) Traumatic left - 1 case.

The radiological appearances in these conditions were seen to be very diverse. Eventration is distinguished from phrenic nerve palsy by absence of movement or very minimal paradoxical movement (Rabin) Eventration usually displaces the heart and mediastinum to the opposite side. Filling of the right cardio-phrenic angle may be due to a diaphragmatic hernia, but a collapsed lower lobe or other lung lesion may be difficult to exclude on the right, without a pneumoperitoneum.

A small right diaphragmatic hernia may show as a rounded opacity projecting above the right diaphragm or even two such opacities may be seen. These opacities may be mistaken for hydatid cysts unless a diagnostic pneumo-peritoneum is carried out.

Sub-phrenic and Liver Abscess

Complicating appendicitis, cholecystitis, or perforated ulcer, a peritoneal abscess may develop below the diaphragm. Radiographic signs in this lesion are:—

1. Immobilisation of the affected diaphragm - seen on careful screening (the patient sitting behind the screen).

2. Gas in the abscess cavity under the diaphragm. Radiographs should be taken in P. A. and lateral erect, or P. A. lying on the unaffected side.

3. Pleural effusion, or minimal collapse-consolidation with hazy opacity in the lung above the affected diaphragm.

Liver abscess may occur in many inflammatory conditions such as appendicitis, Harombophleitis and bacterial endocarditis, but it is commonest in the tropics as a complication of amoebic dysentery. Radiographic signs are:—

1. Enlargement of the liver, possibly with displacement of the stomach and transverse colon.

2. Lack of movement, and elevation of the diaphragm on the affected side (may be the left).

3. Gas due to perforation into bile duct or *E. coli* infections, may occasionally be seen.

4. Calcification in a healed abscess may occur.

5. Rarely a liver abscess may rupture into a bronchus. Pneumoperitoneum should not be given in such cases as it may cause spread of the infection.

Free Gas in the Peritoneal Cavity

May be due to perforation of a gastric, duodenal or typhoid ulcer. Post laparotomy air may remain in the abdomen for about ten days.

Films should be taken in sitting position to show gas under the diaphragm, or in very sick patients lying in one side to show gas in the flank.

REFERENCES

1. Ansell, G. and Edwards, F. R. : *J. Fac. Radiol.* 9, 154, 1958.
2. Astley, R. : *Radiology of the Alimentary tract in infancy*, Ed., Arnold. Lond. 63, 1956.
3. Astley, R. and French, J. M. : *Brit. J. Radiol.* 24-321, 1951.
4. Barlow, D. : *Brit. J. Surg.* 45-100, 1957.
5. Barrett, N. R. : *Brit. Med. J.* 2-247, 1960.
6. Betts, R. H. : *Cal. Med. J.* 50-43 and 89, 1953.
7. Betts, R. H., Thomas, T. and Gopinath, N. : *Surgery St. Louis*, 38-555, 1955.
8. Betts, R. H., Thomas, T. and Gopinath, N. : *Ind. J. Surgery*, 22-511, 1960.
9. Berridge, F. R. : *Brit. J. Radiol.* 34-487, 1961.
10. Botha, M. : *Annals R. Coll. Surgeons, Eng.* 25-91, 1959.
11. Brunton, F. J. and Aban, R. E. : *Clinical Radiology*, Lond 11-65, 1960.
12. Cooper, M. M. : *M.Sc. Thesis (Madras University)*, 1959.
13. Creamer, B. Olson, A. M. & Code, C. F. : *Gastroenterology*, 33-293, 1957.
14. Creamer, B. Harrison, G. K. Pierce, D. W. : *Thorax* 14-132, 1959.
15. Donnelly, B. : *Brit. J. Radiol.* 26-441, 1953.
16. Edwards, D. A. W. : *Brit. J. Radiol.* 34-484, 1961.
17. Evans, K. T. : *Brit. J. Radiol.* 32-233, 1959.
18. Gopinath, N. Betts, R. H. and Thomas, T. : *J. Ind. Med. Assn.* 27-81, 1956.
19. Harrington, S. W. : *Amer. J. Roentgenol.* 49-185, 1940.
20. Johnson, C. & Northever, B. : *Personal communication*, 1960.
21. Johnson, C. Paterson, D. E. Scudder, I. B. & Fernando, M. : *Ind. J. Radiol.* 15-169, 1961.
22. Johnson, C. Paterson, D. E. Scudder, I. B. : (2) *Brit. J. Radiol.* 34-499, 1961.
23. Johnstone, A. S. : *Brit. J. Radiol.* 33-723, 1960.
24. Kaufman, S. A. and Levene, G. : *Ann. Int. Med.* 49-684, 1958.
25. Laws, J. W. and Pitman, R. G. : *Brit. J. Radiol.* 33-211, 1960.
26. Milstein, B. B. : *Brit. J. Radiol.* 34-471, 1961.
27. Murray, J. P. : *J. Fac. Radiol.* Lond. 9-175, 1958.
28. Nakoyama, K. : *Surgery*, 45-883, 1959.
29. Nelson, S. W. : *Amer. J. Roentgenol.* 77-599, 1957.
30. Nice, C. M. : *Ind. J. Radiol.* 14-150, 1960.
31. Neuhauser, E. B. D. and Berenberg, W. : *Radiology*, 48-480, 1947.
32. Paterson, D. E. : *Ind. J. Radiol.* xii-68, 1958.
33. Pattinson, J. N. Osbern, G. and Morson, B. C. : *J. Fac. Radiol.*, Lond. 7-91, 1956.
34. Pierce, J. W. : *Modern Trends in Diagnostic Radiology*, Butterworth-London, P. 75, 1960.
35. Rabin, C. B. : *Roentgenology of the Chest - Charles C. Thomas, Ill.*, 331, 1958.
36. Schinz, H. R. et al. : *Roentgen Diagnostics* Grune & Stratton, New York, 1954.
37. Scott Hardon, W. G. : *Modern Trends in diagnostic radiology - third series*, Butterworth, London, P. 84, 1960.
38. Smithers, D. W. : *Brit. J. Radiol.* 28-554, 1955.
39. Sparks, J. V. : *J. Fac. Radiol.* Lond. 9-84, 1958.
40. Steiner, R. E. Sherlock, S. and Turner, M. D. : *J. Fac. Radiol.* *VIII*, 158, 1957.
41. Templeton, F. E. : *Gastroenterology*, 35-498, 1958.
42. Terracel, J. and Sweet, R. H. : *Diseases of the Oesophagus*, Saunders, London, 1958.
43. Thomas, E. Sathe, P. and Gault, E. W. : *Ind. J. Path. and Bact.* *III*, 45, 1960.
44. Thomas, T. : *Personal communication*, 1960.
45. Watson, W. L. and Goodner, J. T. : *Am. J. Surgery*, 93-259, 1957.

(To be Continued)

Abstracts of Radiological Literature

Vincent C. Hinck ; Carl E. Hopkins ; and Bhim S. Savara, Diagnostic criteria of Basilar impression, *Radiology*, April 1961, Vol. 76, 572-585.

Basilar impression may be congenital or it may be acquired as a result of malacic changes of the osseous structures around the foramen Magnum, as in Paget's disease or osteogenesis imperfecta. There are 7 diagnostic methods. (1) Mc Gregor's line is a line from the postero-superior aspect of the hard palate to the lowermost point on the midline occipital curve. Normally the apex of the dens should not be more than 4.5 cms above this line. (2) Mc Rae's line is a line from the ventral border of the foramen Magnum to its dorsal border. If the line of the occipital squama lies above the foramen Magnum, or if it is convex upward, then basilar impression is present. (3) Bull's angle. A line along the hard palate intersects a second line along the plane of the atlas, subtending an angle, which does not normally exceed 13 degrees. (4) Klaus' height index. A line from the tuberculum sellae to the highest point on the internal occipital protuberance, a second line perpendicular to the first extends to the apex of the dens. Values between 36 and 30 mm. reflect a tendency to basilar impression, while lower values are diagnostic. (5) Bimastoid line between the tips of the mastoid processes. Normally it should cross the atlanto occipital joint. (6) Digastic line between the 2 digastic grooves lying just medial to the bases of the mastoid process. The distance of this line to the middle of the atlanto-occipital joints is normally about 10 mms. and decreases with invagination. (7) Temporomandibular line. The distance between the 2 parallel lines, one at the level of the temporomandibular joints and another at the superior

margin of the anterior arch of the atlas is about 30 mms. The distance is diminished in basilar impression.

No measurement will be sufficiently sensitive to identify the mild case of invagination, but a moderately accurate system of measurement will serve a useful purpose as a general diagnostic guide. Of these Mc Rae's line and the digastric line appear to be best. Despite its limitations, the authors feel that Mc Gregor's base line is the most satisfactory available system for measurement on the lateral film. Measurements for Mc Gregor's line are different for the adult male and female. With Fischgold's digastric line, the measurements taken correspond fairly well with those given by Fischgold.

S. N. Deboo, Bombay.

Ole G. Backer, S. Brunner and V. Larsen, Radiologic evaluation of Funnel Chest, *Acta Radiologica*, April 1961, Vol. 55, 249-256.

The primary and secondary operative results in 74 cases of Funnel chest were evaluated radiologically by means of 2 relative measurements of the sternal depression, viz., a fronto-sagittal index and a vertebral index, defined in a series of 445 normal subjects. The fronto-sagittal index indicates the percentage ratio between the maximum internal frontal diameter of the chest and the minimum sagittal diameter measured from the anterior surface of the vertebral column to the nearest point on the body of the sternum. The vertebral index indicates the percentage ratio between the minimum sagittal diameter of the chest, measured from the posterior surface of the vertebral body to the nearest point on the body of

the sternum, and the sagittal diameter of the vertebral body at the same level.

The index fell abruptly during the first 5 or 6 years of life, after which it remained practically unchanged, around a mean value of about 46, throughout the remainder of the growth period.

In Funnel chest, the fronto-sagittal index is below normal, and the vertebral index above normal. After reduction of the sternum, the 2 indices show a rise and a fall respectively. Where the primary operative result is good, the indices are brought within the normal ranges. A recurrence manifests itself in a renewed fall in the fronto-sagittal index and a rise in the vertebral index, as compared with the values found immediately after the operation.

The secondary results of the operation in the 74 operated cases show that 27 per cent were unchanged or worse, 38 per cent were corrected to within the normal range, and the remaining 35 per cent were markedly improved. The results were most satisfactory in cases of severe Funnel chest. Of 28 severe cases, 25 were improved, while in 3 the conditions post-operatively was unchanged (11 per cent). Among the moderate and mild cases, no improvement occurred in 31 per cent and 71 per cent respectively. Among the 74 patients, 49 (66 per cent) had displacement of the heart to the left preoperatively. Out of these 49 patients, 35 had a satisfactory correction of the sternum, but the displacement of the heart remained unchanged in 18. In other words, the heart remained displaced in half the cases, even despite correction of the sternal deformity.

S. N. Deboo, Bombay.

Philip M. Johnson; Ernest H. Wood; Bernhard S. Pasternack and Morris A. Jones, Roentgen evaluation of

pulmonary arterial pressure in mitral stenosis, *Radiology*, April 1961, Vol. 76, 541-547.

Roentgenograms of the chest give reliable qualitative evidence of pulmonary hypertension in mitral stenosis and numerous methods of estimating the degree of hypertension have been devised. The development of Kerley's B-lines is presumptive evidence of pulmonary venous hypertension. The presence or absence of these lines correlates some what closely with the level of "capillary" pulmonary pressure than with mean or distolic pulmonary arterial pressure. It was found that B-lines were never present when the mean left atrial pressure was below 10 mm. Hg. If the mean left atrial pressure was in excess of 24 mm. Hg., B-lines were invariably present.

It was found by measuring the width of the upper part of the descending branch of the right pulmonary artery on 2 meter chest radiograms, that the upper limit of normal width was 14 mms. In all of 68 patients with a vessel width of 15 mms. or more, there was significant pulmonary hypertension.

By means of chest roentgenograms and pulmonary artery catheterisation, correlations were obtained between 51 measurements of mean resting pulmonary arterial pressure and certain quantitative roentgenologic variables in 48 patients.

With the use of statistical methods, several objective roentgenologic parameters for the determination of pulmonary arterial pressure were investigated. Regression equations were derived which gave a strong correlation (r equals plus 0.87) between mean resting pulmonary arterial pressure and 4 roentgen parameters: the presence or absence of Kerley's B-lines, the height in mms. of the pulmonary artery segment, the

width in mms. of the right descending pulmonary artery branch, and the "pulmonary arterial size in centimeters.

Methods described by others for quantitation of pulmonary arterial pressure by roentgenologic measurements were found to have lower degrees of correlation when applied to the group of patients examined.

S. N. Deboo, Bombay.

F. H. Doyle, A. E. Read and K. T. Evans. The mediastinum in portal hypertension, *Jour. Fac. Radiologists*, April 1961, Vol. 12, 114-129.

In portal hypertension, some of the blood from the splanchnic bed bypasses the liver and is shunted by collateral channels to the systemic venous system. These collaterals ultimately drain into the superior and inferior vena cavae. The last link shunting blood from the portal system to the superior vena cava is the azygos and hemiazygos system of veins. Any prolonged increase in the blood flowing through these azygos and hemiazygos veins in portal veins would result in an increase in their diameters.

A METHOD OF MEASUREMENT of the diameter of the azygos vein using tomography is described. In a group of 48 patients (controls) without portal hypertension, the mean diameter of the weight standardised azygos vein was 14.2 mms. (standard deviation 2.6 mms). in 36 patients with portal hypertension, the mean diameter of the azygos vein corrected to a standard patient weight of 140 lbs. was 18 mms. standard deviation 3 mms). The azygos vein was best shown in sections at levels 8, 9, 10 cms. above the table top. The shapes of the azygos shadow may be spindle shaped, almond shaped, pear shaped or like an inverted comma.

There was no good correlation between the size of azygos vein and the extent of

collateral circulation assessed by splenic venography or the size of the oesophageal varices demonstrated by barium swallow. There was no correlation between the clinical features of ascites, encephalopathy or gastrointestinal bleeding and the size of the azygos vein.

The width of the left paravertebral shadow was measured in forty patients with portal hypertension and in 54 control subjects. The width of the shadow is increased on the average in patients with portal hypertension, but it is not a reliable indication of the size of the hemiazygos veins. A very wide paravertebral shadow in a patient with fluid retention may be due to mediastinal oedema. There are other abnormal mediastinal shadows in patients with portal hypertension, it is important to recognise this and so avoid diagnostic errors.

S. N. Deboo, Bombay.

I. Patton and W. C. Harris. Herniation through the foramen of Morgagni, *Br. Jour. Radiol.* May 1961, Vol. 34, 378-383.

Herniation through the foramen of Morgagni is relatively uncommon compared with herniation through other diaphragmatic openings. It does not usually cause symptoms until adult life, and often remains symptomless, being discovered at routine radiography. The diagnosis is a radiographic one, and the diagnosis depends on the type and amount of abdominal viscera contained in the hernial sac. Two cases of hernia through the foramen of Morgagni are described.

Anatomically there is a small opening between the ensiform process and the costal attachment of the diaphragm, and is known as Larrey's fissure or space. Increased intraabdominal pressure might cause herniation at this point. In favour of the

congenital origin of the condition is the fact that it is not infrequently associated with other intestinal abnormalities such as incomplete rotation of the gut. The term "Morgagni" is now applied to any anterior retrosternal hernias, whether they lie in the mid-line or lateral to it, whether it occurs through a true congenital defect or through a weak area.

By far the commonest herniation is seen on the right side, even a hernia through the mid-line defect tends to project to the right. Herniation through the foramen of Morgagni is usually found in adults, the highest incidence is seen in the age group between fifty and sixty years. But the condition is also seen in children and even in infants.

Clinically, the symptoms depend on the size of the hernia and on the type and amount of abdominal content involved. The commonest contents of the sac are omentum and colon, usually the transverse colon. There are 2 distinct groups of symptoms, the one is related to the chest, and the other to the abdomen. The commonest complaint is that of pain in the chest, attacks of cough, breathlessness and dyspnoea. The abdominal symptoms consist of flatulent dyspepsia, abdominal pain and rarely symptoms of intestinal obstruction of the colon.

The diagnosis is made by radiography. The plain chest films show a roundish opacity in the right cardiophrenic angle, which may or may not displace the heart to the opposite side. In the lateral view is seen the retrosternal position of the shadow at its junction with the diaphragm. If an air translucency is seen the diagnosis is made. Even if it is not seen, herniation is not excluded, and a barium follow through investigation should be carried out routinely.

S. N. Deboo, Bombay.

Solve Welin and Folke Brahme. The double contrast method in ulcerative colitis. *Acta Radiologica*, April 1961, Vol. 55, 257-271.

A material of 160 cases of ulcerative colitis examined by a modification of the double contrast method is reported here. Patients with an acute exacerbation of their colitis or with colitis in acute stage no longer receive castor oil the day before the examination, and usually no cleansing enema. Clysodrast is not added to the enema given on the day of the examination but incorporated in the 2 Barium enemas, the first of which extends up to the proximal part of the splenic flexure and the other to about the middle of the sigmoid colon. All patients receive 1 mg. of atropine half an hour before the examination.

According to American literature, colitis is localised beyond proctoscopic reach in 8 to 10 per cent of all cases. In their series, the corresponding figure was 13 per cent. The diagnosis of ulcerative colitis can not be established roentgenographically until actual ulceration can be demonstrated. They have been able to demonstrate the early changes in the mucosa in 23 patients. The double contrast film shows a somewhat irregular finely granular surface. This may give the impression of incipient pseudopolyposis. After 4 months of treatment, during which all symptoms disappeared, roentgen examination showed a regression of changes. The ulcers in the sigmoid had then completely disappeared, only a certain granulation persisted, while the rectum showed a normal appearance. Ulcers may develop in more advanced cases, appearing as pin-point serrations along the edge of the bowel, due to formation of miliary abscesses, which on breaking down produce ulcers.

If the process progresses, it will result in deepening and widening of ulcers, causing a

double outline on the roentgenogram. The double contrast modified method gives much more reliable information than any other method.

All authors stress the risk of perforation and formation of fistulae. Malignant degeneration is one of the most serious complications. The degeneration develops more often in children who had ulcerative colitis. Cancer usually sets in within a phase of ulcerative colitis. Their series included only 4 cases with malignant degeneration.

The authors feel that a periodic roentgenographic and sigmoidoscopic study of the colon is indicated in all cases of long standing ulcerative colitis, since the course is characterised by exacerbations and remissions. The so called "cured" cases should also be reexamined at regular intervals owing to the risk of malignant degeneration.

S. N. Deboo, Bombay.

J. Frimann - Dahl, Radiology in tumours of the Pancreas, *Clinical Radiology*, April 1961, Vol. 12, 73-79.

A survey is given of the various methods of examination for tumours of the pancreas, but the radiological diagnosis is difficult whatever examination is undertaken. The methods are as follows:

(1) Conventional Gastrointestinal study. It is estimated here that only 25 per cent are diagnosed by routine barium study. Common to all is the demonstration of indentations in the contours of the stomach or duodenum caused by changes in the tumour, and changes in the mucosal pattern. These indentations occur first on the inside of the duodenal loop and in the pyloric region. The larger indentations on the stomach and colon, corresponding to tumours of the body and tail may represent inoperable neoplasms or benign tumours such as cysts and pseudocysts.

(2) Pre, inter- and post-operative cholangiography (Biligradin). Cancer in the head of the pancreas may encroach upon the common duct with various types of deformities. Gradually the tumour may occlude the duct causing dilatation of it with consequent block of secretion and eventually there will be non-visualisation of the biliary tree after Biligradin. By operative cholangiography, coincidental filling of the pancreatic duct in its entire length may occur. Indentation, displacement or deformity of the common duct may indicate the presence of a pancreatic tumour. If this is hook shaped and there is a duodenal mucosal pattern defect, a small carcinoma may be diagnosed.

(3) Pancreatography during or after operation establishment of an external fistula. Injection of a contrast medium. In acute pancreatitis the entire gland may be visualised. In chronic pancreatitis only the dilated duct may be demonstrated. In some tumours of the pancreas may be detected.

(4) Pneumotomography - pancreatography (insufflation of retroperitoneal air and insufflation of the stomach. This method is abandoned.

(5) Retroperitoneal insufflation, gas in the stomach and transverse axial tomography. It is possible to see the entire pancreas by this method. In the lateral position, with several tomograms, the pancreas is seen "floating" in the retroperitoneal air in front of the kidney bordered anteriorly by the gas-distended stomach. The head of the pancreas is ovoid or pear shaped, the body appears to have a triangular shape, and the tail thin elongated or rhomboid. In pathological cases the pancreas is not defined well, and when the pancreas is not clearly outlined, the contours being blurred, this may indicate a lesion with some degree of certainty.

(6) Aortography, especially by introduction of a catheter into the coeliac artery. Downward displacement of the kidney indicated by a steeper angle of the renal artery is noted in tumours of pancreas. Common hepatic and gastro-duodenal artery may enclose the tumour. Cranial curving of the coeliac artery is suggestive.

(7) Splenoportography. It will show a wide variation in the form of collaterals corresponding to the site of the tumour.

S. N. Deboo, Bombay.

George Theander and Lennart Wehlin. Deformation of the recto-sigmoid junction in pelvic endometriosis. *Acta Radiologica*, April 1961, Vol. 55, 241-248.

The rectosigmoid junction was studied roentgenographically in seven hundred and five cases to determine the diagnostic significance of a deformity observed in that part of the bowel in 6 out of 8 cases of pelvic endometriosis.

It is a fairly common condition characterised by the extrauterine growth of endometrial tissue or possibly metaplastic tissue resembling endometrium. Circumscribed tumefactions may develop (chocolate cysts) but more often the process invades contiguous tissues with the formation of firm and rigid adhesions as well as a marked degree of puckering and scarring. Rectum and sigmoid colon are clinically important sites of predilection.

Clinical and roentgenographic examinations are often insufficient to establish the diagnosis pre-operatively. Roentgen examination of the bowel may disclose endometriomas of this organ as well as any constrictions resulting from the growth, but such lesions may be difficult to distinguish from true neoplasms or inflammatory conditions. Lija's sign (an increase in the strangulating

effect of endometriosis during menstruation) seems demonstrable exceptionally. The lateral view shows a peculiar deformity of rectosigmoid junction, affecting the anterior wall of the bowel just at the level of the superior rectal valve. It appears as a blunt transverse ridge, projecting back into the lumen. The ridge is resistant to any attempts to distend the bowel by instillation of contrast medium or insufflation of air, and it usually prevents passage of a sigmoidoscope.

Shrinkage of tissue covering a segment of the bowel results in permanent folding of the part of the bowel wall adherent to such tissue. If only the anterior wall is affected, the longitudinal component of the contraction will be predominant and give rise to a forward bending of the wall as well as a transverse arrangement of the resultant folds.

The most important point is to distinguish the deformity from infiltration caused by carcinoma of the bowel, as in 4 of their cases, the deformity caused by endometriosis was first erroneously believed to be due to a primary carcinoma.

S. N. Deboo, Bombay.

Richard M. Friedenberg and Charles Ney. The radiographic findings in neurogenic bladder. *Radiology*, May 1961, Vol. 76, 795-710.

The primary changes of neurogenic bladder demonstrable roentgenographically are those affecting the size, shape and position of the bladder, configuration of the urethra, status of external sphincter, and competence of urethral orifices.

Among the more common causes of neurogenic bladder are such entities as trauma with damage to the spinal cord or cauda

equina, congenital lesions such as spina bifida, multiple sclerosis, syphilis, diabetes mellitus, neoplasm.

The clinical picture varies, some show urinary retention with associated overflow incontinence, others show total loss of urinary control, with inability to initiate or inhibit the stream, continuous dribbling, or involuntary evacuation of urine at regular intervals.

The bladder shape varies widely. It may be rounded or oval, smooth or irregular from trabeculations or diverticulae. 2 kinds of descriptive terms are applied to hypertonic bladders. The pine tree bladder is one wide at the base, gradually tapering as the dome is approached, and is commonly irregular. The hour-glass bladder is one which gives the appearance of an hour glass. It is a term limited to congenital lesions. In neurogenic bladders, unless the patient had been studied prior to the neurogenic lesion, the exact cause of the hour glass appearance may not be ascertained. The size of the bladder varies from a few cubic centimeters of urine to many litres. The large atonic bladders are the result primarily of the lesion and secondarily of obstruction. The large hypertonic bladders are due entirely to the outlet obstruction causing a gradual increase in residual urine. In a recent evaluation of 50 patients, the frequency of later all deviation of the bladder was 64 per cent. Most of the deviations were to the right.

The Funnel urethra is a dilatation of the prostatic urethra, the wider portion is at the bladder neck with gradual distal tapering. Saccular dilatation of the posterior urethra in neurogenic bladder is a rarity, found in hypertonic bladders only. It shows the dilatation widest at the mid-portion of the posterior urethra rather than proximally.

The vesico-ureteral reflux is visualised when contrast material injected into the bladder enters either or both ureters.

S. N. Deboo, Bombay.

F. H. Doyle. Cystography in bladder tumours. A technique using "Steripaque" and carbon dioxide. *Br. Jour. Radiology*, April 1961, Vol. 34, 205-215.

A technique of cystography designed to assist in the diagnosis and assessment of bladder tumours is described using Steripaque, a sterilised suspension of Barium sulphate and carbon dioxide. 150 c.c. of Steripaque is injected into the bladder through a catheter under the fluoroscopic screen. Postero-anterior and right and left oblique views are then taken using the undercouch tube. Then the bulk of the Steripaque is withdrawn using the syringe. A residue of 20-30 ml. is deliberately left in the bladder. Carbon dioxide is then injected. The amount injected depends on the comfort of the patient. The quantity aimed is 150-200 ml. the injection being carried out slowly. There are 3 main types of bladder, as assessed by the shape and size assumed when filled with carbon dioxide. They are (1) bladders of high tone, roughly spherical in shape (2) bladders of moderate tone, adopting an asymmetrical shape in lateral decubitus positions. (3) bladders of low tone assuming a large ovoid shape. The patient is then turned on to each side in turn and posteroanterior films are taken with a horizontal x-ray beam.

In clinical assessment of bladder tumours, the following order of investigation is taken (1) Culture of urine (2) plain and excretion urography. The upper urinary tract has to be investigated, to note any obstructive effects on the ureters and pelvi-calyceal systems. Presence of prostatic calculi or evidence of bladder outflow obstruction

may be noted. Direct evidence of a bladder tumour may be present in the form of calcification on the surface of the tumour, whether the tumour is simple or malignant. But the excretion cystogram is unreliable, as even large bladder tumours may fail to be revealed. (3) cystoscopy. This may fail in tumours on the anterior wall of the bladder, where they are difficult to be seen, and in tumours arising in the diverticula. (4) Steripaque-carbon dioxide cystography. This method has succeeded in all their cases except one, and never failed to demonstrate even the smallest of the papillary tumours. The signs of tumour spread beyond mucosa are (1) rigidity or irregularity of part of bladder contour. (2) pseudo-diverticulum formation (3) displacement of the bladder lumen. (4) fixation of the bladder (5) ureteric reflux.

Contraindications are haemorrhage of any severity, and severe urinary infection.

S. N. Deboo, Bombay.

J. S. Fulton, Ankylosing spondylitis, *Clinical Radiology*, April 1961, Vol. 12, 132-135.

Radiotherapy is a useful method of treating ankylosing spondylitis. Of 805 patients referred for treatment for this disease, 657 (81.5 per cent) were male, the maximum age incidence occurred in the third decade. Some patients gave a history of injury, which may have been a contributory factor. Exposure seemed to be a relevant feature in some cases and stress and anxiety were common.

All patients were placed in one of 3 clinical stages. Stage I showed localised pain in lower spine, and x-ray changes limited to sacroiliac joints, and good posture, Stage II showed generalised pain, an early interference with posture, and x-ray changes beyond sacroiliac joints. Stage III showed bad posture, marked limitation of movements, and

x-ray evidences of ankylosis. As a general rule, complications occurred more often in the later stages of the disease. These included iritis, bronchitis, pulmonary tuberculosis and peptic ulceration. Blood dyscrasias were found in 17 patients, 12 showing changes when the patient was first seen, before treatments were begun. Abnormalities after treatment included one case of plastic anaemia and one of subacute myeloid leukemia. Cancer developed subsequently in seven patients.

Radiation was carried out by one of 4 methods. (a) Trunk baths (b) whole spine (c) limited portions of the spine (d) isolated joints or muscle insertions. Seventy two per cent of patients in Stage I remained improved after five years, but this figure fell to fifty four per cent in the third stage. A better result was always noticed when the whole spine was treated, than in those cases in whom treatment was limited to the area in which symptoms were more marked. The patients were divided in to two groups. the first "high dose" group received 2000 or more to the skin of the back in two weeks, or 750 r to a local area at a single session. The second "low dose" group was given 1500 r or less in two weeks to the skin overlapping the spine, or a long protracted treatment. It was noticed that a high dose level (2000 r) to the whole spine in 2 weeks achieves a better and more lasting result than lower doses.

The benefits of radiotherapy outweigh the risks of damage to the hemopoietic system. The risks are negligible.

S. N. Deboo, Bombay.

Ake Lindblom., Gunnar Soderberg and Harlan J. Spjut. Osteosarcoma a review of 96 cases. *Acta Radiologica*, July 1961, Vol. 56, 1-19.

Ninety six cases of osteosarcoma are reviewed. The authors have classified their cases into osteoblastic, fibroblastic and chondroblastic, depending on the dominant tissue element present. Of the 94 classifiable tumours, 68.7 per cent were of the osteoblastic type, 15.6 per cent were of the chondroblastic type, and 13.8 per cent were of the fibroblastic type. An examination of the microscopic preparations left the impression that degree of differentiation bore little relationship to the survival of the patient, histologically the neoplasms of the 5 year survivors were not distinguishable from those in which the patient died in a short time.

57 per cent of the lesions were located in the region of the knee. Of the 86 cases eligible for 5 year survival, 18.5 per cent lived more than 5 years from the time of the diagnosis. Of the 51 cases eligible for 10 year survival, 17.6 per cent lived more than 10 years. The 5 year survival covering all 96 cases was 16.6 per cent. The age of the patients possibly had some effect on survival. 26 of the cases were more than 25 years old and 26 cases were in the age group of 3 to 13 years. The older group had a somewhat better survival rate than the younger.

The survival rates for the preoperatively irradiated 50 cases and the 28 directly operated cases were identical at 1, 2 and 3 years, but were better for the directly operated cases at 4, 5 and 10 years, 36 of the cases had amputation or resection done without prior biopsy. The chondroblastic and fibroblastic tumours had a better survival rate than osteoblastic ones.

Radiologically bone destruction was seen in 72 cases, bone sclerosis in 57, radiating bone formation in the soft tissue component in 57, destruction of the cortex in 56 and periosteal bone formation in 59 cases.

No standard method of therapy was used for their cases. The treatment was predominantly surgical. 78 patients had amputation

or resection of the affected part, 18 were treated with irradiation. Irradiation doses in these 18 cases were not high, the tumour dose rarely exceeded 3000 r. The effects of irradiation was observed in several cases. There was calcification and ossification in the tumour, and was detected in the soft tissue component of the tumour, and in a few cases, the tumour became surrounded by a shell of calcium. Prognosis is very poor.

S. N. Deboo, Bombay.

C. J. Barton. Tuberculosis of the Vault of the skull. *Br. Jour. Radiology*, May 1961, Vol. 34, 286-290.

Three cases of Tuberculosis of the vault of the skull are presented here. It is mainly seen in young people, about 75 per cent of cases are seen before the age of 20. There was no history of trauma in the cases reported here. The skull lesion is usually secondary to a primary focus elsewhere in the body. The most commonly associated lesion is pulmonary. In a high proportion of patients, there is an associated lesion elsewhere in bone. Only one of those reported here shows this.

Clinically, the appearance of a fluctuating swelling in the scalp is usually the first evidence of the disorder. The involved area is sometimes tender to palpation. Pain and headache are rare.

Skull foci are mostly seen in the frontal and parietal bones, less common in occipital and temporal bones, the ratio being five to one. Of the lesions seen in the cases reported, four were in the frontal bone, and one in the occipital. Two types of lesions are seen in the skull; the circumscribed or punched-out type, and the progressively infiltrating type. When the response to infection is good, the lesion develops slowly. Extension takes place through either table. If the outer table is destroyed, a fluctuating swelling develops, and subsequently the skin breaks down with the formation of a

sinus discharging pus. The sutures form no barrier to the perforation and advance in either table. If the process is rapid, sequestration may take place.

The first change is a small area of translucency due to decalcification. As the lesion progresses, the area of decalcification increases in size, and bone destruction occurs. If there is progressive infiltration, the area of infiltration spreads in an irregular fashion, the edge is less well defined, and destruction of the cortex may be seen at several points. Bone sand or actual sequestra may be visible.

The rapid and almost complete reconstruction of bone follows specific therapy (P. A. S., and I. N. H.). The prognosis is good in both types of the lesions. Radiological evidence of repair lags behind clinical evidence of improvement. As treatment is continued, the margin of each lesion becomes less well defined on the radiograph and new bone forms from the edge.

S. N. Deboo, Bombay.

Philips Rubin and Dusdee Prabhasawat. Characteristic bone lesions in post-irradiated carcinoma of cervix, *Radiology*, May 1961, Vol. 76, 703-717.

The characteristic appearance of bone metastases and destruction in cervix carcinoma reflects its mode of spread. Three groups are recognised (1) Direct extension (2) lymph-node involvement (3) hematogenous metastases. The changes are mainly a result of direct invasion of bone or lymph nodes.

The earliest changes due to direct invasion of the bony pelvis by parametrial infiltration are along the compact cortex between the inferior margin of the sacroiliac joint and the iliac spine near the sacroiliac notch. As cancer invades more deeply, the ileopectineal line becomes more ragged, and a

sharply circumscribed lesion with irregular margins is noted. Extension into sacrum and destruction of the sacroiliac joint have been reported. Acetabular surface of the hip may be destroyed, with intrapelvic protrusion of the femur.

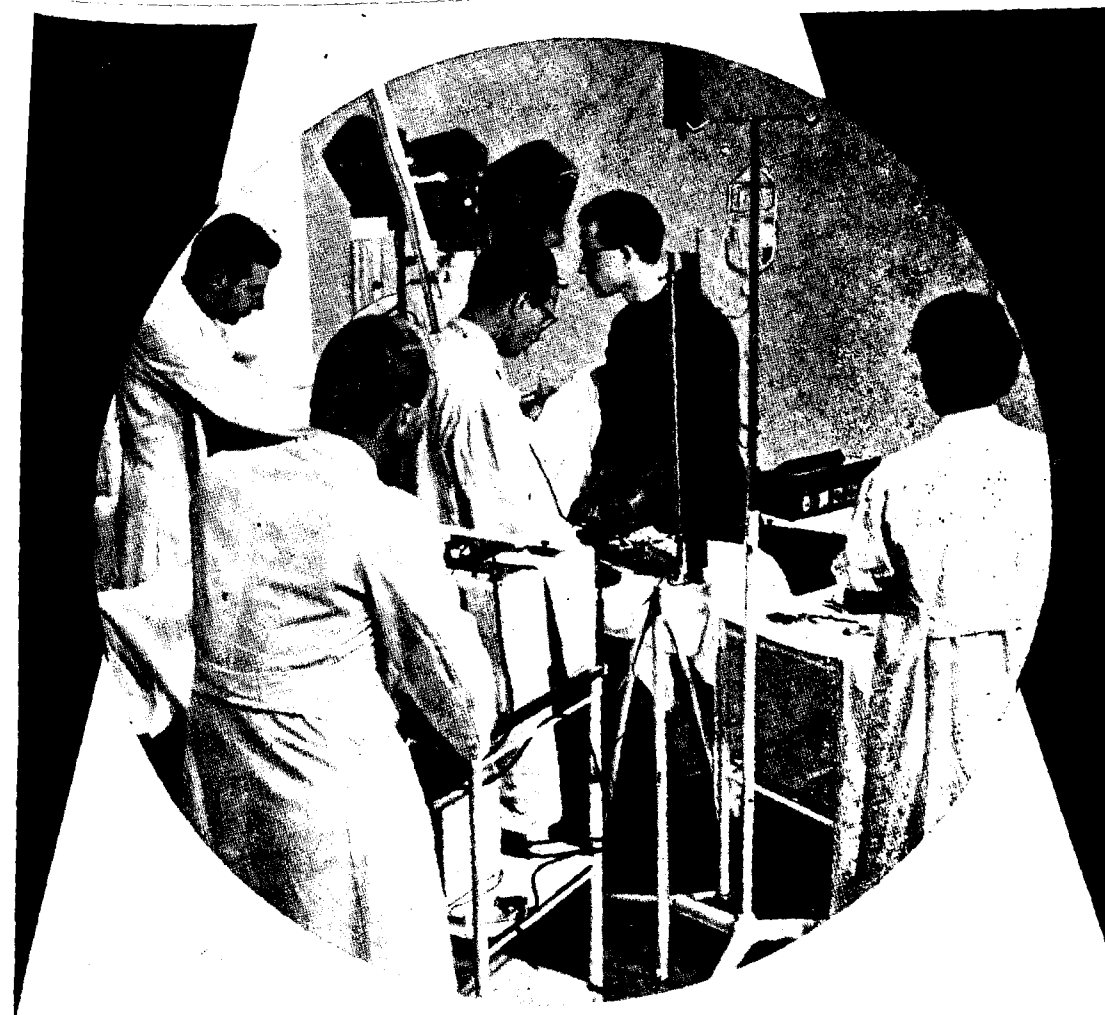
In lymph node metastasis, the earliest vertebral changes are a destruction along the lateral aspects of the lumbar vertebrae usually unilateral. The articular process on the affected side are more apparent. Associated with the lytic lesion in the bone is a soft tissue tumour representing involved nodes, and which may be recognised in the loss of definition or the bulging of the psoas muscle outline, and displacement of kidneys and other abdominal organs.

Hematogenous metastases are indistinguishable from those of other neoplasms. Most metastases are located in bones of the lower extremity - the femur, tibia, fibula, patella, calcaneus and talus, and pathological fractures are occasionally associated.

Radionecrosis of the pelvis is shown by a predictable pattern of bone sclerosis and cortical fractures. If the fractures are unrecognised, displacement of the parts and non-union may occur. Fractures occur in femora, pubis and ilia depending on portal arrangements.

Radiotherapy to the metastases relieves the pain. A tumour dose of 2000-3500 for vertebral lesions and upto 4000 r for lesions of the extremities is given. For therapy to be effective, the entire soft tissue mass must be included in the treatment field. For pelvic metastases, for relief of pain, a dose of 4000 to 5000 r is required and can be rarely given unless a year has elapsed since the original therapy. Supervoltage irradiation may be used in such cases.

S. N. Deboo, Bombay.



More information—less radiation!

PHILIPS 9-inch Image Intensifier used in heart catheterization

In heart catheterization with image intensification the doctor receives more information, while the patient is exposed to less radiation in spite of repeated and prolonged fluoroscopy. The possibility to switch over at once to cineradiography or to visualize the X-ray image via a t.v. link brings a new conception to group viewing.

For further particulars write to:

PHILIPS INDIA LIMITED

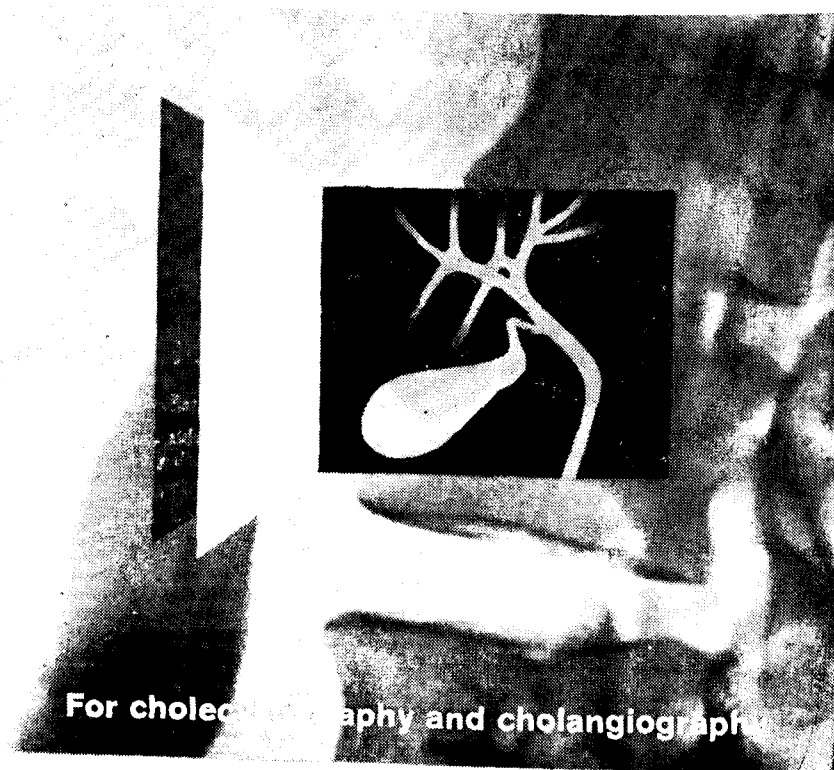
Calcutta Bombay New Delhi Madras Patna Lucknow Kanpur Bangalore



PHILIPS *in the service of the medical world*

PHILIPS INDIA LIMITED

24042



For cholecystography and cholangiography

Oral biliary contrast media

new! Biloptin Solu-Biloptin

Biloptin. Sodium salt of *N*-(3-dimethylamino-methylenamino-2,4,6-triodophenyl)-propionic acid.
6 capsules, each of 500 mg.

Solu-Biloptin. Calcium salt of *N*-(3-dimethylamino-methylenamino-2,4,6-triodophenyl)-propionic acid.
Bottle with 3 g. of active agent in powder form for the preparation of a suspension.

**Improved oral radiological diagnosis
of the biliary system**

Exceptional tolerance

**No disturbing residua of contrast medium
in the bowel**



SCHERING A.G. BERLIN/GERMANY

For further particulars contact:

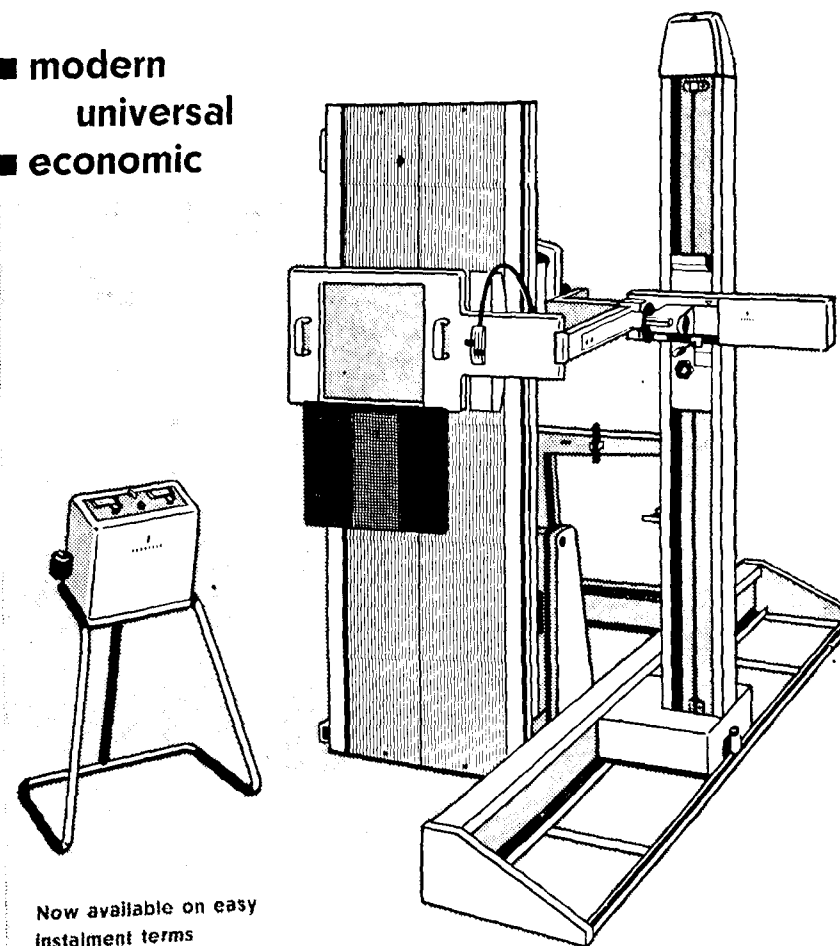
SCHERING ASIA G.m.b.H. Bombay Branch
16, Apollo Street, Bombay 1.


SIEMENS
INDIA

POLYSKOP

X-ray diagnostic unit

- modern
- universal
- economic



Now available on easy
instalment terms

Manufactured and Marketed by

SIEMENS ENGINEERING & MANUFACTURING CO. OF INDIA LTD.

Bombay • Calcutta • New Delhi • Madras • Bangalore • Visakhapatnam
Ahmedabad • Lucknow • Nagpur • Hyderabad • Trivandrum • Rourkela

AN IMPROVED CONTRAST MEDIUM FOR
SUPERIOR RADIOGRAPHIC VISUALISATION

TRIOPAQUE

Crystalline sodium-3-acetylamino-2, 4, 6-triiodobenzoate (sodium acetrizoate)

TRIOPAQUE contains in a relatively small-sized molecule
3 iodine atoms which are firmly bound.

The Iodine content is 61.96%

★

Available as

TRIOPAQUE '200' TRIOPAQUE '300'

AND

TRIOPAQUE '400'

Containing 200, 300 and 400 mg. of organically bound iodine per ml.
of the respective solutions

Manufactured by :

**CILAG - CHEMIE LIMITED
SWITZERLAND**

Further Information from:

NEO-PHARMA PRIVATE LTD.

"KASTURI BUILDINGS"

Jamshedji Tata Road :: B O M B A Y - 1

SOLE DISTRIBUTORS FOR INDIA

Crem-O-Bar is the only Barium preparation in
ready-mixed concentrated suspension form which
dilutes readily and does not settle. It does not
flocculate with change in pH. Its cool, pleasant and
acceptable mint flavour prevents feeling of nausea.

CREM-O-BAR

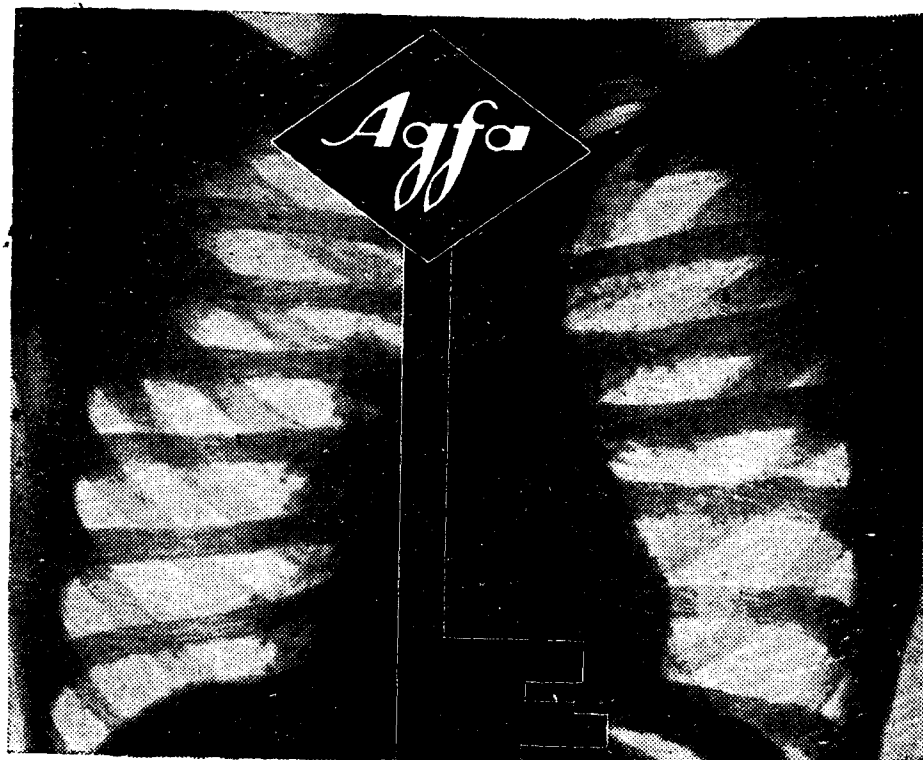
**gives
the best
definition**

HIND CHEMICALS LTD. - KANPUR



a **NEW**
and
ORIGINAL
BARIUM
preparation
in cream form





Agfa is the key to successful radiographs. The scientific excellence of Agfa X-Ray films ensures pictures of high detail and correct contrast. Agfa offers you Fluorapid X-Ray Films • X-Ray Rapid Film • X-Ray Paper • Standard Dental X-Ray Films • Direct Duplicating Film Rapid • Isopan-F Reversal Film.

Also available are X-Ray accessories such as Cassettes, Screens, Hangers etc., of well known German makes.

For full particulars please write to: **AGFA INDIA LIMITED**
198 Jamshedji Tata Road, Bombay 1 • Branches at: Delhi • Calcutta • Madras

Printed and Published by Mr. R. Ravaimanickam at Ravai Press, 148, Big Street, Madras-5
for the Indian Radiological Association and edited by Dr. A. N. K. Menon,
"Gitanjali", 35, Albany Layout, Village Road, Nungambakkam, Madras-31.