THE Indian Journal of Radiology

A quarterly Journal devoted to Clinical Radiology and allied Sciences

Owned and published as its Official organ by the Indian Radiological Association

Vol. XI JULY 1957 No. 2

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THE INDIAN JOURNAL OF RADIOLOGY

(QUARTERLY)

The official Journal of the Indian Radiological Association

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Subscription for India Rs. 16/- per annum. Single copy Rs. 4/- plus postage.

Foreign subscription £ 1/6 per annum.

Free to members of the Indian Radiological Association.

Annual subscription for Membership Rs. 18/-.

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THE UNDERMENTIONED BACK NUMBERS OF THE INDIAN JOURNAL OF RADIOLOGY ARE AVAILABLE.

Price Rs. 3/- per copy. Postage extra.

Apply to:

THE SECRETARY IN-CHARGE

Vol: 1 No. 4	November 1947
Vol: 2 Nos. 2-3-4	May-August-November 1948
Vol: 3 Nos. 1-2-3-4	February-May-August-November 1949
Vol: 4 Nos. 1-2	February-May 1950
Vol: 5 Nos. 1-2-3	May-August-November 1951
Vol: 6 Nos. 1-2-3-4	February-May-August-November 1952

EDITORIAL

BY

DR. K. M. RAI, M.B.B.S., F.R.C.S., D.M.R. (LOND.)

I owe an explanation as well as an apology for the late publication of the second issue of the Indian Journal of Radiology to all the members of the Indian Radiological Association and to all those who send their valuable contributions; regular subscribers and advertisers in this Journal.

The delay was unavoidable and beyond the control of the present Editor-in-Chief. The office of the Journal had to change from Bombay to Madras due to certain circumstances, resulting in the inevitable delay in the publication of this issue.

Our Readers would not have failed to notice that the February issue came out under my Editorship; but it was printed and published from Bombay to avoid delay and my thanks are due to the out-going Editor-in-Chief, Dr. K. P. Mody and to Dr. L. H. Athle who was the Joint General Secretary, for bringing out that issue, although the office was in the process of transfer. I hope our Members and subscribers would understand the difficulties and the inevitable delay that results in setting an organisation so complicated as bringing out a Scientific Journal in a new place and would in their usual generosity forgive this delay.

I shall be failing in my duty if I do not here publicly acknowledge the great debt the Association owes to the two stalwarts from Bombay, Drs. K. P. Mody and R. F. Sethna who shouldered the responsibility of editing and publishing this Journal from Bombay ever since 1950 when the office of the Editor was transferred from Madras to Bombay.

Although this journal took its birth in this ancient city under the Joint Editorship of late Dr. P. Rama Rao and myself; after an year or so, the sole responsibility of editing this Journal fell on me and with the willing co-operation of the Editorial Board, the Journal continued to be published from here until July, 1950 when all of a sudden, the publication of the Journal had to cease from Madras for certain reasons beyond the control of

the Editor-in-Chief and the Association till the next annual congress in January, 1951. It was at this critical juncture that Dr. K. P. Mody and Dr. R. F. Sethna stepped into the breach. Since then the members are fully aware of the continued progress of this journal under their able guidance. However much all of us desired that Dr. Mody should continue as the Editor-in-Chief for at least another year, we were not able to persuade him to continue the responsibility, as the weight of years and other responsibilities seem to be weighing heavily on him. So the inevitable duty of shouldering this responsibility has fallen on my shoulders once again. It was with great trepidation and humility that I accepted this responsibility once again at the present juncture. About a decade ago, I willingly took up the responsibility of Editing this Journal from Madras. Probably it was the youthful exhuberance that egged me on to take up this responsibility. But I have known since then what a big responsibility it is and how much work it involves to run a journal of this magnitude and therefore this time it was not with such optimism that I agreed to take up this responsibility though the request of all my friends in the Association was overwhelming. Having vested me with this responsibility, is it too much if I ask all the friends in the Association and others to help me continuously with all their advice and contributions, so that this Journal may not only maintain the reputation and progress it has attained but carve out a permanent place of eminence in the field of scientific journals in general and Radiology in particular. It is needless to stress that our place as Specialists in Radiology—specialist in every sense of the word—evoking the respect and admiration of our brothren every where in this speciality can only be gained by persistent effort and faithful adherence to the scientific practice of Radiology. To what extent we would fulfil this high ideal and ambition would be truly reflected in the Scientific literature we would be publishing in this Journal—our only invaluable asset and a true reflection of the nature of work we all do in this dear country of ours. May God help us to achieve this desire of all of us.

From: The Radiographic Centre of the Royal Swedish Medical Board, The Department of Radiology of the Epidemic Hospital, and the Wenner-Gren Research Laboratory, Stockholm, Sweden.

The Use of Single Films Instead of Roll Film in Photofluorography

BY

CARL WEGELIUS, M.D., KAJ NOSCHIS, Techn. Adviser
and PLIOROZE BILLIMORIA, M.D.

Recent developments in the technical field of Mass Radiography has enabled the construction of devices operating with single films instead of the conventional roll film. These devices, which include specially adapted equipment for developing and processing, are already commercially available.

This new method has been used sufficiently to permit an assessment of its value. The experiences obtained at the institutions from which this paper originates, as also those of several European and North American centres both for chest surveys and radiography indicate very promising future potentialities for this method. These potentialities concern not only the established special field of photofluorographic recording, Mass Chest Radiography, but also the whole of general radiodiagnostics.

There are reasons to believe that this slight technical change in the procedure of substituting roll film by single films will be the decisive factor in enabling the indirect photofluorograms in diminished scale, replacing the standard large direct radiographs in several routine applications.

Inasmuch as the smaller sized pictures can be produced qualitatively not inferior to the large size radiographs and permit the same diagnostic accuracy, they offer several considerable advantages.

The film costs by photofluorography are impressively reduced, using 100 × 100 mm. film size, to about 25% of the cost per corresponding direct radiographs and to less than 20% using 70 × 70 mm. sized films. The processing, filling, and archive work is also very much easier.

In view of these advantages, not the least of them being the economical one, it may be worth while already now to consider the future potentialities of single film photofluorography in the organization of both the present and new planned radiodiagnostic activity.

The present standard performance of photofluorography with roll films has to be regarded against the background of its development. At the onset, as a practical utilization on a large scale, it was introduced mainly for the control of pulmonary tuberculosis. The organizations fighting this dangerous disease on a broad frontier, needed a sift method to enable the diagnostic control of the lungs of a whole population. For this purpose, indirect radiography in reduced size on roll film offered unique possibilities with regard to application and cost, compared with screening and "conventional" radiography. The examinations did not demand the participation of the physician himself in the field work, but could be made by technicians alone, and the diagnostic interpretation could be made later on. The devices were mobile and could be brought out to the persons to be investigated instead of the opposite arrangement wherein the patient had to come to the X-ray unit—

an efficiency which brought for the first time a sort of industrialized mechanization into medicine.

The favourable results of the application of the new procedure are well known and generally recognized. In this connection only the film problem should be touched upon. The system with roll film was found to suit very well the purpose of an investigation aiming mainly to serve as a sift survey in the detection of unknown diseased cases. Until recently, the vast majority of all Mass Radiographic investigations concerned individuals never examined earlier by that method. The diagnostic approach had the character of a "one time" procedure, enabling only the finding of positive cases. When this was done, the film had served its purpose and was laid aside. The picture quality of the photofluorograms, especially when the small 35 mm. film size was dominant, was regarded too poor to permit satisfactory accuracy in the final analysis of the pathological changes in question, and large sized conventional radiographs were necessary to complete the examination.

With these considerations in mind, it was both practical and convenient when the complete picture material could be presented as long film rolls comprising of 50 or more pictures, each representing a different individual, and enabling the successive viewing of a continuous row of new cases. As and when one of the films was "suspected", it was necessary to recall the person and complete the examination. The construction of the optic cameras and the viewing devices, in order to solely produce and serve the use of roll films, was on this basis found quite satisfactory. The filing of the long film strips, in small sized compact rolls, was found convenient for storing purposes.

They were seldom reviewed and special measures in the archives, to facilitate future study of individual pictures diagnosed earlier were not regarded necessary. When, however, this was needed it had to be done in 3 phases.

At first, the corresponding identification card with the number and the data of the picture with the name and medical data about the person in question had to be located from the filing system. Secondly, from the numbering, the particular roll of film had to be located and lastly, the picture itself within the roll. Thus every time it was necessary to review a picture, the whole procedure had to be repeated. It was still more awkward, however, when different pictures from one roll of films were required for review at the same time. When such a demand was made, it was either not possible to meet it or it was necessary to cut the film into pieces. These drawbacks naturally did not stimulate to exceptions from the main principle of a diagnostic "one time" procedure.

It seems likely that the development and practical application of photofluorography, restricted only to mass chest surveys, would show a rise or decline depending on its need and utilization in the campaign against pulmonary tuberculosis. This would imply that as soon as pulmonary tuberculosis was brought under control there would be no further need for this procedure.

Certain factors not considered earlier, however, change this situation and offer promising future potentialities for this kind of examination. These are:

(*a*) The extension of photofluorography to new fields of radiodiagnostics, beyond mass chest surveys,

(*b*) The utilization of the total stored material of mass chest pictures for diagnostic comparison purposes,

(*c*) The technical facilitation of the performance of single films instead of roll films, including decisively improved simplification of the photographic part of the work (elimination of dark room development).

(*a*) Besides contribution to the defeat of pulmonary tuberculosis mass radiography can now make gradually increasing claims in the detection of other diseases of the chest. This is strikingly illustrated by an analysis of the final results of mass radiography in Sweden. Already now more new cases, reported for therapeutic measures of non-tubercular rather than tubercular character, are detected by mass radiography, and this is a gradual and definitely increasing trend.

Consequently, continued usage of the procedure for mass surveys will be justified as abnormal conditions non-tubercular in origin like tumours, inflammatory non-tuberculous pulmonary lesions, occupational lung diseases and cardiac diseases, must be considered to be as important from the national health point of view as tuberculosis.

Photofluorography will be able to replace more and more full sized pictures even with regard to other organs besides the chest. In the last few years it has become possible due to the improved performance of the optical system of the cameras available and the production and use of fine grain films to markedly improve the picture quality by photofluorography. Thus 100 and 70 mm. sizes can now in practice be considered qualitatively equal to the full size pictures. The smaller and economically more favourable photofluorograms can now be used not only for the chest but also for the investigation of the skeleton, the digestive and urogenital organs with satisfactory diagnostic accuracy. Reports on these new applications are already published and this trend will certainly increase.

(*b*) In all kinds of x-ray diagnosis, the evaluation of pathology, activity, progress, and regression is considerably facilitated and rendered more reliable when current findings can be judged against the background of documentary information obtained from earlier studies. This applies particularly to the chest organs, with structural changes in the lungs, alterations in size and configuration of the heart, etc. A collection of mass radiographic pictures is especially well suited for the purpose of diagnostic comparison; particularly as such material covers more or less the entire population.

It has been the experience in Sweden that there is a vast improvement both as regards under-diagnosis and over-diagnosis of the mass chest films when previous films are available for a comparative study. In order to do this, it would be necessary to establish central archives containing, as far as possible, all the pictures anywhere or at any time taken of the population in a certain region and so arranged that the material can be made available without delay. The work of establishing such archives would undoubtedly be very valuable. If the filing system is so arranged that comparative studies can be made easily, the total picture material including the previous pictures will be used repeatedly for diagnostic purposes. The initial costs would thus be spread over a broader basis, and would be proportionally diminished and more justifiable. Progressive prophylactic control of whole populations would also benefit by such an arrangement.—The technical requirements for the necessary filing and archive work of this type would hardly be possible either by handling

conventional radiographs in their large awkward size or mass chest roll films. But the single films in reduced size, one or several attached to the corresponding identification cards, will facilitate the work to such an extent that it can be practically overcome, as shown by Hagn-Meincke in Denmark.

(*c*) The Manufacturers of photofluorographics equipment being for years aware of the possible latent advantages of single films, have intentionally and intensively worked on practical solutions for their technical performance. The first processing device for single films, utilized in larger practice, has been commercially available since a few years. The films are in this apparatus semi-automatically fed into a plastic rack, containing up to 50 films, which is transferred by a detachable stainless steel grip into a developing tank, containing about ½ a gallon of developer. Figs. 1-3.

All the processing operations, developing, fixing, rinsing and drying, are performed in this rack, which delivers the films in a completely finished condition. In this way, processing is greatly simplified and much time is saved. Between the component parts of the rack there are small spacing devices which keep the films exactly in position throughout processing. The positioning of the films gives an easy access, so that not only can the developer, fixer, and rinsing water easily make their way to the films, but in addition a plentiful air circulation is ensured during drying. As during all the processing operations, the single films are only inserted and removed once, which prevents errors and obviates the risk of damage to the film. As the developer and fixer consumption is very small, one can always use fresh solutions and also easily keep the temperature controlled by simple means, such as an electric hot plate or a small refrigerator. The drying of the film can also take place under ideal conditions as the film remains in the processing racks all the time, and these can easily be put into the usual dust proof film drier. In tropical countries this is quite an advantage: also as the films need not be touched by hand before they are dry, finger marks and scratches are avoided.

It has been supposed that the developing and other dark room work would imply considerable technical drawbacks when handling single photofluorographic films instead of the conventional roll film. In order to study this problem, comparative analyses were made simultaneously of both methods in 1954-55. Our experience with the above described procedure for the processing of single films were favourable. There was no delay or increased demands on manual work even by application on a large scale of the single film system. At the same time our first single film material was ready and we found that also the above discussed advantages of this system for filing and archive work as well as from diagnostic points of view were valid in practice.

While the described manually operated first procedure for the processing of single films was introduced, the situation had technically improved in an almost revolutionary way by the development of a fully automatic developing machine for photofluorographic film. This was designed by the Odelca factories in Holland and was for the first time presented and marketed at the VIII International Congress of Radiology in Mexico, 1956.

The function of the developing machine is based on the use of daylight processing in a light tight box, in which all the photographic phases of developing, fixing, rinsing, and drying are performed. The need for a dark room is thus completely removed. The capacity of the device by both 100 mm. and 70 mm. single films is up to 360 processed films per hour, ready and dry. It is motor driven and all automatic. The machine is put to operate by simply pressing a button on the control panel. The processing liquids are kept constantly in circulation by pumps and their temperature, as well as the temperature of the drying section are thermostatically controlled. The construction of the device with the film transport system is shown in figures 4-6 and corresponding legends.

It seems obvious that the introduction in applied practice of automatized day-light processing will imply very valuable additive advantages for the diminished photofluorographic film in considering the choice between them and normal sized direct radiographs for practical diagnostic use. It was stated above, that the former now are qualitatively and with regard to diagnostic accuracy equal to the latter, and for the human optic perception even superior and more convenient, as well as favourable from economical, filling, and archiving aspects. The technical realization of a corresponding procedure for conventional large size direct radiography is, at present, not possible and hardly to be calculated with even in the future. The advantages of the diminished films, when processed and utilized in this way, are the theoretical possibilities of their substituting conventional direct radiography in the vast majority of its applications.

Conclusions

1. The performance and utilization of single films instead of roll film in Mass Chest Radiography and other applications of photofluorography with small sized pictures for roentgen-diagnostic work is now technically possible both for individual and large scale work.

2. Mass Chest Radiography, hitherto operating mainly with roll film, would profit by substituting it by single films with regard to:

(*a*) improved processing facilities,

(*b*) improved filling and archiving conditions,

(*c*) improved diagnostic accuracy, due to facilitated follow-up and comparative studies of the individual case.

3. The trend of improved diagnostic facilities with the single films will become still more evident as the tendency of the mass chest surveys to control, not only pulmonary tuberculosis but also other pulmonary lesions like tumours, occupational diseases etc., as well as changed heart conditions, increases. In addition to all the above discussed advantages of technical and diagnostic nature the considerable reduction in film costs will certainly play an important part in this connection.

4. There are also evident trends to a future development, where the photofluorograms (small size pictures) will replace radiography also in other investigations than that of the chest, such as gastrointestinal, urogenital, skeletal, etc., as well as all serial recording of dynamic events.

5. With regard to the future development of the photofluorograms (post-card size or other diminished scale pictures) more and more substituting the conventional direct radiography in large size, there are numerous reasons to consider already now an intentional change to the new method, especially by planning future radiographic work, new installations, etc. That should be done as soon as possible in order to avoid unnecessary double investments later and to ensure the economical profit offered by the new method. This would result in a wider application of radiological investigations than otherwise possible. The advantages are evident from the viewpoints of general health service and national economy.

★

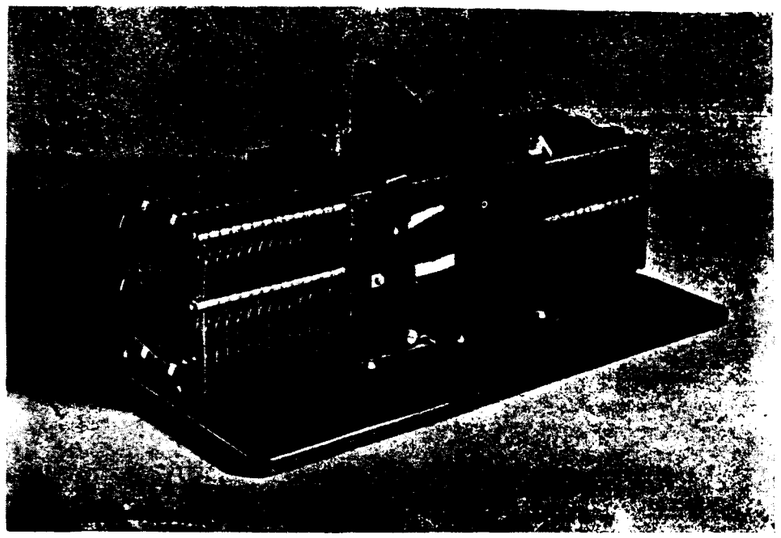

Fig. 1.

Semi-automatic feed unit for plastic rack containing up to 50 single films.

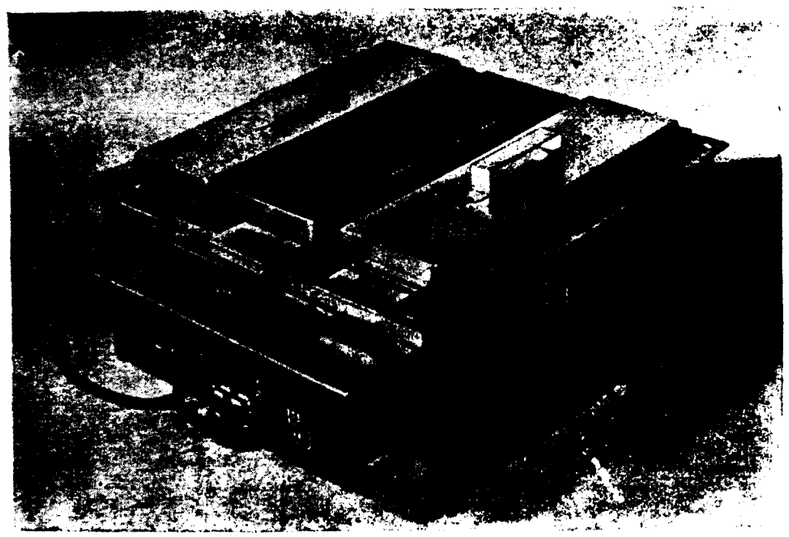

Fig. 2.

Temperature controlled processing equipment taking 50 single films in the rack shown in Fig 1. Developing, fixing, rinsing, and drying are performed in the three stainless steel containers.

Fig. 3.

The Selectoscope viewer, especially constructed for single film. Positives and negative cases can after viewing be separated in different receiving boxes.

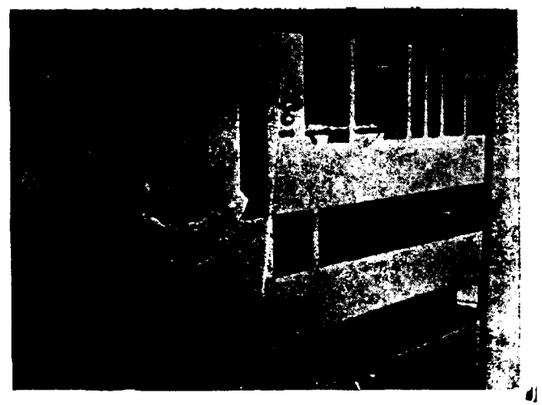

Fig. 4.

The full automatic processing device for single films in daylight. The cassette with undeveloped films is attached to the short end of the cabinet. The films are automatically released by means of springs in a continuous flow into the apparatus in which all the processing operations, developing, fixing, rinsing, and drying automatically take place.

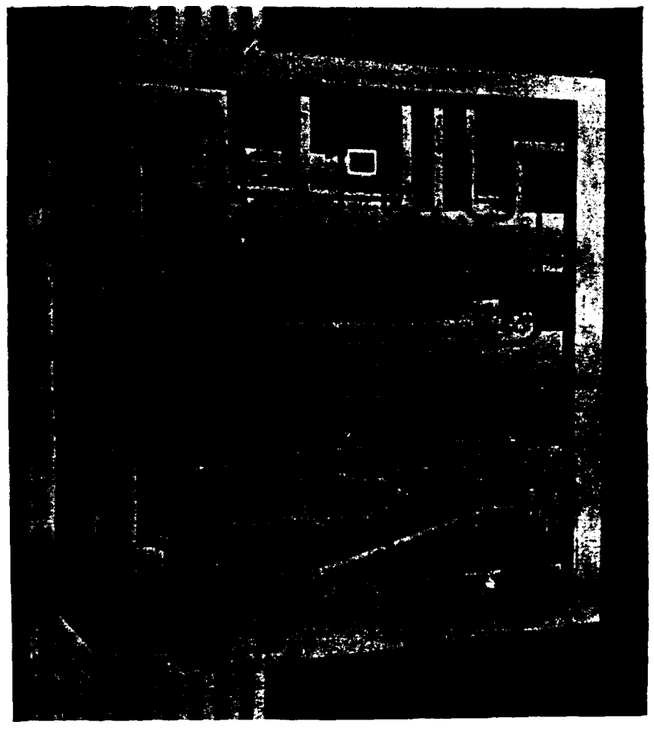

Fig. 5.

The cabinet with front covers removed. The passage of the films through the different processing stages is indicated, as well as their delivery, ready and dry, at the short end opposite the loading device.

The Role of Medical and Biology Physics in the Field of Medicine and Research

BY

Mr. N. K. VERMA, B.SC.,

Tata Memorial Hospital, Bombay.

This subject has many facets and I shall deal with them one by one.

One of them is the application of the fundamental laws of Physics to the science of treatment of human ills, helping to find out ways for the study of biological phenomena for the advancement of knowledge in this direction. Basic laws of physics have helped in understanding the function of biological behaviour of organs, tissues or cells. The relation between biology and physics is a well established fact. When about forty years ago, Harvey first tried to carry out systematic measurements in biological investigations and attempted to find relations between physical laws and biological phenomena it was little recognised at that time the important role that is played today by these laws in the spheres of biology and medicine. There was never such close relation in the past between these two as it is seen to-day.

Advances in physics have accelerated development in modern medicine, and co-operation between these have helped diagnostic and therapeutic efficiency to a great extent. Suitable physics apparatus have actively contributed to the rapid advance of knowledge in this direction. The atom is no longer regarded as a static structure but "dynamic entities changing in response to outside agencies affecting them and in turn being affected by them". A cell is not the unit of matter, it is the atom, whether of living or non-living substances. It is both "an anatomical and chemical structure and a highly complex biological entity; and to probe into its innermost secrets for a study of its function and behaviour depends upon how powerfully a physical apparatus can be turned towards helping for a knowledge of biological phenomenon on cosmic scale and the accuracy of measurement and observations on atomic and sub-atomic scales".

The other facet is Radiation-Physics, it's application to the science of medicine and biology has been most important. In modern medical institutions, such a department is an absolute necessity.

Fifteen years ago, people were dependent only upon Radium, Radon and X-ray for Radiation therapy of cancer patients. Limitations of cross-fire treatment of gamma radiation is a well known fact. Due to the longer mean free path of this ray and also due to many other factors it has not been possible to get a total destruction of the cancerous cells. Incomplete cure by this method is a foregone conclusion. Further, we are not able to measure or know the biological effects due to excitation of tissues. Upon what we depend is the process of ionisation in the tissues and cells and bank our calculations of the radiation-effects on this factor only. Naturally then we look around for any other alternative or any other improved way of treatment.

During the year 1923, findings of Hevesy, about the Brownian movement of Radio-isotopes even in solid matters, opened up

vistas for their use in research and therapy. But the limitations of their availability could not be increased sufficiently even with the coming into existence of artificial radio-activity (Curie F. Joliot and I) and Cyclotron (Lawrence—E. O.) till the advent of a chain reacting pile about ten years ago.

For our country, the demand for isotopes will still remain till a pile comes into operation for large scale therapy and research. Undoubtedtly, this new and power-ful tool has distinct advantages over the former sources of radiations, in both—therapy and investigations. Pressure of ionisation from within is achieved by the isotope ; and beta radiation, having mean free path of a few milimeters only, is capable of giving rise to localised action and there-fore possesses more efficiency of treatment than gamma radiations. But to achieve this therapeutic radiation effect, isotopes in sufficient quantity are required to be present in the tissues in question.

The diseases treated by isotopes are—leukaemias, Hodgkins Disease, Polycythemia Vera, Hyperthyroidism, thyroid tumours and a few others.

As for tracer methods, radio-isotopes have proved to be of immense value in the studies of shock, blood preservation, respi-ratory and circulatory physiology and in many other directions.

Its fundamental importance lies in the fact that it allows the examinations of the biological phenomena during the changing conditions going on inside the atomic or molecular constituents of tissues or cells undergoing metabolic reactions. And it is here that this powerful tool makes the investigations independent of " morphologi-cal description and analysis by the method of classical chemistry ".

Having these qualities and many other of isotopes in the background, surely there is strong reason for 'faith and hope' in this new direction. Out of hundreds of isotopes only forty-four have been introduced for research work and nine for human therapy purposes. About others, we lack sufficient information for their use. The day is not far off when all the big hospitals of this country will have separate isotope depart-ments.

The study of Radiation-physics is not complete and it is only half way if the knowledge of health-physics is not obtained with it. This branch of the subject tells us how to deal with radiations without being affected by the harmful biological affects of penetrating rays by remote-control, auto-matic control and other safety devices. It teaches us how to avoid inhalation, inges-tion and contamination due to radio-active products and also how to keep the level of radiation inside the laboratory under safe limits by careful designing of the radiation laboratory with proper ventilation, complete dust filtration, arrangement for sufficient rate of change of air flow, forced ventilation in the fuming chamber, stainless-steel coated work tables, linoleum covered floors and good sewage system for the radio-active waste plus decontamination procedures in case of emergency, or accident. This subject further directs the managements of a close watch and safe guard for the health of the individual radiation worker and for keeping a continuous check by proper instrumenta-tion, careful monitoring, dosimetry, film-badges, periodic blood-count and chest-screening etc.

The next fact is Medical Electronics. It may be mentioned here that this is the most interesting and existing branch of Medicine in the modern world. Like Electricity it is the man's silent servant in every day life and in many other important spheres. In

fact, there is no branch of medicine where it cannot be applied with precision and benefit. It has got varieties of its applica-tions in this field of medicine. Any variation convertible into electric pulse can be record-ed by electronic circuits. These electronic devices are such that under suitable condi-tions they can give both aural and visual indications. And the conditions can be fixed in terms of " time, speed, position, tempera-ture, pressure, humidity, size, shape, colour and sound ". Not only the non-electric quantities such as variations in the brain, muscle and heart—can be easily amplified by means of an electronic amplifier and the patterns of amplied things can be focussed in the form of oscillographs, on the screen of a cathode ray oscilloscope. Medical appli-cations of electronics is expanding at a rapid pace and it is the " dynamic field of inter-relationships with other branches of medi-cine and science ".

The medical applications in the form of C. R. T., electron-microscope, serve-mecha-nism, G. M. Counters, Linear accelerator, Cyclotron, Betatron and the synchroton are well known. I venture to submit here that since world war II, many new devices have come up for the treatment of cancer, and some of these mentioned here are modern ones, applied by the leading cancer hospitals of the Western countries.

This science of electronics has proved to be a powerful means in the hands of medical men and biologists and it is for them to derive as much benefit as they can from this ingenious branch of science.

All these facets mentioned above consti-tute the branches of a single main subject —and that is medical and biology-physics. Ever growing necessity of this subject has brought it in the forefront to help medical people and the biologists for investigations and treatment purposes. And it's import-ance is being felt everywhere. It is impos-sible to run a modern cancer or medical institution without its help. Growing de-mand of workers, trained in this direction, has caused the organisation of teaching of this subject on University level in degree course. English and American Universities have thrown open their gates for imparting knowledge of this branch to the students. Leading hospitals of the world in Cancer therapy and Research, are represented by pioneers of medical and biology-physics field like Dr. Mayneord, Dr. Failla, Dr. Sievert and others.

Unfortunately there is no such provision for training in this subject in any Indian University, and hence the necessity for training abroad. Higher training facilities are given by the Columbia University, by the Physics Department of the Royal Can-cer, Hospital, the London University and other important centres leading to the M.Sc. and Ph.D. degrees in Bio-Physics.

Planning of Radiology on a National Basis

PART—I

BY

Dr. R. F. SETHNA, M.B., B.S., D.M.R.E. (CAMB.)

Senior Honorary Radiologist, Sir J. J. Group of Hospitals and Lecturer in Radiology, Grant Medical College, Bombay.

The most important and urgent problems facing the Radiologists in this vast sub-continent are the following :—

(1) *Radiological Education :* Under-graduate and post-graduate training in Radiology.

(2) *Radiological Service to the Nation :* (*a*) Diagnostic. (*b*) Therapeutic, including radio-active Isotopes in treatment and research.

(1) *Radiological Education.*

Introduction

This article is written with the sole desire that Radiological Science which is at present at a very low ebb will look up and its status raised considerably not only by the older generation but by the enthusiastic younger generation of Radiologists returning from Europe and America to this country in a post-war period, after receiving adequate training in the subject and who are fully conversant with the very high standard of post-graduate training and Radiological service to the people prevailing in those countries.

It is upto us therefore, the heads of Radiological Departments in the country, especially those attached to medical colleges, to evolve schemes of uniform standard of under-graduate and post-graduate training in Radiology with the high ideal of establishing a high-grade Radiological service both in diagnosis and treatment, that would compare very favourably with those prevailing in Europe and America. Let us not put up a false facade that everything is well and be complacent but face the stark realism that Radiological training and service is totally inadequate and antiquated as compared to European and American standards. Let us not shirk our responsibilities and to quote Eugene P. Pendergrass[1] : " My friends, the future of Radiology can be bright. It is still young and there is still much to be learned. It is a great speciality in the greatest of all professions. By far the most dangerous we have to fight are apathy, indifference, carelessness and self-satisfaction. Beware, lest we fall heir to these faults ".

As the first step towards the ideal we are aiming at, formation of a National Board of Radiology is of paramount importance and whose advice and decisions should be predominant in formulating all policies pertaining to this science in this country.

The next question that arises is the composition of the Board. At the present time, there are 44 Medical Colleges in India and three Universities conferring Diplomas in Medical Radiology.

The number of Medical Colleges in each State is as follows :

Bombay ...	9	Punjab ...	3
West Bengal ...	4	Bihar ...	3
Madras ...	4	Assam ...	1
Mysore ...	3	Kerala ...	1
Uttar Pradesh...	3	Pondicherry ...	1
Andhra ...	4	Orissa ...	1
Madhya Pradesh	4	Rajesthan ...	1
Delhi ...	2		

The composition of the Board is made intricate due to the fact that there is unequal distribution of Medical Colleges in various states. I believe, however, that a small compact body of members preferably teachers in Radiology belonging to scientific institutions of proper standing, possessing adequate equipment and laboratory facilities will do a very good job rather than a packed unwieldy body of members representing each state.

I would therefore, suggest the formation of the Board on the following basis.

Composition of the Board

	Cities and States	No. of Colleges	No. of Members
(a) *Cities* ...	Bombay City ...	3	1
	Madras City ...	3	1
	Calcutta City ...	4	1
(b) *States* ...	Bombay ...	6	2
	Madras ...	2	1
	Kerala ...	1	
	Pondicherry ...	1	
	Madhya Pradesh...	4	1
	Andhra ...	4	1
	Mysore ...	3	1
	Uttar Pradesh ...	3	1
	Bihar ...	3	1
	Orissa ...	1	
	Assam ...	1	1
	Rajesthan ...	1	1
	Delhi ...	2	
(c) *Association.*	Indian Radiological Association ..	—	1

The number of members will be 14 if contiguous states are grouped together where there is only one medical college in a state with those having two to three medical colleges. The list includes one representative of the Indian Radiological Association. If however, all states—Kerala, Pondicherry, Orissa, Rajesthan—each having one medical college, should all be represented by a member, the number increases to 18 members. It would however be extremely important to include Radiologists, practising solely Radiotherapy in the Board, and for that purpose one member from Bombay, Madras and Calcutta should be included in its composition, as majority of members from states will be Radio-diagnosticians or those practising both Radio-diagnosis and therapy combined.

The emphasis should be on quality rather than numbers. However, adjustments by mutual agreement are always possible in constituting the Board. The ticklish question of selecting members from each state or group of states is difficult to suggest, but I believe, that the Universities, as guardians of medical education, should nominate a member and approval of the State Health Ministry obtained. The board thus constituted, should elect its own President, Vice-President and Secretary-Treasurer. Members should be nominated for a period of three yeras as also the Secretary-Treasurer to facilitate smooth and efficient conduct and continuity of the work. The Board should meet twice a year. The venue of the meeting should be New Delhi, as Medical education being the responsibility of the Central Government, the Board has the opportunity to seek interviews with Ministers and give on the spot advice on formulation of new policies. However, if we consider the time and the expense involved in travelling vast distances, Nagpur would be an ideal meeting place for the Board.

Fares for air or rail travel and other incidental expenses of the full-time Radiologists employed in the State Medical Services, should be incurred by the Government and those working part-time as Honorary Radiologists should receive half their travelling and hotel accommodation expenses, the latter however may be fixed.

Functions of the Board

The functions of the Board should be as follows :

(1) Uniform syllabus in under-graduate studies in Radiology in all Medical Colleges and in post-graduate educacation in the three Universities (Bombay, Madras and Lucknow) which at present confer post-graduate diplomas.

(2) Early introduction of post-graduate training in Radiology in the Medical Colleges in the different states of India.

(3) To arrange, control and conduct inspection of adequate facilities for the training, equipment and adequately trained teaching personal in the X-Ray Departments of recognised teaching institutions.

(4) Any matter relating to the Control of practice of Radio-diagnosis and Radiotherapy.

(5) To maintain a register of qualified Radiologists to be supplied to all medical colleges and hospitals in the country.

(6) To secure the status of qualified Radiologists on par with the Clinical staff with regard to rules of service and emoluments in all Government, public and charitable hospitals in the country.

(7) Strict implementation of the Recommendations of the International Protection of X-Ray and Radium workers.

(8) Control and distribution of Radioactive Isotopes.

This may not form a complete list of functions assigned to the Board, but suitable revision should be made as further experience is gained in its working. Dr. B. R. Kirklin[2] writing about the sixteen speciality Boards in U. S. A. says :—" The Boards have been composed of honest, fearless and conscientious men who have given freely of their time in an effort to raise the standards of their speciality without self-aggrandizement. All boards have attempted to set up their organisations in such a manner as to prevent politically-minded, selfish persons or groups from gaining control. If any such group ever becomes selfishly dominant, the Board affected will cease to perform its proper functions ".

I have indicated roughly in what way we, in this country, should do, and do it quickly, to improve considerably the standard of Radiological education. I feel sure that if we should all work in the same selfless spirit as so aptly described by Kirklin, and weed out political and medical sycophants and parasites whose baneful influence can do immense harm to our all-important speciality, the successful working of the Board for improvement of Radiology is assured.

Pre-clinical institutions in Anatomical-Radiology

A pertinent question arises whether it is advisable to throw any more additional burden of study on the already hard-pressed medical students early in their pre-clinical career by inclusion of Anatomical-Radiology in their syllabi s. The students already complain of heav' and unpleasant burden of study in genetics which has lately assumed great importance with some Professors of Anatomy. The students complain bitterly of the large amount of useless material they are made to cram for their examination, both in anatomy and physiology. I believe,

efforts to draw up a basic syllabus of study and throw out the junk has been tried out with anatomists and surgeons disagreeing. It is high time herculean efforts are made in the interest of the students to arrive at definite conclusions and frame a condensed course of study to exclude whatever will be useless in their further studies and include a subject which is nowadays considered absolutely essential in their clinical study and that is, undoubtedly, Anatomical-Radiology.

The question arises, " What is the justification for such a course ? ". The answer is, that gross " living " human anatomy is quite different to the study of anatomy in a cadaver and will exert an important influence on the outlook of the students in their clinical studies. Besides, the study of normal living anatomy and physiology and the variations within normal limits is essential in pre-clinical days as without adequate preliminary study of the normal, the students will not be in a position to appreciate and recognise pathological changes as seen in the radiograms. It cannot be disputed that Radiology has proved of inestimable value in diagnosis of diseases, without which, it is no exaggeration to say, that the surgeons and physicians would compare with and wander about like lost babies in the woods.

It is very desirable that the anatomy department is equipped with a 200-300 mA apparatus complete with files and arrangement for multiple viewing-boxes and a processing room. At present our teaching institutions possess a small 30mA X-ray Unit with make-shift arrangement for screening, which apparatus may not be used at all and kept there just to satisfy the regulations and also the University inspectors. This state of affairs will hardly ever impress the students.

It is essential that two senior Resident Radiologists who have acquired adequate knowledge in the science and in protection measures against radiation and truly interested in Roentgen-anatomy will make an un-qualified success in teaching. Each instructor should spend approximately twelve hours per week for a period of about six months in the anatomy-Roentgen Department. Approximately 50 hours are spent in demonstration of X-Ray films and fluoroscopic instructions in normal and variations of the normal to group of 8-10 students. The demonstrations are so arranged that the students acquire radiological instructions on the particular part of body-system they are going to dissect.

The film library should consist of a large and comprehensive file of films which should include radiograms of all parts of the body of different age-groups and portray the normal, the normal variations and if possible common developmental variations. The library of films should also include Bronchograms, Cardio-angiograms, Cerebral arteriograms, Pyelograms, Venograms, Pneumoencephelograms, Myelograms and radiograms of Gastro-intestinal-tract. The film file should be in a constant state of revision and addition.

At present, the scheme on such an ambitious scale may not be possible in the existing Medical Colleges, and then it would be advisable to send students in small batches to the X-Ray Departments of the institutions, which are fully equipped to cater to their wants. In addition, wherever possible Cine-films, due to recent advent of image-intensifier technic, will play an increasingly valuable role in training in normal anatomical-radiology in the living. For that purpose, all Radiological Departments in teaching institutions should have the adequate facilities to install an Image-Intensifier X-Ray Unit.

I will close this chapter by quotations from late Dr. A. E. Barclay,[3] an internationally famous Radiologist of his time and an old revered teacher to many of the older generation of Radiologists, who writing as far back as 1943 remarked that :

" To my mind, what is needed is a radiological research institute, devoted solely to the study of the body in health, and whose primary object it is to lay those foundations of a definite knowledge of the normal and its possible variations that form the essential basis for a reliable assessment of pathology ".

(To be continued)

Radiological Investigation of the small intestine in South India

(Value of non-flocculating media)

BY

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

Christian Medical College, Vellore, Madras.

Stimulated by the visit of Dr. Ross Golden to India we decided at Vellore to start in January 1956 a more intensive study of the small intestine. In this paper I shall describe how first of all we investigated the problem of flocculation of barium in the intestine, and then how we have attempted to assess the value of different mucosal patterns, calibre of the bowel, and transit times, as seen by non-flocculating barium media. Finally I shall give the incidence of the various radiological signs, and the incidence of diagnoses made.

Materials

Out of a total of 450 routine barium meal examinations in a four month period, 162 patients were selected for small intestine study usually because they complained of loose motions and vague abdominal pain. Later a review of 855 barium meal examinations in nine month period was made.

Methods

87 patients were examined using 25% ordinary medical barium sulphate in tap water. 4 patients were examined using a more concentrated solution of 4 oz. barium in 4 oz. tap water.

66 patients were examined using a 50% barium with aluminium hydroxide preparation.

41 patients were examined using a finely divided barium powder that is said to form a colloidal suspension. Usually this was given as a small 100% meal (2 oz. media in 2 oz. tap water), If the stomach appeared in any way abnormal, however another 4 oz. concentrated suspension diluted by another 4 oz. tap water was given.

20 patients were examined using a proprietory colloidal suspension of barium (100%) 4 oz. flavoured with mint.

It was found impracticable to take films of the small intestine every half hour, and so the following *procedure* has now been adopted :

1. Routine examination of the oesophagus, stomach and duodenum.
2. Careful observation of peristalsis in upper loops of jejunum under the fluoroscope.
3. Second fluoroscopy and film prone at ½ hour.
4. Film at 1 hour if need be.
5. Fluoroscopy and film prone and spot films if need be at 2½ hours. A food stimulus (lunch) is usually allowed at 3 hours.

6. Fluoroscopy and spot films of terminal ileum at 6 hours.

7. Fluoroscopy and films if necessary at 24 hours.

On reporting all these films it was some times been necessary to order a *repeat meal* with particular attention to a certain part of the intestine.

A. Comparison of Opaque Media:

I. *Flocculation patterns:*

Among the 450 routine barium meals seen in a four month period, at least 74 cases where ordinary barium was used, and 30 cases where "non-flocculating" preparations were used, showed one of the following :—

1. *Clumping:* as described by Berridge (1952) may take place in the head of the barium column in the jejunum early, but more commonly it does not occur until barium has been present in the gut for about half an hour (Fig. 1-A.)

2. *Spiculation:* is the flakey appearance that is often seen after the column of barium has passed through the jejunum. (Fig. 4).

3. *Granulation:* is a late effect seen with the "non-flocculating" barium preparations. (Fig. 7).

4. *Milkyness:* is a late effect seen only with the aluminium hydroxide preparation, and with the proprietory colloidal suspension. This effect may be seen even in a normal subject. (Fig. 6-B).

Table 1 shows an analysis of the frequency of these various effects using different media :

Table 1—Analysis of Flocculation Patterns

N.B.—*These cases were selected from 450 barium meals often because a flocculation pattern was obtained with ordinary barium.*

Media	Total Cases	Clumping		Spiculation		Granulation		Milkyness	
		Early	Late	Early	Late	Early	Late	Early	Late
Standard Ba. SO_4 ...	87	13	61	1	9	...	...	...	...
"Alubar" ...	66	1	7	3	15	...	4	1	14
"Micropaque" ...	41	...	5	...	4	...	3	3	...
"Crem-O-Bar" ...	17	...	1	...	2	...	1	...	2

From this table it will be seen that in about 75% of these selected cases, ordinary barium shows the clumping type of pattern both early and late. It will be seen that in the same type of cases "non-flocculating" colloidal suspension types of media show hardly any early clumping and only about 11% late clumping. The suspension that uses aluminium hydroxide to maintain the water content of the bowel and so hasten transit times showed some late milkyness or haziness of bowel outline in about 20% cases. The preparation using a proprietory suspending agent flavoured with mint showed no increase in transit time, but did show cases of milkyness.

Barium and 'Alubar' were compared in the same patient within an eight day period in 12 cases. In 10 of these cases barium showed the clumping pattern where Alubar did not. In one case of sprue both barium and Alubar showed clumping. In two cases of possible sprue both Alubar and Micropaque showed clumping (Fig. 2). In four cases where 4 oz. barium was given in 4 oz. tap water flocculation occurred.

Flocculation did not appear to depend on the concentration of the media but on the size of the particles.

II. *Transit times*:

The transit times using three media in patients who were considered to be normal and in those thought to have motor disorders of the small intestines are compared in table 2.

Table 2—Comparative average transit times using different preparations

Condition of Patient	No. of Cases	Barium		Alubar		Micropaque	
		Ileum	Caecum	Ileum	Caecum	Ileum	Caecum
Patient's considered normal ...	24	½–1½	1½–5	½–¾	1–3	½–2½	2–5
Hypo-motile (Sprue e c.)..	73	1½–4	5–8	¾–2½	3–6	2–3	5–8
Hyper-motile ...	14	½–¾	½	¼	½	¼	½

III. *Discussion:*

Cause of Flocculation Pattern

Frazer, French and Thompson (1949) showed that a segmentation pattern could be induced in the jejunum by giving (*a*) Hypertonic sodium bicarbonate or sodium chloride solution (*b*) Hydrolysed fat, sprue faecal fats or short chain fatty acids (*c*) gastric or duodenal juice containing mucous.

Ardran, French and Mucklow (1950) pointed out that ordinary barium suspensions flocculate in the presence of mucous, where as gelocolloid suspensions do not flocculate. Zimmer (1951) showed the value of barium sulphate suspended in colloidal aluminium hydroxide (Alubar). Astley and French (1951) showed the value of non-flocculating barium preparation in the investigation of coeliac disease. A preparation containing 25% barium sulphate and 1% carboxymethylellulose was found to be satisfactory, but a proprietory preparation was found to be more stable. Astley and Gerrand (1954) found that clumping occurs in the jejunum of normal children below the age of five and they concluded that the use of ordinary barium suspension in the investigation of coeliac diseases was unhelpful. French (1953) states that the flocculation pattern (previously called "deficiency pattern") is due to mucous secretion and water absorption. Such a pattern he states is normal in the ileum but abnormal in the jejunum. Manufacturers of barium sulphate state that flocculation is due to rapid changes in ph. values.

Clinical significance of Flocculation patterns

From the writing of the above authors we find that flocculation in the jejunum may occur in the following conditions :

(a) *Where there is delayed emptying of the stomach* with abnormal residues of gastric mucous or fatty acids in the jejunum. In normal infants the emptying rate of the

stomach may be eight hours, and so if a feed has been given within twelve hours before the barium meal there may be fat in the jejunum (French).

(b) *Where there is abnormal fat content or mucous secretion in the Jejunum* :

1. In new born babies before the first feed a flocculation pattern may be seen in the jejunum (Astley 1951). This flocculation cannot be due to fatty food, and is presumably due to mucus.

2. Where there is allergy to certain foods (wheat gluten in coeliac disease), there is thought to be mucus secretion and there is steatorrhoea.

3. In the presence of intestinal parasites (hookworm, etc.).

4. In some cases of pulmonary T. B. (? T. B. intestine).

5. Clumping may be seen in cases of jejunitis, and hypoproteinaemia.

6. In sprue syndrome.

IV. *Author's Conclusions* :

I have found as did Berridge (1952) that clumping may take place in the head of the column of barium early, or that it may take place later in the head of the column or in the entire column. I consider that the 'spiculation' or 'snowflake' effect seen in the jejunum after the column of barium has passed is a late flocculation effect in which flecks of barium are left in pockets between the valvulae conniventes. This type of flocculation does not however interfere with diagnosis. A third type of flocculation seen in non-flocculating preparation shows granular effect, and a fourth type seen with the aluminium hydroxide preparation and with a proprietory colloidal suspension is a milky appearance The Milky appearance is considered by some authors to be due to increased intestinal secretions. Aluminium hydroxide maintains an increased amount of fluid in the gut, and so might also be expected to produce milky appearance. Milkyness may be to failure of normal absorption of fluids rather than increased secretions.

Where there are flocculation patterns described as clumping granulation or milkyness the details of the mucosal pattern of the small intestine cannot be seen. Clumping gives rise to a false idea of segmentation in the jejunum and ileum, and clumping gives rise to a false impression of a narrow calibre bowel. Granulation and milkyness similarly obscure mucosal pattern.

Using ordinary barium however, details of mucosal pattern can (before clumping occurs) be seen in a large number of cases, and in many cases loops can be picked out where calibre can be accurately measured, but in the very cases where the diagnosis is in doubt ordinary barium may be of least help. Where there is a minimal organic stricture the flocculation pattern may mask it and give rise to a wrong diagnosis.

Figure 3 illustrates the clinical value of the flocculation pattern. Among 104 cases, 41 were found to have definite evidence of thickened mucosa dilated loops and altered transit time, suggestive of malabsorption syndrome, 24 of these were found to have an abnormal fat balance. 17 cases were found to have thickened mucosa and hookworm infestation. 7 were found to have duodenal ulcer, but in 13 cases there was no definite clinical evidence of pathology. Very few patients were thought to be suffering from malnutrition, some were taking very good diets. One patient with symptoms suggestive of peptic ulcer, and a barium clumping pattern showed in the F. T. M. evidence of excessive gastric mucous.

It is seen from the above findings that where a clumping pattern is present there is usually some disease of the G. I. T. but on the other hand clumping may be seen in normal patients or in malnutrition. The diagnostic value of the clumping pattern is therefore very low.

In a busy hospital, it did not prove practicable to repeat the barium procedure using a non-flocculating medium in all cases, still less did it prove easy to repeat the procedure within a few days, we therefore find that the use of flocculating barium is a wasteful procedure and should be discontinued in favour of examinations with a non-flocculating barium.

It was concluded that Alubar and Micropaque were superior media to ordinary medical Barium sulphate suspension because with these media the clumping pattern was much less frequent. The proprietory preparation of liquid colloidal suspension flavoured with mint compared favourably with micropaque and showed no difference in transit times, but there were some cases of milkyness. A concentrated solution of micropaque 4 oz. was therefore found to be the best medium of the three for routine examination of the intestine.

B. Evaluation of Radiographic signs using Non-Flocculating Media:

I. *Mucosal patterns* :

Duodenum and Jejunum

The narmal duodenum and Jejunum show an even distribution of barium throughout the gut, and a uniformly feathery appearance in jejunum that gradually gives place to an area where a few transverse folds are seen and then to an area of smooth outline or longitudinal folds in the ileum.

The abnormal findings I have noted in the jejunum in brief are as follows :—

1. Loss of normal feathery secondary folds. When a bolus passes along the gut the feathery folds are temporarily ironed out. If there is any permanent loss of tone in gut wall the feathery folds are more permanently lost.

2. Where feathery folds are ironed out, primary folds or valvulae conniventes are seen. The valvulae are seen as indentations of the barium silhouette about one eighth to one quarter inch deep and one eighth to one quarter inch apart. Each indentation is about 1/16 inch thick. This appearance again I believe to be due solely to loss of tone in the musculares mucosae.

3. Feathery folds may be spread out, and primary folds may be thin and diminished in number. (Fig. 4-B). This appearance I have noted in malabsorption syndrome. It is usually associated with increased calibre of the bowel again probably due to lack of tone in the gut wall.

4. *The primary folds* may be reduced or normal in number, but they are seen to be *thickened*. The indentation being $\frac{1}{8}$" to $\frac{1}{4}$" across. Transverse bars across the lumen are thus seen in partly empty jejunal loops, and a *cog-wheel* effect is seen at the edges where loops are full. (Fig. 5).

Table 3 shows the incidence of thick and thin primary mucosal folds in the series of 162 cases.

Table 3—Diagnostic Significance of Mucosal Folds

Particulars	Thick folds Transverse bars	Thin folds	Total Cases
Malabsorption syndrome proved ...	23	5	31
Malabsorption syndrome unproved ...	31	4	35
Hookworm ova seen	15	2	22
Ileo-caecal T. B.	2	1	2
Regional Enteritis	4	1	5
Jaundice	2	1	5
D. Ulcer	5	0	7
Bacillary dysentery	2	0	2

There may be a quite *shaggy outline* to the mucous folds. Some authors have described bulbous ends to mucosal folds and had said these are a sign of hookworm, but I have been unable to confirm this. (Fig. 2-B).

Transverse barring with thick primary folds and increase in calibre is the most constant feature I have noted in cases that showed malabsorption of fat, glucose or Vit. B_{12} but *the cause of this radiographic appearance* is still unknown.

In one case that showed this appearance associated with a chronic duodenal ulcer, the surgeon took a biopsy of the grossly dilated loop of jejunum. The biopsy showed a perfectly normal mucosa and normal ganglion cells were seen.

5. There may be a *complete absence of all mucosal pattern* or pipe-stem appearance similar to that seen in the colon in colitis. One case showing this appearance died of pneumonia, and at post mortem he was found to have an "atrophic" type of jejunitis with strongyloides infestation.

6. There may be *scalloping* of the border of the jejunum due to filling defects, due to infiltration by lympho-sarcoma.

7. Lesions of the mucosa in the jejunum and ileum are said to be present in 80% of cases of pulmonary tuberculosis. (Goldbery et al 1928). Prevot (1951) has described *constant filling defects* in the walls of the intestine in cases of tuberculosis which he has seen by means of spot films with compression. I have not found this method very practicable in a busy hospital routine, but I have noted a few cases where there has been a more obvious lesion with stricture formation and dilated loops (Fig. 6). In one case spot films with graded compression revealed *a constant narrow area* of gut, and at operation tuberculous stenosis and ulceration was found. Another case showed a constantly dilated loop above a fairly tight stricture. At operation however 24 strictures were found in the jejunum and five feet of gut had to be resected! In yet a third case a constant narrowing was shown by spot films with compression, but laparatomy revealed no lesion. The condition was due solely to a constant spasm.

Ileum

In the ileum the mucosal pattern is more difficult to assess, In normal individuals in the lower jejunum and upper ileum transverse mucosal folds are seen. In the lower ileum there is (with non-flocculating media) usually an even filling of pelvic loops. One or two loops rise up out of the pelvis, then the terminal ileum is usually seen as a straighter length of bowel entering the caecum. There is slight narrowing at the ileo-caecal junction. Serial films with compression over the normal ileum usually show longitudinal mucosal folds at site of contraction, but no folds at site of relaxation. Star or rossette shaped area of folds are seen between areas of longitudinal folds. These may possibly be due to Peyer's patches.

By barium enema I have sometimes noted transverse mucosal folds in the lower ileum in apparently normal cases but by barium meal transverse folds in the lower ileum have been in my experience associated with abnormality. Well marked transverse folds were seen in a case of mesenteric thrombosis with dilated loops. A crazy-paving type of mucosa was seen in a case thought to be malabsorption syndrome. Branching transverse folds in a partly gas filled dilated loop of ileum were seen in another case where there was thought to be a T. B. lesion in the terminal ileum. Cobblestone mucosal pattern has been said to be due to regional ileitis but Caffey quotes Welk, as saying that in children it is due to normal lymph follicles.

Cases where tuberculosis or regional ileitis have progressed to stricture formation are fairly easy to diagnose (Fig. 7). Our aim must be however to diagnose diseases in an earlier stage when ulceration is said to produce merely a heaped up filling defect in the bowel.

II. *Calibre and dilated loops :*

Alterations in calibre of the jejunum and ileum may be noted radiographically so long as a standard technique is always used. I have measured the calibre of the duodenum, jejunum and ileum in a number of cases where the intestines were apparently normal and related these calibres to the transverse diameter of the fourth lumbar vertebra (to allow for size of patient). I found for example that where the transverse diameter of the fourth lumbar vertebra was 4·5 c.m. the average diameter of the duodenum was 2·5 c.m. the jejunum 2·3 c.m. and the ileum 1·7 c.m.

Table 4—Significance of Increased Calibre of the Jejunum and Ileum

Particulars	Cases	Diseases	Total Cases
Malabsorption Syndrome Proved ...	11	Variable increase up to 3--6 c m.	31
Malabsorption Syndrome Un-Proved...	14		35
D. U. or Old Dyspepsia ...	2		2
Hookworm Infestation Proved ...	3	Increase in calibre less marked	22
Abnormal Bile Excretion ...	2		5
Regional Enteritis ...	4	Increase in calibre localized by stricture	4
Intestinal Tuberculosis ...	2		2

A uniform increase in calibre of the gut I found in 32/162 cases. In 35% cases of proved malabsorption syndrome there was increase calibre of gut (Fig. 5). In two cases of peptic ulcer a general increase in calibre up to 4·0 c.m. was found with apparently normal absorption of fat and no megaloblastic anaemia. There was an active duodenal ulcer in one case.

Increase in calibre of the small intestine can of course take place in a large variety of "deficiency states" as described by Golden (1941). Allergic condition such as sensitivity to wheat gluten or milk may be found, Malnutrition with lack of vitamin intake may be a case. Electrolyte imbalance and uraemia can cause dilatation of the intestine. Disorders of bile excretion were found in 2 of the cases with increased calibre.

Many of the cases of increased calibre also showed thick transverse mucosal folds in the jejunum, but some showed thin folds. The signification of these two types of folds has yet to be assessed.

To sum up if there is found to be uniform increase in calibre of the gut with thick or thin folds, then radiologically this abnormality can be described, but it is the duty of the physician in charge of the case to carry out clinical and biochemical test to try and assess the cause of such abnormality. Stool tests for parasites, blood and marrow picture, urine for bile, serum amylase, glucose tolerance curve, fat balance, etc., may be studied.

The most important task of the radiologist is to decide whether or not there is an organic filling defect or stricture formation in the intestine. *A localized increase in calibre* in the jejunum often acts as a pointer to an organic defect.

III. *Alterations in Peristalsis :*

While it is not usually practicable to follow peristaltic movements all the way down the 22 feet of small intestine, it is fairly easy to follow peristalsis under the screen down the first few feet of jejunum. At 2½ hours we can observe peristalsis again in the lower and perhaps terminal ileum.

In *normal individuals* peristalsis pushes a bolus of barium smoothly and evenly down the intestine until all of that bolus has been plastered on to the walls of the gut and no more is left. Another bolus then comes down and spreads itself out along a further piece of intestinal mucosa and so on.

In *abnormal intestines* I have noticed to and fro movements, irregular movements, slow movements, and fast movements.

To and fro movements : I believe to be due usually to the attempt of rather feeble peristalsis to push barium up the hill over the vertebral column in the lying position, or up over the fourth part of duodenum in the standing position.

Irregular movements : consists in sudden rushes of peristalsis in some loops, followed by areas of absent peristalsis or stasis in other loops. These irregular movement give rise to a condition sometimes described as "*Segmentation*". Several boli of barium are seen to accumulate in one loop or segment until finally the stimulus to further peristalsis is touched off and the whole segment may be seen to contract and move the barium on by a sort of mass peristaltic effort such as is seen in the large bowel. Such an abnormality of peristaltic action may give rise to a false impression of stricture or adhesions especially if flocculating media are used, and if only a few films are taken. Even using spot films and graded compression it may be impossible to get good filling of the narrow part of the gut,

and so it may be impossible to say whether or not a tuberculous lesion is present. Irregular movement are an abnormality, but what the cause of that abnormality is we may not be able to say without other tests and finally laparatomy.

IV. *Transit times :*

Transit times using three types of opaque media have been analysed in table 5. In 24 patients who were considered normal the transit times to ileal loops using poor barium sulphate were found to be ½—1½ hours, and to caecum 1½—5 hours. If aluminium hydroxide was added transit times were reduced to ½—¾ and 1—3 hours respectively.

27 patients were found who had slow transit times and 14 patients were found with rapid transit times.

The diagnostic signification of transit times may be judged by the following table :

Table 5—Transit Times

Diseases		Slow Transit	Rapid Transit	No. of Cases
Malabsorption Proved	...	11	0	31
Malabsorption Unproved	...	6	1	35
Hookworm Ova Seen	...	5	2	22
Ileo-caecal T. B.	...	2	0	2
Regional Enteritis	...	3	0	5
Hypermotility	...	0	8	8
Psycho-motor Proved	...	0	3	3

Where there is slow transit time therefore motor disorder of the intestine with malabsorption may be suspected, but hookworm, and chronic inflammatory lesions cannot be excluded. Where there is rapid transit time and no evidence of bacillary dysentery or gastro-enteritis, tubercular lesions still cannot be excluded without other tests, but psycho motor disorders must be considered.

V. *Gas in the intestine :*

The presence of gas in the small intestine is an abnormal finding. If there are fluid levels the possibility of subacute obstruction must be considered, but severe motor disorder cannot be excluded. There is no harm in giving a small barium meal to cases suspected of having partial obstruction of the small intestine.

Incidence of Signs and diseases

The incidence of the various signs described above is illustrated in (Fig. 8).

In a further review of 855 barium meals performed in a nine month period, the following incidence of groups of defects were found.

1. Peptic ulcer (gastric 14, duodenal 226) ... 28%
2. Small intestine disorder (Jejunal 185, Ileal 95) ... 32%

3. Other condition 99 (carcinoma stomach 25, Post operative 16). 12%

4. No lesion shown 236 ... 28%

A radiological study of the small intestine is time consuming and it needs more films. In view of the fact that we have found radiological abnormalities in 28% of all barium meal examinations that we have found laboratory proof of malabsorption in a large percentage of these cases, and that we have surgical proof of organic defect in a few, we are convinced that the procedure is not only worth while, but that it is essential as a routine. Especially is it essential in India where it is now known that sprue and allied disorders are far more common than was originally thought.

Summary

As a result of my investigation of these first 162 cases have come to the following conclusions :—

1. The use of ordinary medical barium sulphate suspension gives rise to flocculation patterns that are of very little diagnostic significance. The occurrence of these patterns can be markedly reduced by so called non-flocculating media.

2. The findings of a general increase in calibre of the small intestine together with prominence of the primary transverse mucosal folds and decrease in transit times must be reported. Such findings may be found in a large number of diseases but in South India these findings often point to the presence of motor disturbances that can be relieved by antispasmodics or to a malabsorption syndrome that can be treated by appropriate replacement therapy. Hookworm infestation and the possibility of localized dilated loops and strictures must be carefully excluded.

3. The findings of localized dilated loops of intestine are strong indication of the presence of intestinal tuberculosis or regional enteritis, but even if such localized dilated loops cannot be found the presence of tuberculous ulceration in the intestine cannot be excluded. Observation of peristaltic movement, mobility of the gut, chest radiography, and other clinical tests are needed in such cases.

4. A considerable number of cases complaining of vague abdominal pain, and loose motions have been found to have been wrongly diagnosed and treated in the past. A careful radiographic study of the small intestine is in many of these cases a rewarding part of the diagnostic procedure. Radiographic findings alone not diagnostic, but they do in South India point the way to further investigation and treatment in about 90% of cases suspected of small intestine disorder.

5. Small intestine disorders in our clinic total 32% of all cases referred for barium meal examinations.

Acknowledgements

My grateful thanks are due to Dr. Ida B. Scudder, Professor of Radiology, Drs. P. Kutumbiah, S. Baker, K. I. Vythylingam, and P. Koshy, physicians, and to Dr. D. Hancock, surgeon and Dr. Hadley, pathologist for their valuable help in preparation of the paper.

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Idiopathic Malabsorption-response to medical treatment.

History: Man aged: 32: Four stools per day. Anorexia, distension, sore mouth.
Laboratory findings: Fat balance 54%. Glucose tolerance curve flat. Megaloblastic anaemia.

A

Film taken half an hour after ordinary barium meal, shows marked "Clumping" pattern in upper jejunum (late) and a grossly dilated loop of lower jejunum with separated mucosal folds.

B

Repeat barium meal after 3 weeks in hospital, using "Alubar". At 10 minutes the meal has already passed to lower loops of jejunum. Clumping pattern not present. Thick mucosal folds seen in upper loops. Previously dilated loop of lower jejunum no longer present.

C

After seven months treatment and replacement therapy, repeat meal using "micropaque" shows restoration of normal mucosal pattern, calibre, and transit time.

Fig. 1.

Minimal flocculation with two "non-flocculating" media.

History:—Woman aged: 25. Abdominal pain, loose motions, distension, sore mouth. Megaloblastic anaemia.

Fig. 2.

A

"Micropaque" meal (4 ounces) showed at ½ hour irregular distribution of barium in loops of jejunum of apparently varied calibre. In some loops finger like filling defects due to thickened mucosa and possibly areas of muscular contraction seen.

B

Repeat meal after 9 days using "Alubar". Increase in calibre of all jejunal loops associated with a 'spidery' type of mucosal pattern now seen. Some areas of very thick mucosal folds visible.

Clinical value of flocculation patterns in 104 cases.

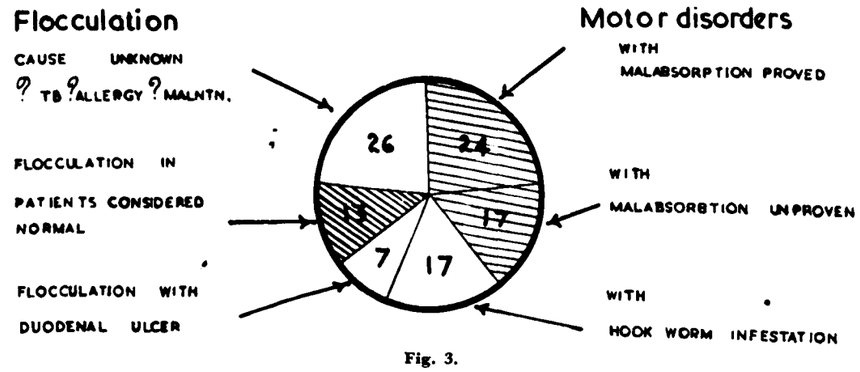

Fig. 3.

Tuberculous ileum-Granulation in a dilated loop at 6 hours. Terminal ileum normal.

Fig. 7.

History :—Man age : 33. Pain in R. I F. 3½ years, remission of 2 to 3 months, worse recently. Has felt a lump in the R. I. F. which appears about 5 minutes O. E. Vague mass R. I F.

Laboratory findings :—Hookworm cysts present.

X-ray findings :—Micropaque meal shows gross dilatation of an ileal loop seen at 3 hours. Terminal ileum seen *at 6 hours* appears normal but there is granular clumping in the dilated loop of upper ileum.

Impression :—Partial obstruction ileum : T. B.?

Operative findings :—Ileum studded with tubercles, loops of ileum adhered to the bladder causing obstruction.

Path. findings:—Bowel is markedly dilated measure 13 cms. in circumference at its widest part. There are also 3 ulcers the largest measuring 2½ × 1 cms. They run transversely across the gut. Mic. found to be many tubercles with giant cells.

Diagnosis :—T. B. ileum.

Frequency of Radiographic Abnormalities

In a Series of 162 Examinations of the small intestine using various Media

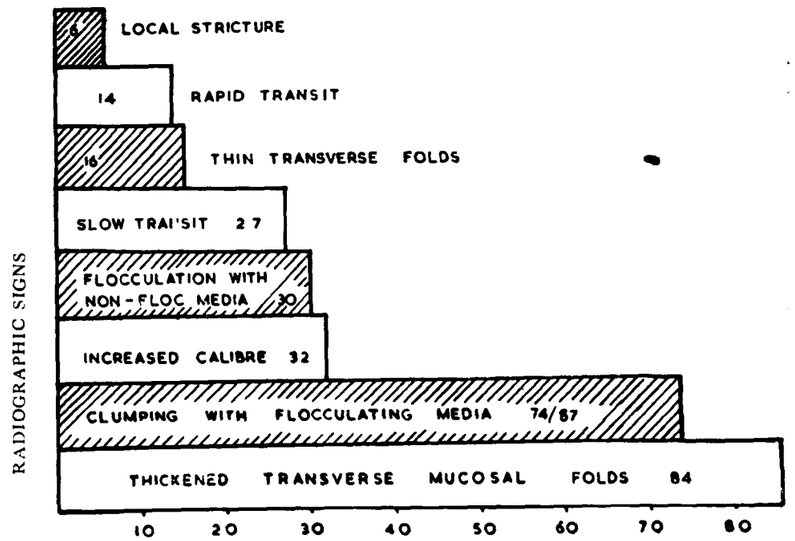

Fig. 8.

Frequency of radiographic obstruction in 162 examinations of the small intestine.

Abstracts of Radiological Literature

Focal Pulmonary Hemosiderosis in Rheumatic Heart Disease. Esposito Michael J. The Am. Jour. of Roentgenology. Vol. 73. March 1955. Pages 351-365.

Focal pulmonary hemosiderosis is not as rare a sequela of rheumatic heart disease as earlier reports would indicate. A study of one hundred necropsied cases with rheumatic heart involvement disclosed twenty-eight histopathological examples. With the exception of four early cases due to aortic narrowing, all cases were the result of mitral stenosis. Five advanced cases with focal hemosiderin collections, measuring 1 to 3 mm. on the microscopic section, revealed a very definite diffuse miliary nodulation of the lungs roentgenographically. Three additional cases with striking roentgenograms, two of which were verified at postmortem are also reported.

Clinically there is a high incidence of hemoptysis, but the condition presents no distinctive features.

The salient pathological finding is a well demarcated nodule of agglomerated pigmented macrophages produced by repeated hemorrhages ; edema and venous congestion exert a favourable influence on the development of such foci. It occurs in 2 distinct clinical states, (*a*) In Idiopathic pulmonary hemosiderosis a frequently fatal disease of unknown etiology seen almost exclusively in children, and characterised by recurrent episodes of fever, dyspnea, cyanosis, hemoptysis, and anemia, (*b*) In chronic failure of the left heart due to any cause, but almost invariably as the result of rheumatic heart disease with mitral stenosis.

The roentgenographic incidence is 5 per cent. Small foci of hemosideri were observed with aortic stenosis alone, but the vast majority, including all large enough to be recorded on the roentgenogram, were the result of mitral stenosis. Patients with mitral stenosis have a relativelygood life expectancy, and this, coupled with their proclivity for both pulmonary hemorrhages and repeated episodes of congestive failure, makes them particularly prone to develop hemosiderosis.

The essential roentgenologic feature of focal hemosiderosis is a diffuse, fine, granular pulmonary nodulation. This is nearly always associated with an enlarged heart bearing a mitral configuration. The nodules are irregular in outline and on the roentgenogram generally measure between 2 and 4 mm. in greatest diameter. On occasion they may be as large as 5 mm. They are concentrated in the mid-zones but do extend towards the periphery in all directions. The apices are usually spared but in the more advanced cases this may not be so.

Nodularity is primarily in the parahilar areas, and fades out as the vessels course peripherally. In contradistinction to this, the aggregates of hemosiderin are often clearly visible in the outermost lung fields. It is the presence of these nodules beyond the confines of any conspicuous vascularity that is diagnostic.

In general it may be said that diffusely scattered hemosiderin collections of less than 1 mm. do not cast an appreciable shadow. Those measuring about 1 mm. can be identified unless congestive changes are extreme. Deposits measuring between 2 and 3 mm. in diameter give rise to conspicuous nodulation at all times.

Disseminated, calcified and bony nodules occurring primarily in the lower half of the lungs is still another pulmonary manifestation of mitral stenosis.

The course of rheumatic heart disease is in no way altered by the presence of nodular hemosiderosis. The nodules are not responsible for any symptoms, nor do they adversely affect pulmonary function. They do not influence the prognosis, although in most cases the prognosis is grave because the mitral stenosis is marked.

5 cases are reported in detail with autopsy findings.

10 radiographs. 14 photomicrographs.

S. N. Deboo, Bombay.

Gould. David M. and Torrance Daniel J. Pulmonary edema. Am. Jour. Roentgen. March 1955. 73 : 366-374.

The authors studied 100 cases of pulmonary edema abstracted from a total number of 982 patients considered to have entities which are known to produce episodes of pulmonary edema, and have analyzed them morphologically.

Pulmonary edema manifests itself by clouding or opacification of the lungs, this has to be differentiated from congestion, and from dilatation of pulmonary arteries and veins. In congestion, the vessels are enlarged and hazy in outline. In edema the opacification completely obliterates the vessels traversing the edematous lung, and demonstrates small bronchial air shadows.

They divide edema into 3 types, Type I central edema, Type II diffuse edema and Type III Focal edema. Their series show no single pattern differentiating the underlying causes of pulmonary edema. There is some correlation between the poorly defined congestive type of edema and cardiac failure without uremia, and between the massive central type of edema without congestive changes and uremia.

Pulmonary edema is frequently confused with pulmonary infarction or bronchopneumonia. A differentiating point in favour of pulmonary edema is the absence of pleural pain. Frequently however the 2 conditions, namely infarction and edema coexist.

The uremic cases tend to show a well defined and dense type of central edema without associated congestion. On the other hand the cardiac cases without uremia tend to show poorly defined central edema of lower density and associated with congestive changes. 90 per cent of all their cases were central edema. The x-ray diagnosis of massive pulmonary edema carries with it a poor prognosis as the great majority of such cases in their series died within several days or weeks. Cases of focal edema proved rare.

7 radiographs. One diagram.

S. N. Deboo, Bombay.

Gudbjerg Carl E. Roentgenologic diagnosis of bronchiectasis. Acta Radiologica. March 1955. 43 : 209-226.

The author analyses chest roentgenograms of 112 patients with verified bronchiectases. The changes demonstrated were 4 in number.

(I) Increased pulmonary markings were found in 79 per cent of the patients. The changes appeared in the form of linear bands extending from the hili downwards along the heart border, and formed a characteristic coarse meshed network. (II) Honeycomblike structures were observed in 43 per cent of the patients, resembling those of congenital cystic degeneration. (III) Atelectasis, either total or partial lobar, should always arouse a suspicion of bronchiectasis especially in children. In the series studied, atelectasis associated with more or less pronounced displacement of organs was present in 35 patients (31 per cent). (IV) Pleural changes were observed in 47 per cent of cases, and included flattening or obliteration of the phrenicocostal sinus, widened interlobar fissure, and small adhesions of the diaphragm A normal appearance was found only in 7·1 per cent of the 112 cases of verified bronchiectasis.

The importance of the signs of bronchiectasis in the conventional film is discussed, but it is pointed out that a definite diagnosis can be made only by bronchography.

The author discusses bronchography, and mentions that both antero-posterior, and postero anterior views are necessary. A bronchography gives information as to the type and extent of the pathologic process. A criterion for dilatation usually employed is that the lumen of the contrast filled bronchus remains unchanged in width and does not become narrow from the hilum towards the periphery. In addition to dilatation, distinct contrast filling of the ducts on bronchial glands was observed in 6 cases. In well established bronchiectases, the calibre of the bronchi does not change upon inspiration and expiration.

The disease involved the right side in 33 per cent, the left side in 41 per cent, and both sides in 26 per cent. The left lower

lobe was involved in 59 per cent, the lingula in 36 per cent, the right lower lobe in 42 per cent, the right middle lobe in 41 per cent, while the right and left upper lobe were the site of involvement in only 17 and 21 per cent of cases respectively. The dilatations were cylindrical in 52 per cent, and saccular in 18 per cent, while 30 per cent showed a combination. A comparison between the bronchograms and the operative findings showed complete agreement as regards the type and extent of the changes.

24 radiographs. 4 tables. 1 diagram.

S. N. Deboo, Bombay.

Basil Strickland. Pulmonary appearances in polyarteritis Nodosa. Jour. Fac. Radiol. Jan. 1955. 6: 201-208.

Although the responsible antigen is unknown, it seems likely that it is bacterial in origin. It is a necrotising inflammatory lesion of the small arteries, arterioles and occasionally veins. The lesions are wide spread throughout the body, and it is rarely that the arteries of only one organ are involved.

In practice the clinical diagnosis is considered when no other explanation can be given to account for the bizarre symptoms and signs which may be referable to any organ in the body. Since any system of the body may be affected, a typical clinical picture can not be described. The number of diseases which polyarteritis can simulate is legion and the diagnosis is often very difficult. Biopsy of a skin nodule is the most accurate method of diagnosis, but since these nodules are not always present, the usual method of diagnosis is by muscle biopsy. The part that radiology can play is very limited. Changes are most commonly seen in the lung fields, by far the commonest being those due to cardiac failures, often a terminal event in this condition. Changes other than those directly attributable to cardiac failure are rare.

Six proved cases of periarteritis nodosa are presented. The radiological findings in these cases seem to have no common fundamental pattern. The only persistent clinical feature common to all 6 cases was a well marked respiratory illness dominated by cough and dysponea, but only in case I were the symptoms truly asthmatic in type.

It seems from the post mortem findings, the haematological findings in vivo and a review of the scant literature on the subject that pulmonary eosinophilia and pulmonary granulomatosis are the 2 most likely factors causing the pulmonary opacities in polyarteritis nodosa, but multiple small infarcts and lobular atelectases may account for some of the changes.

From the radiological point of view, one may draw attention to the bizarre nature of the opacities, their transience, their tendency to appear first at one site and then at another, often progressing in one lung field, while simultaneously regressing in the other, usually leaving a normal appearance, once the resolution is complete. The opacities may remain discrete or may cealesce, they may be dense and homogenous, or of extremely low density and irregular: the very lack of pattern seems almost a feature in itself.

While the commonest radiological findings are those due to cardiac failure, with or without pulmonary oedema, the changes described by the author, although rare, should nevertheless, be borne in mind in any undiagnosed condition presenting bizarre signs and symptoms, where the clinical possibility of polyarteritis nodosa may arise.

15 radiographs. 2 tables.

S. N. Deboo, Bombay.

The Pneumomediastinum. Juha Tapiovaara. Acta Radiologica. Feb. 1955. 43: 104-114.

The pneumomediastinum methods based on the use of gas which are in use at the present time may be divided into 2 groups according to whether the direct or indirect routes are employed.

Direct routes introduced by Condorelli, who as a result of experiments carried out, suggested a puncture superior to the manubrium sterni for the injection of gas into the anterior superior mediastinum for the radiologic examination of this region. Transtracheal insufflation, in which the puncture needle is introduced through the trachea into the loose connective tissue between the trachea and the oesophagus.

In the indirect method, which is based on the principles of Ruiz Rivas the gas is introduced by precoccygeal injection moves from the retroperitoneal space into the anterior and posterior mediastina simultaneously.

The presacral gas insufflation method of Ruiz Rivas, combined with tomography has been chosen, and this method has been used in 30 patients from 20 to 61 years of age, 4 of whom were female, all being admitted for Thoracic Surgery. Ordinary radiography and tomography having failed to determine with certainty the relation of the process under investigation to the mediastinum and its structures, a combination of oxygen insufflation and tomography in sagittal and lateral projections was employed.

After completion of the insufflation the patient is placed in the prone position for 20 to 30 minutes with the upper part of the body slightly elevated to permit the gas to mount higher. It is as well to examine its progress by fluoroscopy. The tomographic examination is usually started 1 to 1½ hours after the commencement of the gas insufflation.

Gas injected into the pararectal tissue is diffused into the pelvic connective tissue, some portion continuing into the retroperitoneal region, where after filling for instance the perirenal spaces, it finally reaches the level of the caudal surface of the posterior portions of the diaphragm. It penetrates chiefly through the apertures between the crura of lumbar portion of the diaphragm and through the oesophageal foramen and the aortic hiatus with which these are connected.

In the posterior mediastinum the gas moves along the spaces, dorsal to the descending aorta and the oesophagus. The space bounded by the diaphragm and posterior portion of the pericardium becomes filled with gas and in the roentgenogram these organs are visualised with sharp margins. Gas is also evidenced in the region of the arch of the aorta and the hili of the lungs, and the large blood vessels, as well as the trachea and the large bronchi may be seen surrounded by narrow bands of gas.

A single presacral injection of gas offers simultaneous visualisation of both the posterior and the anterior mediastina, which is an advantage not obtained with the so-called direct route methods. The contrast medium around the mediastinal organs given by the pneumomediastinum is a marked improvement in tomographic roentgenography of this area, which otherwise is homogeneous to roentgen rays. Thus gas insufflation and tomography complement each other.

9 radiographs.

S. N. Deboo, Bombay.

Tumor Outline of Oesophageal Carcinoma. Haas Lewis L, and Baker Bernard. Radiology. February 1955. 241-248.

A satisfactory roentgen study of Oesophageal cancer should give detailed information not only as to intraluminal involvement and the length of the lesion, but also concerning its lateral and paraesophageal extension. This information may affect the prognosis, type of therapy, and radiotherapeutic technic.

The direct tumor shadow is visible in a significant percentage of x-ray films taken with adequate technic. Even on plain films the tumor outline is frequently visibie. Regression or progression of oesophageal cancer may also be followed in many cases on plain films. For a complete follow-up, conventional barium studies are indicated.

In lesions of the cervical and highest thoracic segments, alterations of the hypopharyngeal structures (piriform sinus) and widening of the prevertebral soft-tissue shadow on the lateral neck film are diagnostic.

For these reasons it would be desirable to depict on the roentgenogram not only the internal contours of the oesophagus, but also the external soft-tissue shadow.

Visualisation of the tumor is aided by the pre-esophageal location of the trachea, the air content of which is in sharp contrast to the tumor tissue density. It must be stressed, however, that the tumor is demonstrated not only by the border-forming trachea, but also by its own density, which frequently differs not only from air but also from the surrounding normal tissues. This makes it possible to outline the tumor shadow against other structures posteriorly.

In the normal oesophagus, the wall and peri-esophageal tissue usually produce a thin, uniform, parallel shadow, a few millimeters in thickness along the barium-filled lumen. The thickness of this normal shadow between the barium-filled lumen and the trachea depends upon the degree of barium filling and the consequent distention of the esophageal lumen.

In the presence of a tumor, this surrounding shadow is neither straight nor uniform. With an infiltrating growth, the appearance may be cylindric or spindle-shaped, with more or less widening. If the growth is fungating, it may produce an irregular, bulging, dense shadow, sometimes lobulated. Not only can a tumor of the thoracic portion of the oesophagus be visualized on the plain film and delineated by its difference in density from that of air or normal surrounding tissue structures, but radiation effects can be followed in a similar manner.

The visualization of tumors below the carina is less favourable because of the absence of the tracheal air content. In spite of this, the tumor may frequently be differentiated from the surrounding structures, as mentioned above. A secondary bronchus may sometimes outline the tumor anteriorly and the air-containing lung may furnish good air-tissue contrast.

The posterior parts of the tumor are also usually visible, not only because the surrounding structures of the posterior mediastinum are less dense, but also because of superimposition on other tissue, as when the tumor is projected over the vertebrae.

The shadows produced by tumors in the subdiaphragmatic area are similar to those of gastric carcinoma of the fundus and cardia, and differentiation as to the origin becomes difficult.

14 radiograms.

S. V. Deboo, Bombay.