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IMPORTANT ANNOUNCEMENT

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Editorial

BY

Dr. K. M. RAI

13th INDIAN CONGRESS OF RADIOLOGY.

The 13th Indian Congress of Radiology was inaugurated at the Auditorium of the B. J. Medical College, Poona, by His Excellency Shri. Sri Prakasa, Governor of Bombay, on 20th February, 1959. On arrival, the Governor was received by the Chairman, Reception Committee, Lt.-Col. Rebello, who introduced the President and the Office Bearers of the Indian Radiological Association to His Excellency. The Chairman of the Reception Committee welcomed the gathering to the Historic City of Poona, and in a short lucid address explained the part played by the Armed Services Radiologists and the contribution they have made to the advancement of Radiology in this Country.

In the unavoidable absence of the President elect, Dr. R. F. Sethna due to indisposition, the printed address was read by one of the members of the Association. Great sympathy was felt for his sudden indisposition, a keen and enthusiastic member of the Association. It was hoped that he would regain his usual health quickly and his services would once again be available for the Association.

It has to be acknowledged that the Service radiologists have played no mean part in the advancement of Radiology in this Country. This was very much in evidence by the series of excellent papers they read at the Scientific Session at Poona. Though Poona is a very old and ancient city, there are hardly 3 or 4 radiologists practicing on the Civil side. Young Dr. Dikshit, the Hony. Secretary of the Congress had put in a great deal of effort in organising this Annual function, but had it not been for the

splendid cooperation offered by the medical men of the Armed Forces, this Congress would not have been the success it was. The Indian Radiological Association is very thankful to the Services personnel for all that they have done to make this Congress a success.

The papers read at the Congress were generally of a high order. This portends well for the future of Radiology in this Country. The social side was not overlooked by the organisers of the Congress. The delegates thoroughly enjoyed their visit to the several Institutions particularly to the Defence Academy at Kadakvasla, the penicillin factory at Pempri, the artificial limb Centre at Poona etc. These Institutions were an eye opener to many of the delegates with respect to the rapid progress the Country is making in several directions. With the Annual banquet and a message from the President read out to the gathering by his charming daughter, the Congress session concluded to meet again at Hyderabad next year.

SIR JAGADISH CHANDRA BOSE: 1858-1938

Eminent Biologist, Botanist and Physicist, Professor of Physics, Presidency College, Calcutta 1885. With his flair for experimental demonstration he pioneered research in electric waves and physiological properties of plant and animal tissues. Gained international fame with his innumerable "laboratory miracles revealing the hitherto invisible reactions underlying plant and animal life."

Founded Bose Research Institute in 1917.

Elected fellow of the Royal Society in 1920.

Demonstrated growth and tropic movements in plants in 1929.

Member of the Committee for Intellectual Cooperation of the League of Nations—1930.

Dr. K. P. MODY,
Director, Department of Radiology, Tata Memorial Hospital, Bombay.

Development of Radiation and its Contribution to Medical Science: The Cancer Problem

BY

Dr. K. P. MODY

Director, Department of Radiology, Tata Memorial Hospital: Bombay

SIR JAGADISH BOSE MEMORIAL LECTURE—1959

In 1895 Prof. Roentgen discovered X-rays. This discovery added another brilliant chapter to the advancement of medical science, coming as it did in the era which saw the introduction of Anaesthesia by Morton, prophylactic prevention of Small Pox by Jenner, Anti-sepsis and Asepsis by Pasteur, Koch and Lister, and the specific treatment of Malaria by Cinchona. Innumerable tributes have been paid to Roentgen for his monumental discovery considered as one of the greatest achievements of all times it was the dawn of the atomic age. Whilst doing homage to his genius, we are apt to forget the pioneer work of great scientists who preceded him and laid down the fundamental concepts in Electricity and Magnetism. Some of them are familiar to us, such as Newton, Galvani Faraday, Volta, Ampere, Ohm, Maxwell, Hertz, Geissler, Crookes, Leonard. Their achievements date as far back as the 16th century. These men discovered and designed the instruments which enabled Prof. Roentgen to carry out his experiments, which culminated in the discovery of X-rays.

There was a great deal of heart burning and rivalry between Prof. Roentgen and other workers, particularly Leonard, who claimed priority for the discovery. It is an old story, too well known and publicised and proved that the real credit for the discovery goes to Prof. Roentgen.

Soon after the discovery X-rays began to be used by scientists and medical men as well as by quacks and charlatans in the diagnosis and treatment of diseases. Even simple parts of the body such as the extremities required exposures of one hour and more, instruments were crude and primitive.

In the early years our greatest difficulty was in interpretation. Co-relation with anatomy, physiology and pathology was totally lacking so that many of our findings were inaccurate and led to disastrous results. To give a few examples, we were very fond of emphasising ptosis of the G.I. tract and Kidneys as being pathological resulting in disastrous and unnecessary surgical procedures. Another "howler" was the diagnosis of hilar tuberculosis. Many a patient in the old days had to spend months in a sanatorium. We failed to realise that prominent hilar markings were due to vascular changes.

Since then Radiology has consistently advanced, till to-day we see it's culmination in the manufacture of apparatii of great precision and power. Amongst the great advances, which made Radiology what it is to-day, may be mentioned the High Tension Transformer, the Coolidge Tube and the Potter Bucky Diaphragm. These revolutionised the practice of radiology, precise and accurate technic became possible. At first confined to the study of bones and foreign

bodies, it expanded its scope and soon after genito-urinary and gastro-intestinal investigations and chests were routinely done. The next phase was the introduction of opaque substances for the study of urinary, gall bladder and cardio-vascular functions adding another glorious chapter to the history of Radiology. We are witnessing to-day a great advance in the study of diseases, we are no longer content to merely visualise gross anatomical structures, we are now attempting to unravel physiological processes.

It is interesting to record that as early as 1897 Dr. John McIntyre of Glasgow experimented with Cine-Radiography. He studied the movements of a frog's hind legs by taking serial pictures, which were later re-photographed on a continuous cinematographic film. After every exposure, which took several minutes, he altered the position of the leg by hand. It was a marvelous achievement, at a time when even ordinary cinematography was not well established. To-day Cine-Radiology has developed to a stage of perfection and precision with the introduction of High Voltage Radiography, Image Amplifier Mirror Cameras and Photo-fluorographic methods. It's recent development has been largely due to the efforts of Dr. Reynolds, who started experiments as early as 1920. To-day specially designed apparatii are available. The method has several advantages, particularly in the study of peristalsis, movements of joints and angio-cardiography. So far it has not been routinely practised, but it is likely to become popular very soon.

Modern Medicine has made great strides during the last 50 years. It is no exaggeration to state that most of this progress is due to the valuable help from radiological methods, radiology has enabled us to be precise in diagnosis, and permits us to gauge the extent of the disease. Many obscure diseases have been brought to light and diagnosis in the early stages is made possible. Under it's influence and guidance new specialities were able to develop such as Gastro-Enterology Orthopaedics and Cardiology. New surgical technics have developed solely through its influence, such as Cardiac, Lung and Neuro-surgery. Above all it has been chiefly responsible for bringing into control such destructive diseases as Tuberculosis and Cancer, made possible by early diagnosis by radiological methods.

Soon after the discovery, radiological investigation of the G. I. Tract made slow and steady progress, in which fluoroscopy played a prominent part. Insufflation of the stomach, ingestion of a bismuth tablet and introduction of opaque catheters were the first contrast media employed. Amongst the early workers were eminent men such as Antoine Beclere, Levy-Dorn, Rieder, Holtznecht, Handek and a few others in Europe and America. Ried of Munich introduced the Bismuth meal, Holtznecht made a special study of peristalsis, Hauclek described the gastric niche. As early as 1904 the French school under the leadership of Beclere established the first Radiological Clinic in Europe. Side by side with the added knowledge through Radiological methods, Gastro-Intestinal Surgery developed as never before.

Equally spectacular progress took place in the investigation of the Heart and Aorta. Three distinct phases in its development can be recognised. In the first few months after the discovery, orthodiagraphic studies of the vascular system were routinely practised. At that time the usual 6 foot film procedures could not be adopted owing to inadequate machinery, entire reliance was on screen tracings, quite a reliable method. Unfortunately, the early workers, in their zeal for information suffered serious injuries due to radiological hazards, at that time unknown and unheard of.

When instruments of reasonable capacity were manufactured, teleradiography was largely practised and the diameters of the Heart, and different chambers were meticulously worked out. In this connection may be mentioned the valuable contribution of Vaques whose classical work still stands supreme.

In recent times, cardiac measurements were replaced by simpler technic, and although still practised by the older school, we now rely more and more on delineation of the shape of the Heart and its different chambers by radiographic projection in different oblique positions.

During the last 15 or 20 years radio-opaque substances have come into use for special study of the circulation, particularly in Congenital Heart Disease. This has been made possible due to the manufacture of powerful units, permitting very short exposures of the order of 1/100th of a second and even less, High K. V. Radiography and elaborate arrangements for serial pictures. Cardiac Surgery is the direct result of these angio-cardiographic studies. In this connection, may we stress that however valuable these specialised procedures, a correct interpretation of routine radiograms give valuable information in 75 to 80% of cases. A word of caution is necessary, as in our enthusiasm for newer methods, we are apt to forget the dangers, however small, associated with them.

Chest radiography has made great progress. Delineation of the different lobes and lobules of the lung has made possible great advances in surgical technic. Tomography has appreciably helped in the accuracy of localisation. In order to obviate the great exposure involved in having to take several pictures in conventional tomography a special device has been designed to enable several layers to be taken simultaneously with one exposure. The technic in chest radiography is undergoing radical evolution. High K. V. technic upto 150 K. V. to 200 K. V. is preferred. Very recently radiography by super-voltage units of a million to 2 million Volts has been attempted. Utilising homogenous gamma radiation the characteristic absorption in bone is much minimised and we get a chest radiogram completely free from the confusing shadows of the ribs, sternum and spine. Radiograms of great diagnostic value are produced. The technic has great uses particularly in Intra-Thoracic Tumours and Aneurisms.

Gall Bladder Diseases can now be diagnosed with almost a 100% accuracy with the use of the newer dyes. We have travelled far in this direction since the first gall stones were demonstrated in 1896. Retrograde pyelography has been practised ever since 1904. Radio-opaque bougies were first used, later on radio-opaque solutions of Collargol and now Sodium-Iodid. Intravenous pyelography came on the scene at a much later date, adding another brilliant chapter in the study of kidney function and urinary diseases.

X-ray studies of the Skull in the early days was unsatisfactory and discouraging. Schuller of Vienna published a monograph on the subject as late as 1917, since when slow and steady progress has been achieved. To-day Radiology is recognised as being the premier method of diagnosis. Neuro-surgery owes its present position to the great help that Radiology can offer. Radio-active Isotopes are also valuable adjuncts in the localisation of Intra-cranial neoplasms.

Amongst recent advancements must be mentioned the introduction of the Image Intensifier, High Voltage Radiography, automatic rapid serial changers and Photo-fluorography. The quality and speed of films have also been improved. These are

important factors in speeding up radiographic exposures, reducing radiation hazards to the patient. A great deal has been achieved, a great deal yet remains to be unravelled. We are not able as yet to visualise solid organs such as the Pancreas, the Liver, the Spleen except by indirect means. Attempts were made with the injection of chemical substances such as Thorotrast, but they were found to be dangerous. It is not too much to hope that harmless chemical combinations will be available to achieve progress in this direction.

Radio-diagnosis to-day has advanced to such a stage of technical perfection that it is necessary for the Radiologist to specialise within the speciality. Modern developments in Neuro-Radiology, Angio-cardiography, Cerebral Angiography, Cinematography, Aorto and Splenography are highly complex and specialised problems requiring experience and elaborate machinery. Radiology is useful from birth to death and every age group has its own problems. A correct appreciation of the physiological differences at different age groups is essential if grievous errors are to be avoided in interpretation. In old age for instance, a broad aorta is not always pathological. Decalcification of the skeletal system, kyphotic and other deformities, osteo-phytes and lipping are often physiological, an expression of wear and tear. Such changes must be assessed in their proper perspective.

My talk would be incomplete were I not to refer to the important role of Radio-active Isotopes in the investigation of the body processes and the diagnosis of diseases. The human system is actuated by a series of physiological processes which maintain the body economy and keep us healthy and well. These are of a bio-chemical nature and the study of these manifold reactions is of paramount importance. One of the greatest discoveries of the age is the production of artificial radio-active isotopes in 1934.

The phosphates that we take with our food or as drugs are absorbed by the blood-forming organs, mainly the bone marrow, slightly so by the Liver, the Spleen, and other organs. It is important to study the intake by the different organs and for this we tag on radio-active phosphate which settles in the different organs and reveals it's presence by emitting radiation which can be accurately measured by the Geiger-muller counter. The thyroid gland is concerned with the metabolism of Iodin. If the Thyroid is over-active as in Toxic Hyperthyroidism, radio-active Iodin will detect such an excess. This is a simpler and more accurate test than the study of Basal Metabolism. In malignant neoplasms of the Thyroid, some types will show a greater intake of Iodin, others will show much less than normal. Moreover, the test will enable us to detect metastatic deposits, which may not be clinically evident. These investigations will be valuable guides for treatment.

Polycythemia Vera is a well-known entity in which there is an excess of RBC's in the blood. If we use radio-active iron in a normal person it will be concentrated chiefly in the Bone Marrow and to a small extent in the Spleen and Liver. In Polycythemia, not only are the red blood cells excessive but they are formed essentially in the Spleen, the Bone Marrow being fibroitic and sclerosed. Removal of the spleen was once advocated as the treatment for this disease. Isotope studies on the other hand has shown us that the spleen is essential for the patient, being the only blood-forming organ left. In Splenic Anaemia, on the other hand, isotope studies show us that the spleen in these cases acts as a blood destroying organ. Removal of the spleen is the obvious treatment.

Sugar provides an important source of energy to the system, when an individual does not utilise the sugar properly, he is a victim of Diabetes. This subject was studied chemically for a number of years but there was no clear understanding of what actually takes place when sugar is taken in the system. Isotope studies have clarified the situation. We can tag on radio-active carbon to sugar given by the mouth and we can systematically follow where the sugar accumulates, where and in what organ it metabolises. In the same way we can study the action of vitamins, hormones, various drugs and the circulation of blood. Localisation of Brain Tumours is much facilitated by the use of Radio-active-Fluorescin which settles selectively in the tumour cells. It gives valuable information to the operating surgeon. To make it more precise, the counter is used after the Brain is opened up.

Radio-active Isotopes are largely used as sources of High Energy radiation for long distance therapy. In the same way, attempts were made to use them as sources for radio-diagnosis. The requirements for a diagnostic source are rather difficult to secure. The source has to be sufficiently powerful so as to cut down the exposure time and it must have a long half life, and the radiation emitted should not be more than the equivalent of 85 K.V. in order to obtain sufficient contrast. Only 2 isotopes could satisfy these conditions, Thullium 170 and Zenon 133. Dr. Mayneord succeeded in designing a tiny source with which he could take radiographs of thin parts of the body such as fingers, toes and the jaw. The advantages of such a set-up are obvious in field work—no electrical current is required. One such model has also been constructed in the U.S.A., essentially designed for field work for the forces, for civilian defence, and for street casualities. Screening is not possible, but a very useful combination would be to carry a Picker-Polaroid Unit for developing films on the spot. It is not likely however that radio-active isotope units will displace conventional apparatus, but in therapy on the other hand the modern tendency is to use Radio-active isotopes rather than the complicated Electrical Machinery necessary for the production of X-rays.

Radiation Therapy to-day covers a wide field including as it does, Radium X-rays and artificial Radio-active Isotopes. Commencing with small and primitive beginnings, it has become a vast and complicated subject. The use of X-rays in treatment started soon after the discovery. Ignorant of the nature of radiation and its damaging properties the early workers suffered from various injuries. Undue exposure affected the skin causing redness, inflammation and even burns. Sterility and epilation were also noted amongst the workers. These ill effects paved the way for the treatment of skin diseases, benign and malignant and of gynaecological conditions. Albers-Schonberg of Freiberg successfully treated cases of Menorrhagia and Fibroids as early as 1903. He was one of the first to introduce multi-port technics. Blood changes were noted amongst X-ray workers, and this led to the treatment of Leukaemias. The field was later on extended to the treatment of epitheliomas, Breast cancers, Lympho-Sarcomas and even some deep seated conditions. The field was widened with improvement in apparatus design. The advent of the Coolidge Tube and H. T. Transformer laid the foundation of modern Therapy. The first deep therapy unit was designed at Erlangen working at 200 K. V. and fitted with an automatic regulating tube. A series of depth dose charts were made available for the first time, through the pioneering work of Prof. Wintz and Prof. Seitz of Erlangen. The advent of these units created

a sensation and people from Europe and America flocked to this small University town for treatment, many of them to return disillusioned and disappointed. This was the year 1920, soon after the Great War. Decades have passed since then. Inspite of great advances in instruments and technic, the problem of Cancer and its treatment has still eluded us.

A few words about Dosimety. At first this could only be guessed at by voltage and milliamperage of the high-tension circuit and time. Peak voltage was measured by a parallel spark gap.

Quantity of X-rays was first measured by Holzknecht of Vienna in 1900 by his radiochronometer, it established the first unit of X-ray measurement, the "H". Kienbock, also of Vienna, introduced a photographic method which was a permanent record, but could only be determined after the treatment, as strips of sensitised paper had to be developed in a standard developer at a given temperature for a given time. His new unit the "X" was half the "H". The introduction by Sabouraud and Noire of barium platinocyanide pastilles, which changed colour to a definite comparison tint on X-ray exposure, was a big step forward, but they had their limitations. Becquerel used an electroscope for measuring radiation and it was his work that resulted in the discovery of radium in uranium by the Curies. Probably the first electroscope for measuring X-rays was used by Franklin of America in 1905. Szilard of Paris started his researches in 1908 but it was not until 1913 that he produced a satisfactory Iontoquantimeter. This type of instrument was improved during the 1914 war by Voltz, Friedrich and others in Germany, Solomon in Paris, and the work of these and Wintz, Dessauer and Doderlein brought about big improvements in the technique, Reginald Morton performed a signal service in making English radiologists aware of the work of Wintz and Voltz. They used a water-phantom for calculating the dose at a depth. Modern depth dose measurement has resulted from improvements of this somewhat primitive device.

Supervoltage Therapy was introduced in the 1930's, 600 and 800 K.V. Units were occasionally used at a few clinics. But it was after the World War that Super-Voltage Units really came into routine use. In the beginning they were rated at 1 to 2 MeV, later on came the Linear Accelerators going upto 4 to 6 MeV and finally the Betatrons from 15 MeV. upwards. Super-Voltage Units have distinct advantages over the conventional 200, 250 and 400 K.V. Units. The percentage depth doses are much higher, the back scatter and side scatter are much minimised, the scatter in the forward direction is predominant, the differential absorption in bone is reduced almost completely. Skin reaction is minimal and higher does can be tolerated. Smaller fields can be used, reducing the integral and volume dose. Technic is much simplified owing to the high depth doses, fewer ports are necessary to build up an adequate tumour dose. But on the other hand we must not forget that the relative biological efficiency of Super-Voltage—the R. B. E. as it is called—is 25% less than that of conventional units. A tumour dose of 4000r on conventional units is equivalent to 3000r only on the Super-Voltage units and hence it is necessary to give 25% more dose.

Super-Voltage Units are very expensive and require elaborate and complicated electrical machinery such as high tension transformers, condensers, tubes, valve tubes, etc. This adds to the practical difficulties of working with such high energy, particularly in a country like ours, far away as we are from the factories and efficient service arrangements. Breakdowns hold up our work time and again. A new development of great importance has taken place during the last 5 years. Radio-active Isotopes are utilized as sources of high energy radiation. A large source of Radio-active Cobalt is put in a suitable container with heavily protected metal covering all round. The source emits continuously Gamma rays of high energy, equivalent to 2 to 3 MeV. The problems involved in evolving a practical apparatus were many, but they have been successfully overcome. Several such units have been in operation at many centres in Europe and America. India already has 2 Units operating. Since our country has a large atomic programme in the near future, these units have a special interest for us. Unlike X-ray plants the radiation in a Cobalt Unit is emitted all 24 hours, day and night so that elaborate devices are necessary for turning the radiation towards the patient, when required, and shutting it off when not required. It has to be a fool-proof arrangement with automatic devices, the safety of the entire area round about depends on this. With such a unit we have the advantages of Super-Voltage, without the drawback of complicated electrical machinery.

The most popular and useful units are the ones with Cobalt 60. There are big plants containing 1200 to 3000 curies, the Kilocuries, than there are the smaller units of 600 curies and still smaller one with 30 to 60 curies. They are simple to use, they have no complicated generating machinery, they emit a pure homogenous beam of Gamma radiation of the order 2 to 3 MeV. Moreover, a plentiful supply of Cobalt is available from the Nuclear Reactors. The only drawback is that their half life is 5 years and their output falls consistently and frequent measurements are necessary. The renewal of the capsule after 5 years presents no difficulty. The manufacturers have closely co-operated in the scheme and uniform capsules are now available. A large source, to start with say 2000 curies, becomes one of 1000 curies at the end of 5 years, which can be transferred to a smaller unit. One of the drawbacks of the original units was the large penumbra region surrounding each field. This has now been minimised by suitably designed treatment cones and collimating devices. The simplicity of design is very appealing. In Europe, a fovourite method of treatment, uptil recently was by a 10 gm. Radium Bomb. Owing to the small output, treatment time had to be prolonged and shorter distances were used. These bomb units are now converted into Radio-active Isotope Units by substituting Cobalt 60 for Radium, saving enormous cost and at the same time increasing the efficiency.

Other Isotopes are also used, particularly Caesium 137, which has the advantage of a very long half life of 35 years. They emit gamma radiation equivalent to the output from conventional units of about 600 K.V. Caesium is a bye product from a Nuclear Pile and can be obtained very cheaply. The process of separation and purification has been perfected recently and large quantities will soon be available. In time to come these units will replace our conventional Deep Therapy machines.

A favourite Isotope used in England is Iridim, the half life is very short and the capsule has to be renewed every 2 to 3 months. The only advantage is cheapness in construction, as it does not require heavy protection. It's output is equivalent to a 400 K.V. It is not likely to find favour generally, owing to it's short half life of 74 days.

Radio-active Isotopes can be used in many other ways, for instance in interstitial radiation, instead of using Ra. Salt. They can be produced cheaply and they can be

made to own specification in any shape, size and form. They are very flexible, Tantalum, Cobalt and Gold are the common isotopes used.

Artificial radio-active isotopes were discovered by the Joliot-Curies. That was in 1934. At that time the Cyclotron was used to bombard elements and compounds with a view to convert them from being inert substances into a radio-active state. The production of isotopes by this method was very small.

After the 2nd World War, Isotopes were obtained on a large scale. There are nearly 1000 of these artificially produced in the nuclear Reactor. When Uranium 235 is bombarded with neutrons or alpha particles it splits up into 2 equal parts releasing a tremendous amount of energy, which can be utilised for various peaceful purposes. In this process, called fission, innumerable neutrons are released, which can be utilised for the production of artificial radio-active substances. These neutrons, moreover, which are liberated cause further fission, a chain-reaction sets in.

When Radio-active isotopes can be given by the mouth or injected, they settle down in tissues for which they have selective preference. Radio-active Iodin, for instance accumulates in the Thyroid Gland, Radio-active Ph. 32 settles in the bone marrow. In these tissues they give out radiation causing damage to the cells. It is one form of radiation treatment. Unfortunately other organs and tissues, which are not affected by disease at all also take it up. It is the same old story as with radiation given by external sources, the diseased as well as healthy tissues suffer damage. This introduces us to a factor which is known as the therapeutic ratio, if the rate is high, in other words if the diseased tissue is more vulnerable than normal tissue, the chances of survival are good, if not, then the chances of controlling the disease are poor. At present, efforts are directed to increase the therapeutic ratio, for which radio-biological research is being carried on an intensive scale. The problem is to increase the radio-sensitivity of diseased cells. Some advance is made in this direction, for instance, increasing the blood supply to the diseased area and the oxygen tension increases the tumour sensitivity. Formerly heat was applied prior to radiation, now-a-days the patient's oxygen tension is increased artificially, by making him breath oxygen under high tension, during the course of treatments. Results seem to be encouraging. Various chemicals and harmones were tried out with the same object in view, so far with no results. This seems to us to be the crux of the problem. So far we have been attempting to hit the tumour with ionising radiation of greater and greater intensity and though there may be some difference in the results, they still are disappointingly low. The tumour is not an isolated phenomenon, it is surrounded by normal healthy tissues. If you attempt to hit the diseased tissue harder and harder, you are hitting the normal tissue also the same way. You may succeed in eradicating the tumour, but in the process you are damaging the healthy tissues beyond repair. The patient must die. This is how the problem strikes us and there seems no way out except by improving the sensitivity of the diseased tissue. "It is well worth emphasis that from whatever source it comes, discovery of any method whereby a 20% of absolute improvement in the ratio was obtained would represent a major advance particularly in the treatment of the common tumours of limited sensitivity and would repay all the effort expended in its elucidation" (Ralston Paterson). The Treatment of malignant Disease by Radium and X-Rays.

60 years have passed since the discovery and yet there is no finality as to the time-dose relationship. Fractionation during

treatment, period of treatment, the daily dose are factors about which no agreement has been reached, everyone works according to his own personal experience. Even the fundamental conception of the cancericidal does is not known.

Some works fractionate for 18 to 20 days, others 30 to 40 days. The French School believe in fractionating for 70 to 80 days and more. It is purely a personal factor, neither proved nor disproved by any experimental data.

Radio-active Iodin is used in Thyroid Carcinoma, particularly after operation. This form of Therapy is useful in cases with multiple bone metastasis, with some good result in a few selected cases. The response depends on the uptake of Iodin, which can be investigated by the G. M. Counter or by anto-radiography of a biopsy section. One feels, however, that Deep X-ray Therapy is more convenient and useful.

Radio-active Ph. 32 is being used in the Leukaemias, there is marked amelioration of the symptoms, the spleen goes down, the WBC's go down but unfortunately the RBC's also go down. It is a purely palliative procedure. Conventional X-ray Therapy in our opinion is superior. When X-rays fail to work, Chemo-Therapy may be attempted. Results so far are disappointing.

On the other hand spectacular results are achieved in Polycythemia Vera, it is the treatment of choice, a single dose of 5-6 mc. keeps the patient comfortable and well for 10 to 20 years and more.

Equally good results are obtained in Toxic Goitre—Hyperthyroidism. One single dose of Radio-active Iodin is sufficient to control the condition. One great danger is that there is a chance of the patient developing Leukaemia. The risk is there but it is minimal—of the order of 1% to 2%, and hence one has to be careful in selection of cases. Only when other methods fail or are contra-indicated should the treatment be given. Dose calculations are purely empirical and arduous.

Insoluble radio-active colloidal solution of Gold and Chromic phosphate are used as palliative procedures. They are particularly useful in 3 different conditions:—

(1) Malignant effusion in Pleura and Peritoneum.

(2) Carcinoma of the Prostate.

(3) Irradiation of the para-metria.

They are essentially Beta Ray emitters, with a short half life of 2·8 days. They enter the lpmphatic chain and are filtered out by the Reticulo-endothelial system.

Radio-active isotopes have universal uses, in medicine, industry, agriculture. To give one example, one is surprised to learn that 1/3rd of the world food grains are destroyed by the depradation of pests and insects. The cockroaches breed heavily, radiation in form of isotopes is used to sterilise the females, so that they stop from breeding and automatically the pest comes to an end. Anti-biotic preparations are also sterilised by the use of isotopes, sterilisation by heat and boiling is out of the question.

During the last 10 years increasing use is made of ionising radiation, over and above which we must not forget that we are living in the Atomic Age with all it's profound implications. Number of cases for diagnosis and treatment has considerably increased. 18 million people received X-ray in the U.K. during 1955. To take our own example, during the last 15 years diagnostic cases have increased 7 times and therapy 3 times. It is therefore not surprising that the hazards of radiation have come into great prominence, the effects of atomic bombardment

of Japan have vividly brought out the dangers of radiation exposure. In discussing this problem, let us not forget that no single discovery has succeeded in helping so many people with harm to so few, as has been the introduction of diagnostic radiology in clinical practice.

When X-rays were first discovered and used for diagnosis and treatment in the last decade of the 19th Century, no one had the slightest idea about the dangers of radiation. Many a patient suffered from severe burns and injuries during the process of simple investigation. Though this was an individual tragedy of great magnitude, such episodes did a great service to humanity by bringing into prominence the biological effects of radiation thus paving the way for the use of radiation in the treatment of diseases. Owing to lack of knowledge and profound ignorance many of the workers in the old days suffered severe damage and were early victims of the ill effects of radiation. A memorial column at Hamburg bears testimony to this great tragedy. Soon after such disasters, scientists began to make up and formulate elementary rules for safe radiography, which served their purpose to some extent. At various national and international congress meetings the question of protection was always an important part of the programme. Rules and regulations were tightened up and in some countries Government control was established. In the early days, attention was solely directed to prevent patients and operators from receiving severe injuries.

The tolerance dose was originally laid down at ·2r per day or 1·2r per week. It was soon tightened up and now the official dose is laid down at ·3r per week, with special directions and recommendation that it should be preferably cut down to ·1r per week and 5 r per year.

Man's most precious trust is his genetic heritage upon which depend the health and development of future generations. To-day genetic damage through radiation looms large in our estimation. Radiation produces mutation changes, which vary in their intensity on the gonadal dose received. With heavy doses, obvious malformations, mental, nervous and physical defects take place in future generations. With mild doses there may be slight reduction in life expectancy, a decrease in fertility, an increase in various kinds of ordinary illnesses and other such non-specific effects. To show the magnitude of the problem, out of 4 million live infants born in the U.S.A., at least 2%—about 80,000—show tangible defects of a hereditary character. Spontaneous mutations also occur, these are not so harmful and there is a possibility of their reverting back to normal. Such changes may manifest as late as 600 to 1000 years after exposure. Some years back I took part in a symposium held at the J. J. Hospital on the subject of radiation treatment in uterine bleedings. I stressed the view point that under no circumstances should young women in the child bearing age be radiated for fear of the genetic changes that would affect the future generation. One of our colleagues, an eminent Gynaecologist, refuted my arguments by giving his opinion that if the sick woman needs radiation she ought to have it irrespective of the danger to the future generation—the needs of the living must be our first consideration. Kaplan recently published in our souvenir number an article on the X-ray treatment of young women for sterility and amenorrhoea. He gave facts figures and illustrations of children and grand children borne by these women, looking perfectly fit and healthy. He further argues that experiments on Drosophilia flies which is the basis of our study on

genetics and mutation changes are not applicable to human material. To-day such statements would call for drastic comments, such is the trend of modern thought.

What is the safe gonadal dose? According to some even a small dose of 5r would be sufficient to damage the genetic system. In other words there is no threshold dose. It is now conceded that 30 to even 50r could be safely received by the gonads from conception to 35 years. Beyond the age of 35 the gonadal dose may be disregarded. In the U. S. A. the maximum safe gonadal dose is restricted to 10r.

Unfortunately the subject of radiation damage has been prominently and indiscriminately ventilated in the lay press and from the platform causing a state of alarm amongst the public, bordering on the hysterical.

One of the serious dangers of radiation is the increase in the incidence of Leukaemia. It is said to be 9 times as common amongst radiologists than amongst other branches of the profession. It has been statistically demonstrated that children born from parents who have undergone x-ray examination during pregnancy show a much greater incidence of Leukaemia. Radiation treatment of patients for Ankylosing Spondylitis also show greater incidence. Out of 13,000 cases investigated there were 46 deaths, 28 from Leukaemia and 12 from Aplastic Anaemia. During 8 years observation in Japan, after atomic bombing, the incidence of Leukaemia has gone up, from the normal 23 to 105 cases, nearly 5 times.

The human race has been always subjected to ionising radiation during past generations and the present. We are receiving back-ground radiation comprising continuous and unavoidable exposure to Cosmic Rays, the natural radio-active substances in rock and building materials and to radio-active isotopes of Potassium and Carbon in the body itself. ·1r per year has been calculated to be the dose received as back-ground radiation. Over and above this there is man made radiation from medical and industrial uses, which in Great Britain contributes an extra 20%. In the U.S.A. and Sweden the figure rises to 100%. Radiation from luminous watches, television, shoe fitting adds another little extra. The wider uses of Atomic Energy is also adding it's quota to the total. We cannot avoid back ground radiation but we can and must minimise the other sources. Frantic efforts are now made to cut down exposures from medical applications of Radiology. One thing is certain that the days of indiscriminate radiology are past and in it's place radiologists must develop a sense of responsibility and realism towards their patients. Films should be restricted to the bare minimum and indiscriminate screening must be drastically cut down. We should use the newer devices which minimise X-ray exposure such as High K. V. in diagnosis, the Image Intensifier in screening, ultraspeed films, high speed intensifying screens, developers etc. The clinician must also co-operate and use his discretion in referring cases—only such cases which defy diagnosis by clinical and laboratory methods should be referred.

One important aspect of the problem must be stressed and that is that if the patient's condition demands X-ray investigations we shall not withhold it irrespective of gonadal and genetic risks. There is a close analogy in obstetrical practice. A question sometimes arises whether to save the mother or the unborn child, the answer is clear—the mother must be saved.

The subject is of fearful importance to us all, but I refuse to contribute to the panic

which it has created even amongst prominent scientists. Some of them have gone so far as to suggest that every man, woman and child shall carry a complete record of radiation received during their life time, it is obviously an impossible task.

Certain fundamental facts must be emphasised. Radiation is cumulative in it's effects. No individual should be exposed to more than 200r in his entire life time. We are all cognisant of the usual precautions to be taken in an X-ray Dept. but over and above that specialised procedures are absolutely essential. The department should be monitored at least once a year, direct reading meters are available. Film badges should be worn by the staff and weekly readings recorded. The Health Division of the Atomic Energy Department of India arrange for the badge service and safety survey. Let us hope that protection regulations will become compulsory in the near future.

Since the gonadal dose is the most important single factor in our campaign against radiation hazards, tables are available giving us an idea of their magnitude. Here are some figures :—(1) Examination of the feet, head, upper limbs—gonadal dose is nil. (2) Abdomen 69 mr for males, 200 mr for females. (3) I. V. P.—500 mr males and 1200 mr females. (4) Hystero-Salpinx—1700 mr (5) Pelvis—males 1100 mr females 210 mr Barium meal 20 mr and 9 mr. Barium enema 40 mr and 20 mr. Chest ·36 and ·07 mr.

Unborn and new born babies are the most susceptible to radiation damage. It can cause death or malformation. In the young child radiation can retard growth and increase the incidence of Leukaemia. Even the small dose from X-ray examination of expectant mothers may be responsible for increased incidence of Leukaemia and other malignancies in childhood. In this connection it is important to bear in mind that there is no statistical record of increased incidence when examination is done in the later months of pregnancy. To sum up our ideas on the subject, every radiologist should frame his own regulations on the subject, in the light of all we have said so far.

1. Benign conditions such as keloids and skin diseases should not be treated by radiation if situated in and about the gonadal region.

2. Expectant mothers should not be X-rayed in the early months of pregnancy. Radiological examination may be permitted in the later months, if absolutely necessary, minimum number of films to be used. If however, the life of the mother demands a more detailed examination of the pelvis, we would be justified in undertaking it regardless of gonadal damage.

3. Radiation treatment to the Ovaries in young women for sterility or amenorrhoea or bleeding should not be undertaken.

4. Radiation may be given in Ankylosing Spondylitis, provided small segments are radiated at a time and the other segments adequately protected. Wide field radiotherapy should be abandoned.

5. Appendix examination should be discouraged in young people, particularly in women, diagnosis in most cases can be arrived at by clinical examination.

6. In barium meal, barium enema and I.V.P. the gonads can be easily protected in males, in women that is not possible.

7. Screening should be minimal and films to be taken sparingly. High K.V. helps considerably in cutting down the dose.

8. Treatment of malignant diseases should be carried out intensively irrespective of gonadal damage.

Amongst the occupational hazards may be mentioned premature ageing and shortening of life. Professor Dall of U.K. has been working on these problems for a long time and has gathered data from all over the world, he holds the opposite view. Another important source of contamination is the fall out radiation from atomic bomb tests. The immediate danger is very insignificant, only about ·001 r the real danger lies in the big reservoir of long life isotopes which travel about 10 to 20 miles above our atmosphere and from there slowly descend during the period of years, contaminating food stuffs, water, milk, fodder, rice and other substances and are thus taken into the system. Caesium 137 Strontium 90, Carbon 14 are the chief constituents of such contamination, causing high incidence of Bone Tumour, Leukaemias, defective children and mutation changes.

So far we have only considered the gloomy side of the picture, let us look at the credit side of the problems involved. We must not forget that tremendous benefits have resulted from the use of X-rays, modern Surgery owes an immense debt to radiology. In 1900 the life span was 49 years, in 1951 it was 68, due in a great measure to the applications of medical radiology. If, as it is contended that shortening of life is due to radiology, it should have shown up by now. Tuberculosis had a death rate of 194 per 100,000 in 1900, to-day it is only 9 per 100,000, radiological diagnosis has a great deal to do with this gratifying state of affairs. Foetal death and infant mortality are claimed by geneticians to be the early detectable effects of radiation. And yet we find that infant mortality has dropped from 10% in 1915 to 2 and ½%. Still births have dropped from 23% to 17% in 10 years. American children to-day are taller, healthier and have lower death rate than before radiation. Motor accidents accounted for the death of 38,000 people in one year, deaths from Leukaemia amongst radiologists were 14 in 20 years. There were 28 deaths from Leukaemia in 20 years, amongst 13,000 patients treated by radiation. Let it be clearly understood that saying all this we are not attempting to minimise or justify the dangers of indiscriminate radiation. At the same time we feel that a balance be struck between the benefits and the bad effects. In assessing the bad effects of diagnostic exposures we must clearly distinguish between total body exposure and local exposure, the size of the area exposed should be taken into consideration. Our chief concern is about the large number of unqualified people, who own X-ray machines without any idea about the fundamentals of the subject. These are the people who should be rigidly dealt with, if necessary by compulsory legislation.

Since radiation is largely used in malignant diseases, a few fundamental facts may not be out of place. Malignant disease is a great killer, in the U. S. A. for instance it stands 2nd on the list of mortality statistics, but in our country the incidence is less. Our expectation of life is very low and fewer people reach the cancer age. Moreover, there is a great deal of malnutrition due to scarcity of food intake. There is some evidence that chronic starvation tends to reduce the incidence to an appreciable extent.

The problem of the cause and cure of cancer still eludes us, although for many years scientists of the first order have concentrated their efforts in this direction. Much has been achieved, but the fact remains that the cause is still not understood and the cure of many types is still unsatisfactory. Whether it is due to irritation, chronic inflammation, cell rests, hormonal influences, vitamin deficiency, embryological stimulus, chemical action, radio-activity or virus infection seems still far from proved.

None of these theories explains the behaviour of malignancies to the satisfaction of the clinician.

What is cancer? The simplest answer is a descriptive one. Certain cells, under the influence of carcinogenic agents, acquire aggressive characteristics of growth and function, without serving any useful purpose in the economy of the system. They acquire invasive characteristics, they enter blood vessels and lymphatics and metastasise to distant organs. These cells require special chemical substances for their survival and growth. Herein may lie a ray of hope that by withholding such chemicals, we may starve these cells so that they may perish. It is possible that there may be a deficiency or excess of certain substances in their environment which alters the behaviour of the cell from normality to malignancy. A virus theory is advocated, now that we have the electron microscope, this very old theory is acquiring new significance. If so, the outlook becomes more hopeful. Geneticians advance a mutation theory, these cells turn malignant because of their hereditary genetic make up.

One out of every 6 individuals develops Cancer, the question arises as to why 5 people should escape this catastrophy. It is surmised that there may be substances in their body fluids which act as defence mechanism. An interesting experiment was recently carried out in the U. S. A. A group of convicts volunteered for the tests. They were all active, healthy, normal subjects. Active cancer culture in solution was injected under the skin. After 3 to 4 weeks they developed skin reactions, which proved on biopsy to be of an inflammatory character, the injected cancer cells were found destroyed, pointing to a built in resistance in their system. The same test was performed on a group of advanced cancer cases. They failed to develop the inflammatory reaction, and the cancer cells remained active on the spot where the injection was made. This corroborates the existence of protective substances in the healthy group. The inference is clear, under the influence of certain substances cancer develops in those who lack the inherent resistance factors. Attempts are now made to find out the nature and composition of such substances. The significance of research on these lines is obviously very great. Once the nature of the defence mechanism is determined, the logical solution would be to build this up in people in whom it is lacking, paving the way for the prevention of cancer.

About 60 years back prior to the discovery of X-rays and radium, to make a diagnosis of cancer was to pass a death sentence. To-day we can save at least 30% of cancer cases with modern methods of treatment. We could do better still if there was more co-operation from the patients, more awareness from our medical colleagues and more intensive educative propaganda amongst the public. We could cure 40 to 50% if only we could get cases in the early stage. Unfortunately, owing to the enormous increase of Lung Cancer in recent times, the overall prognosis becomes poor, as the survival rate is only about 3 to 5%.

Can we prevent Cancer? To a very small extent we can. Smoking of cigarettes and pipes and tobacco chewing are some of the common factors. Unfortunately, these habits are so ingrained in the large bulk of the population, that it is practically impossible to expect millions and millions of people to give them up. Sunlight is a factor, obviously as Prof. Cowdry said, we cannot live in the dark. A recent survey in Kenya throws valuable light on the etiology of Skin Cancer. It is a very common disease amongst the white population of the colony. It has been found that in those who protect

themselves from the sun's rays by a helmet, the incidence of cancer is much minimised.

Another example in prevention is Cancer of the Penis, it is uncommon in Jews and Muslims, who practise circumcision in infancy as a religious right. What is more, Cancer of the Cervix is uncommon in their womenfolk for the same reason. Senile keratosis, Bowen's Disease, is a direct precursor of cancer and should be dealt with. Leukoplakia is another important precancerous condition, particularly in the oro-pharynx, the Larynx and the external genitalia in women.

In the evolution of cancer intra-epithelial changes usually precede the invasive phase. It is recognised as a precursor in cancer of the breast and in cancer of the cervix and probably also in other locations. In cancer of the cervix it can be diagnosed as a precursor by the smear method of Papanicolau, and is largely employed for the detection of what is known as cancer *in situ*, which is classified as League of Nation 0. In these cases prompt measures can check what would surely have developed into invasive cancer. Unfortunately, intra-epithelial changes cannot be diagnosed in cancer of the breast, which can only be detected when the cancer breaks out. The male and female hormones are responsible for a group of cancers, obviously it is not possible to prevent them by castrating every body. Hereditary influences play a certain part in the etiology of cancer of the breast, but the evidence is not sufficient to warrant advising 2 individuals with a hereditary history not to marry.

Our only chance of improvement in results is to catch them early, and we all know how difficult it is to expect it in a backward country like ours. In the U. S. A. intensive propaganda plays a prominent part in bringing patients for treatment in the early stages.

There are over 250 cancer detection centres in the U. S. A. the best known is the Strangeways Laboratory attached to the New York Memorial Hospital Unfortunately, the time, expense and trouble involved are out of all proportion to the results obtained. In our country such ambitious schemes are obviously out of the question for the present. Our best chance is to equip the general practitioner with adequate knowledge enabling early detection of malignant diseases. It should be made a specialised subject in the medical curriculum, and it should be made compulsory for our men to work for a period in a cancer clinic or hospital. A great deal can also be achieved in the out-patient departments of the hospitals, where a routine check-up could be easily done particularly in women, keeping in mind the high incidence of breast and cervix cancer.

It would help us a great deal if blood and urine tests could reveal early cancer, unfortunately they only help in advanced cases. Even radiology can only detect gross lesions, the early beginnings do not present any clinical signs nor radiological evidence. To be frank we have no method of detecting early cancer, when it is confined only to the intra-epithelial region, before it breaks through and appears on the surface.

Treatment of Cancer is essentially by surgery or radiation or both. A gradual and slow evolution is taking place in both directions. On the one hand, radiation is displacing surgery, on the other hand surgery is becoming more and more aggressive. Cancer of the breast is a typical example of the modern trend in the treatment of cancer. Radical mastectomy still holds the field with the further addition of more aggressive procedures such as dissecting the supra-clavicular and mediastinal glands with improvement in the results. On the other hand there is the Edinburgh school under

Prof. McWhirter who rely on simple mastectomy followed by intensive radiation to deal with the glandular metastasis. Apparently his over-all figures are as good as for the radical operation, without it's mutilating effects. Over and above this, cases with metastasis are subjected to bi-lateral oophorectomy, adrenalectomy and hypophysectomy or destruction of the Pituitary by the insertion of radio-active Yttrium. These drastic procedures have a purely palliative action.

We have now various technical improvements on the old methods such as the Converging Beam, Pendulum Therapy, Co. 60, Linear Accelerators and a vast range of supervoltage units. These are valuable technical advances, but the question arises whether the results are any better. Unfortunately the results are not spectacular. We must remember that the radiationist has to work against heavy odds. Radiation can damage the cells only if they are directly hit by the quantum of rays. Compton enunciated what is known as the Law of Chance, which means that however heavy the dose certain proportion of cells are bound to escape and the tumour is not completely sterilised. The cells which escape destruction are often enmeshed in fibrous tissue and are shut out so to say from the body and may do no harm. On the other hand these cells may proliferate and from recurrencies, very often months and even years after treatment. I have known breast cancer recurring even after 20 years, this is rather unusual, but after 10 years it is a common episode. Another serious handicap is that once radiated, the cells become radio-resistant so that they do not respond to a 2nd course of radiation. Furthermore, we must remember that the tumour is not an isolated problem, it is surrounded by normal healthy tissue, which also gets damaged due to the treatment. Success or otherwise depends on the therapeutic ratio. If the normal tissues get damaged to the same extent as the malignant growth, the patient is bound to succumb. If on the other hand the ratio is high, the chances of cure are brighter. It is the same story right through whether we use conventional therapy or supervoltage or isotopes or chemotherapy. The biological response is the same whether we use Contact Therapy or Supervoltage. The only solution and salvation is to improve the biological response of the tumour cells, make them more sensitive. Extensive research is going on in this direction, with some results so far. For instance raising the oxygen tension, and more blood supply makes the cells more sensitive. So long as we are not able to achieve such biological superiority, results are not likely to improve by merely raising the voltage.

It is true that some improvement is noticeable in the cure rate during the last 15 years due to better equipment, better technic and earlier diagnosis, but by no stretch of imagination can we claim that we have solved the cancer problem. There is one aspect which must not be lost sight of in this gloomy picture and that is that we are able to give relief and palliation in a large majority of cases. Palliative results are well worth the effort. There is intensive research going on in chemotherapy. Innumerable compounds are being tried out and high hopes are held that sooner or later newer chemical combinations will be available which will enable us to control the malignant cells without damaging the normal cells. At present the Nitrogen Mustard Group and Myleran are largely used particularly in the Reticulosis—so far the results are only palliative.

A few words about technic. First and foremost consideration is the selection of the K.V. To-day Cobalt 60 units with their high energy radiation are largely used for Head and Neck cases as well. There are many advantages but we are apt to forget the drawbacks. Owing to high penetration there is severe mucosal reaction extending right across the mouth and larynx. Moreover, the exit does is very large so that opposing fields carry their own risk. It is said that owing to greater skin tolerance we can give high doses through 1 field. This is true but we must not forget that since we are using gamma rays of short wave length to produce equal biological effects, we have to administer 20% more radiation than with conventional units in the 250 and 400 K.V. range. An ideal set up for Cobalt 60 in Head and Neck cases would be to use a source of 60 Curies instead of 600 or more and at much shorter distances so as to avoid severe reactions beyond the limits of the growth.

It is the common practice in planning out treatment to specify the number of fields, the size of fields, the daily dose and the total tumour dose from the very beginning and the schedule is meticulously carried out. This we feel rather undesirable since after all we are concerned with the biological effects. We feel that far too much mechanisation is practised, it would be eminently desirable to individualise treatment, all patients cannot be expected to behave in the same mechanical way, the biological and clinical reactions should influence the handling of the case. To give one example, from our experience at the Hospital we recognise 3 types of skin and mucosal reactions. The largest group are the cases which have reactions coming up in the conventional way. A 2nd group comprises a small number of cases where the reactions are markedly delayed, tempting us to force in heavier doses, which often lead to trouble later on. A still smaller group consist of cases who develop intense reactions even after small doses. The size of the fields and the daily dose should be under our constant control.

How shall we evaluate the progress of the case? Mere reduction of the size of the neoplasm or it's disappearance does not necessarily imply a cure. Unfortunately we have no means so far of determining the optimal tumour dose, it is all based on personal experience. Valuable work has been done in the research laboratories in Cambridge by Gluckman and Spier. They advocate serial biopsies once a week which are analysed numerically as regards the changes that take place in Cancer cells under the influence of treatment. It is a precise guide for the therapist to enable him to decide whether the case is suitable for radiation treatment and whether the case is reacting to radiation treatment adequately and gives us the prognosis. Unfortunately the method requires highly specialised skill and knowledge and it is not likely to be routinely adopted.

What is the modern outlook for Cancer? It is one of the world's greatest problem. It is gratifying to note that mortality for cancer amongst women is decreasing at a substantial rate--about 15%—in the last decade. 5 year survivals have also increased for most major sites. Very likely this is due to the fact that more people seek medical assistance in the early stage, due to intensive educative propaganda, which unfortunately is lacking in our country. The Indian Cancer Society is doing it's best in that direction, but unfortunately it falls far short of what is being achieved in advanced countries. It is a tragedy of the first magnitude that our cases come in a very advanced condition. When one studies recent statistics, it is disconcerting to find that although there is improvement in the cure rates in certain locations, the overall mortality statistics for cancer in general shows a great increase. This is because of the much greater incidence in Lung Cancer in recent times. Experiments in the U.S.A. have confirmed the etiological

connection between Lung Cancer and cigarette smoking. On the other hand in the U.K. experimental evidence has failed to support this theory in toto.

Statistical evaluation after regular follow ups is of paramount importance. Having only a few Cancer centres in our country, our patients have to come from far off places, entailing a great deal of hardship and expense. The ideal arrangement obviously would be the establishment of many more tumour institutes and clinics, so that the patients may receive adequate treatment in or near their home towns. Inadequancy of finance and of technical personnel are the main obstacles, and it will be several decades before such a programme could be put through. Until then, we will have to struggle through as best we can.

Before 1941, the facilities for the diagnosis and treatment of Cancer in our country were inadequate. There were a few Deep Therapy Units and a limited quantity of Radium to deal with the large number of patients, and these too were restricted to the big towns. In 1941 the Tata Memorial Hospital was opened up as a centre for diagnosis, treatment and research. During the last decade other centres were established and the position is improving, but a great deal has yet to be done in this direction.

The Geographical distribution of Cancer is engaging the attention of the scientific world. It is well known that cancer in certain locations are more common in some countries than in others. In our country cancer of the Head and Neck are far more predominant than cancer of the lung and the G. I. tract which are so overwhelmingly present in Europe and America. The significance of such behaviour in cancer incidence is of paramount importance and a satisfactory solution as to why it should be so may lead a long way to a fresh approach to the problem of the etiology of cancer, Elimination of the different factors which cause such divergence may pave the way for prevention of the disease. It is a colossal task as so many different factors, enviornmental and genetic may be concerned in determining the type and location of the malignant process. Let us hope that this may eventuate in the near future. Till such time as that our only hope lies in early detection of the disease and early treatment at specialised institutions preferably near their home town or village.

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Prolonging the life of Developer

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In a larger hospital the most satisfactory method of keeping a standard development technique is the replenisher system. By this method small quantities of specially prepared replenisher solution are run into the developer tank (by syphoning from a stoppered bottle) every time the level of the developer goes down. The quantity of replenisher solution added should equal the amount of developer carried out of the tank on the processed films, after they have been allowed to drip for 5-10 seconds only.

Stanford and Hills (1956) have pointed out that the activity of developer solution depends not only on the amount of Elon and Hydroquinone but also on the concentration of Bromide etc. These authors carried out elaborate methods of chemical analysis and showed that replenishment (topping the level) alone was not enough, some developer they said must be removed at intervals and the remaining solution must be "regenerated" by the addition of specially prepared solutions.

Bray and John (1957) have carried out a simple method of replenishment (adding special replenisher when the level in the developer tank was down) and they found by measuring film density that even after replenishing for 8 months (adding 320 gallons replenisher to 25 gallons of original developer) the film density was not reduced and basic fog was not increased.

Minty and Wilson (1958) estimating the P.H. value of developer solution found that during replenishment, the ph. gradually drops, but that inspite of this the film density increases. P.H. values therefore are an unsatisfactory indication of the activity of developer.

Charnin and Barnes (1954) have pointed to a fairly simple method of estimating the reducing power of a developer solution. We have used a modification of their method over a three month period when up to 21 gallons of replenisher were added to a six gallon developer tank.

Method

1. In this method we first had to prepare standard Iodine solution. This was done as follows (Harrison) :—

We dissolved 25 grams of pure Potassium Iodide solution in 200 c.c. of distilled water. We weighed accurately 12·692 grams of resublimed Iodine in a stoppered weighing bottle. 150 c.c. of the Potassium Iodide solution was transferred into a 1000 c.c. volumetric flask. The weighed Iodine was transferred into this volumetric flask. The remainder of the Potassium Iodide solution was used for washing the residual Iodine in the weighing bottle into the volumetric flask. We dissolved the Iodine and then filled with distilled water up to the mark. We standardised this Iodine solution against 0·1 N sodium thiosulphate and stored the Iodine solution in a stoppered coloured bottle.

2. Replenisher solution was issued to the dark room one gallon at a time. When one

gallon had been added to the developer tank 5 c.c. of the developer solution were removed and transferred into an Erlenmeyer flask which contained 20 c.c. of distilled water. Three drops of freshly prepared starch indicator were added using a small pippette. Standardised Iodine solution from a burette was run into the developer till the colour turned blue.

N.B.—We found that the developer solution had to be diluted 1 in 5 so that the end point could be accurately determined.

Calculations

The reducing power of the developer solution could then be calculated as follows: $S_1 V_1 = S_2 V_2$ where:

- S_1: Strength of diluted developer
- V_1: Volume of diluted developer
- S_2: Strength of Iodine solution
- V_2: Volume of Iodine solution reduced as read in burette.

Since dilution is 1 in 5.

The actual strength of developer solution is: $5 \times S_1$. The volume V_1 was taken as an average of three concurrent titre values.

A graph was now plotted showing strength (S_1) of developer solution against volume of replenisher added over a 3 months period.

Results

The first upper graph line (Fig. 1) showed that in the first week during the addition of the first 3—5 gallons replenisher the strength of the developer increased from 3·5 N to 4·68 N. This increase in strength of course had an undesirable effect on radiographs so that the Radiologist complained that the films were too dark.

After about 9 gallons of replenisher had been added (in the 4th week) the strength of the developer solution remained almost constant for another 6 weeks (17 gallons of replenisher were added) and then it began to fall off. Sludge formation became excessive so that the lowest of the film showed a mottled appearance and so the experiment had to be stopped. The colour of the solution had become brown and turbid.

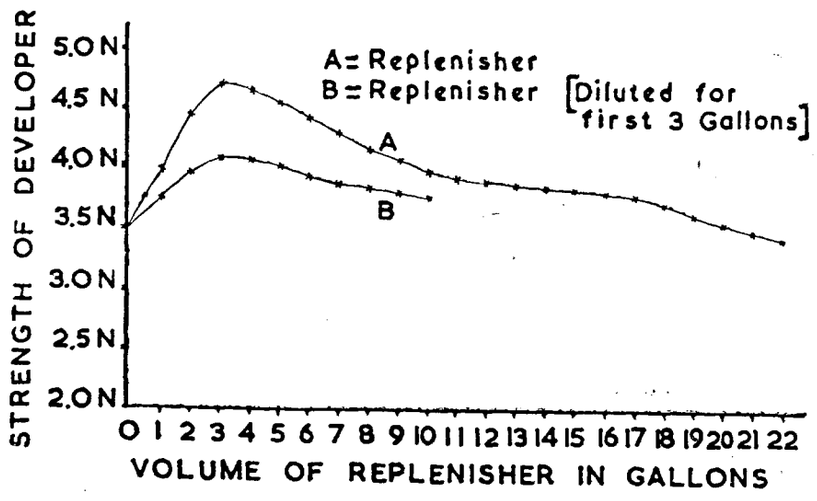

Fig. 1

Because of the high initial increase in developer strength a second experiment was carried out using half strength replenisher solution for the first 6 gallons. Graph line (B in fig. 1) shows that using this diluted replenisher for the first 6 gallons a much more even strength of developer is maintained.

Formula of the solutions used

Particulars	Original Developer to make 1 gallon (4·5 litres)	Standard replenisher to make 1 gallon	Suggested modified formula for replenisher 1 gallon.
Elon ...	9·9 grams	19·8 grams	9·9 grams
Sodium sulphite ...	648·0 grams	648·0 grams	648·0 grams
Hydroquinone ...	39·6 grams	79·2 grams	39·6 grams
Sodium Carbonate ...	585·0 gram	585·0 grams	585·0 grams
Potassium Bromide ...	18·0 grams	—	—
Sodium Hydroxide ...	—	35·68 grams	35·68 grams

N.B.—The first 6 gallons of replenisher could be made as per modified formula (given above).

Conclusions

1. The replenisher system of developer maintenance is a satisfactory method of ensuring a constant strength of developer over a fairly long period but indefinite replenishment is prevented by sludge formation in the tank.

2. Half strength replenisher should be used during the first addition of first six gallons of replenisher to six gallons of developer.

3. The original developer must be discarded and the tank cleaned out, after a volume of replenisher has been added equals three times the original volume of developer.

4. The method is simple, economical and efficient for a hospital where 50 to 200 films a day are processed. In small hospitals it may still be better to use the exhaustion charts.

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A new Technique for the study of the Colonic Mucosa*

BY

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The study of the mucosal pattern in post-evacuation films following the barium enema is of paramount importance for the diagnosis of structural changes of the colon and has been discussed in many papers during the last 3 decades. Frequently, however, the conventional radiographs do not convey the necessary information for reasons beyond the control of the radiologist. Sometimes the remnants of barium are too scarce for good visualisation of the mucosal relief, or the folds cannot be seen adequately if the patient is unable to empty the colon sufficiently. These shortcomings occur especially in functional disorders of the descending and iliac colon following old intestinal infections which are so common in tropical countries. Addition of tannic acid to the opaque enema has been recommended for the better visualisation of the mucosal lining, but this method may produce an artificial pattern of irritation and is, therefore, often unreliable as regards the diagnosis of disturbance of the neuromuscular mechanism or inflammatory lesions. Air insufflation greatly helps to detect small polypi or other interluminary tumours, esp. with the methods elaborated by Stevenson[12, 13], Moreton[10, 11] ane Crozier[6]. More recently Welin[14, 15] has perfected the double contrast enema by employment of Veripaque, and Andren and Frieberg have reported an imporved technique for the detection of small tumours in rectum and sigmoid[2]. Whereas these methods are very useful and often indispensable for the diagnosis of a small polypus or neoplasm, they are not so suitable for the study of the finer details of the mucosa. This is because the distention of the colon by air often breaks down the coating of the barium.

In June 1955 MacLaren, King and Copland[8, 9] claimed to obtain a very good mucosal pattern by adding to the barium Veripaque, an Isatin preparation, which stimulates the contraction of the colon, and by taking radiographs at the moment of the evacuation. But this drug occasionally causes severe colic during the examination and it is, therefore, doubtful whether it can be adopted as a routine method in this country where many patients suffer from active or recent amoebiasis with marked tendency to painful spasms. Moreover, Henderson[7] found the results obtained by this method rather disappointing.

We therefore tried another way to trace the mucosal pattern of the colon, particularly in the region of the sigmoid, the iliac and descending portions which are mostly affected by inflammation. We introduce a small amount of barium into the sigmoid prior to the routine enema, follow it up throughout the length of the colon and study the appearance of the mucosal lining under fluoroscopic control. A preliminary paper about this new method was submitted by me at the Indian Congress of Radiology in February 1956. In the meanwhile, we have elaborated and

*Dedicated to Prof. O. Gans on the 70th anniversary of his birthday and to Prof. B. Rajewsky on the occasion of his 65th brithday.

tested it in 160 patients and are now in a better position to interpret and evaluate the findings.

To my knowledge, this method has not been reported by any other author.

Description of technique

Careful preparation of the patient is essential as for every colon examination. We usually recommend a diet low in residues for 1 to 2 days, 1—2 tablespoons of Castor oil and a cleansing enema the previous evening; a second water enema on the day of the examination. A time interval of 15—20 minutes is advisable between the cleansing enema and the start of the X-ray examination, so that the colon is studied in a relaxed state. A delay longer than 20 minutes is undesirable, particularly in case of hypermotility and hypersecretion; otherwise the colon may again contain faecal matter and mucus.

As contrast medium we prefer finely dispersed barium preparations of colloidal dimensions, such as Cremobar, Micropaque, Alubar, Unibaryt. The concentration of these emulsions is the same as for the routine barium enema. In several cases we obtained also satisfactory radiographs with emulsions of pure barium sulphate. Tannic acid should not be added because it may induce an artificial irritation pattern. The amount of barium necessary for visualization of the mucosa varies between 2½ and 8 oz. according to the length and calibre of rectum and colon, the motility of the intestines and whether the examination is confined to the left or to the entire colon.

As soon as traces of contrast medium are detected by fluoroscopy in the part to be examined, the further flow is stopped immediately. At the beginning the patient lies on his back, and when the barium enters the recto-sigmoid he should turn into prone posture. This facilitates the further passage because the sigmoid runs in upwards-anterior direction. The enema tube should be introduced as high-up as possible without discomfort to the patient. Usually it is easy to place its tip near the recto-sigmoid juncture and occasionally the upper flexure of the sigmoid can be reached. This is advisable for better study of the mucosa of the sigmoid. When traces of barium are seen at the juncture of iliac and sigmoid portions, the patient is turned to the left for a few minutes and than back to the prone posture and in Trendelenburg's position. When the head of the barium reaches the level of the iliac crest, the patient should lie in supine posture in conformity with the slight backward course of the descending portion. Positioning in right lateral decubitus is advisable for investigation of the transverse colon.

As a rule, we take one film for general view in prone posture and some spotfilms with compression in prone and supine posture. The positioning and degree of compression vary on account of individual differences of course and motility of the colon and have to be decided in each case on the strength of the fluoroscopic finding. In the general view of the colonic mucosa the descending and iliac portions sometimes contain too much barium. This can be avoided if a rubber balloon is placed on these parts and inflated by air. Very useful for this compression is an appliance manufactured by the Franklin X-ray Corporation, Philadelphia, and recommended by Barden[3] for G.I. tract examination.

The detailed study of the mucosa is followed by the routine barium enema with the conventional films before and after evacuation and, if it appears necessary, by air inflation.

Results

A few *normal cases* will be first discussed. The films exposed after administration of a small amount of barium prior to the routine enema will be designated as "preliminary films".

Case 1, Mrs. L. Recent history of nausea due to dyspepsia. No abnormality of gastro-intestinal tract detectable after barium meal. At patient's request a barium enema was carried out to exclude a lesion of the colon.

The normal mucosal pattern of sigmoid, iliac and descending colon is well demonstrated in the preliminary films which disclose more details than the post-evacuation radiographs.

Case 2, Mrs. S. Benign tumour in pelvis. Barium enema ruled out involvement of the colon. In the post-evacuation film the iliac colon contained too much barium for visualisation of rugae. Good delineation of its mucosal pattern in preliminary spotfilms.

Case 3, Mrs. D. Appendicitis confirmed by operation. Good visualisation of the mucosa in the post-evacuation film except for the descending colon which is nearly empty. The normal folds of this part can be studied in the preliminary film.

Case 4, Mr. N. Pain in right iliac fossa, apparently due to a kink of the appendix which was confirmed by operation. No intestinal complaints. Post-evacuation film: normal mucosal pattern in ascending and transverse colon, only traces of barium in descending and iliac portion. The normal mucosa of these parts is shown in the preliminary spotfilms. Slight variation of the mucosal relief in these 4 films at the level of the iliac crest, with predominance of longitudinal rugae during transient peristaltic contraction.

Case 5, Mrs. S. Chronic appendicitis confirmed by operation. No pathological changes of colon or caecum. After evacuation the colon contains too much barium for visualisation of the mucosal pattern. The preliminary spotfilms reveal a normal alteration of circular and longitudinal rugae. These films were taken at a relaxed state of the colon and for this reason more rugae were seen than in the post-evacuation films, when the bowel is usually contracted. This appearance in the preliminary radiographs should therefore not be considered as an abnormal crowding.

Case 6, Miss H. Secondary deposits of ovarian carcinoma in peritoneum medial to the descending colon. Barium enema ruled out involvement of the large bowel. In post-evacuation film descending and iliac colon completely empty. The normal mucosal pattern of sigmoid and iliac colon can be traced in the preliminary spotfilms. On external compression, the iliac colon showed marked contraction with predominance of longitudinal rugae.

Remarks

In these cases as in many others, the rugae were much better visualised in the preliminary films than in the post-evacuation radiographs. Sometimes the latter were inconclusive due to excessive or insufficient emptying. In other instances the preliminary films supplied valuable complementary evidence in portions of the colon where the mucosa was not well seen in the post-evacuation radiographs. Though the appearance of the mucosal relief is similar in preliminary and post-evacuation films, the former often reveal more details, particularly the occurrence of numerous circular rugae in the iliac and descending portions under normal conditions. These circular folds are usually not seen to such an extent after evacuation of the enema as the colon is then in a state

of contraction. By means of external compression it could be proved that the rugae show a predominance in longitudinal course when the colon contracts. A similar dependence of the mucosal pattern on the peristalsis could be detected in other normal and in abnormal cases. It appears that longitudinal rugae prevail in contracted segments and circular rugae in relaxed portions, particularly within broad haustra.

Functional disorders

1. Constipation

Case 7, Mrs. H. *Constipation* for many years, recently worse. Routine enema film: Increased segmentation of descending and transverse colon. Post-evacuation radiograph: Too much barium in descending and iliac colon for visualisation of the mucosal pattern. The preliminary films disclose a marked increase of clear-cut circular rugae in transverse, descending and iliac colon. Radiological diagnosis: Spastic type of constipation.

Case 8, Mr. H. *Chronic constipation* since childhood. Sigmoidoscopy: no sign of organic lesion. Routine enema: increase in haustration, particularly in descending colon. Post-evacuation radiograph: Mucosa cannot be studied due to irregular distribution of the barium in broad haustra. Preliminary films of iliac colon: clear-cut circular rugae of normal width; absence of longitudinal folds. On the strength of the radiological diagnosis of spastic constipation patient was successfully treated with Bellergal.

Case 9, Mr. S. *Constipation* since 7 years, sometimes pain in left iliac fossa, particularly when constipated. Routine enema film: loss of haustra in iliac, descending and transverse colon. Post-evacuation radiograph: normal rugae of ascending colon; considerable remnants in transverse, descending and iliac portions. Preliminary films well-defined longitudinal rugae in iliac and transverse colon; almost complete absence of circular rugae in transverse colon. Radiological diagnosis: atonic type of constipation.

Case 10, Mrs. M. History of long standing *constipation*. Routine enema: lack of haustra in descending and iliac colon. Normal haustra of transverse portion. After 1st attempt of evacuation colon still full of barium, and even considerable remnants after an additional water enema. A few peristaltic waves could be stimulated in descending, iliac and sigmoid colon. It is remarkable that the colon did not decrease in length after evacuation. Preliminary film of sigmoid and iliac portion: well-defined longitudinal rugage, no circular folds. Radiological diagnosis: atonic constipation.

Remarks

In post-evacuation films of cases of constipation the remnants of barium are usually excessive and often irregularly distributed so that a clear visualisation of the mucosa is prevented. The latter could, however, well be studied in the preliminary films. They revealed a marked crowding of circular rugae in spastic constipation and a predominantly longitudinal course in atonic constipation. It is interesting to observe that in some cases of atonic constipation the colon showed hardly any longitudinal shortening after evacuation, though its lumen was definitely reduced. This fact points to the thesis that contraction of the longitudinal muscular coat contributes to formation of haustra and predominance of circular rugae and that the action of the circular muscular coat has some influence on the diminution of the calibre of the colon and the stimulation of longitudinal rugae.

2. Functional disorders due to extrinsic lesions.

Case 11, Dr. D. *Gastrogenic diarrhoea.* Loose stools 4-5 times a day, pain in left hypochondrium. Stool test repeatedly negative.

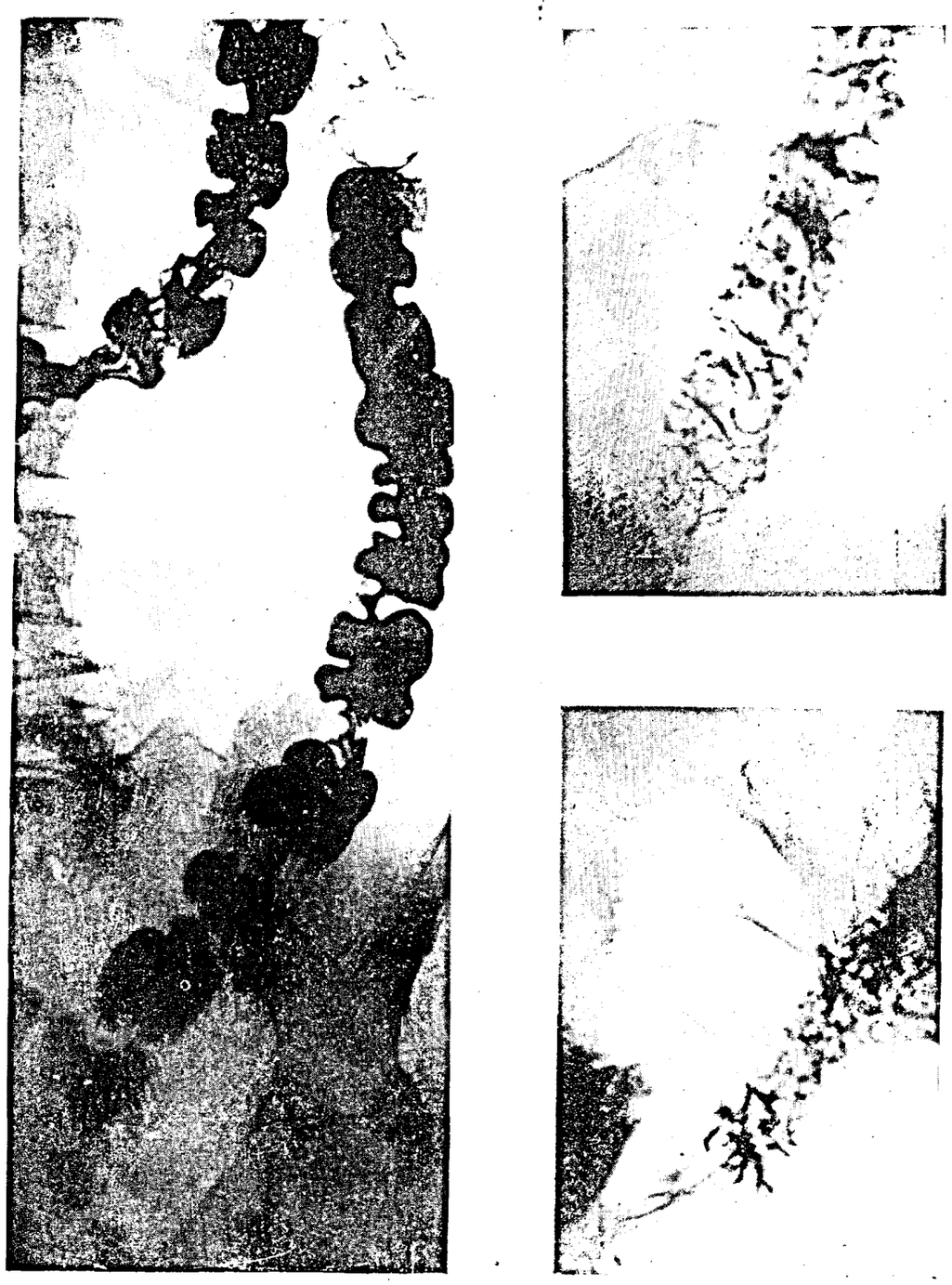

Fig. 1—(A, B & C)

Case 5. Normal mucosa (A). Post-evacuation film: excessive amount of barium in descending and pelvic colon prevents visualisation of the mucosal pattern (B) & (C). Preliminary spotfilms of sigmoid and descending colon: distinct delineation of the mucosal pattern, predominance of longitudinal rugae in the slightly contracted sigmoid and combination of regular longitudinal and circular folds in the descending portion.

Preliminary films: Somewhat crowded irregular mucosal markings the appearance of which changed continuously, in descending, iliac colon and sigmoid. This finding is suggestive of overactivity and hypermotility, but no structural changes of the mucosa of the descending colon.

Disappearance of the intestinal symptoms after treatment with Streptomycin and I. N. H.

Remarks

In these cases the functional disorders of the colon were caused by lesions of stomach, gallbladder, small intestine and ileo-caecal region. The hypermotility prevented the good visualisation of the mucosa in the post-evacuation films. Adequate information was provided by the preliminary radiographs which disclosed minor irregularities of the mucosal relief, esp. crowding of rugae or pattern of irritation, sometimes of "marble-appearance." This marbling should not necessarily be interpreted as a sign of organic disease. It could be shown that it may completely disappear after air inflation. A similar pattern of irritation may be also induced in normal cases by addition of tannic acid to the barium enema, but it was never observed by us under normal conditions with our technique. The overactive peristalsis of the colon produced in some cases such rapid alterations of the mucosal relief that they could be noticed under the screen.

3. The irritable instable colon.

Case 17, Mrs. L. R. R Since some years repeated attacks of diarrhoea with excess of mucus. Stool test negative.

Barium enema : loss of haustra in descending and iliac colon. Normal haustration of ascending and transverse portion.

Post-evacuation film : Mucosal pattern normal in ascending and right side of transverse colon. Descending and iliac portion completely empty. In sigmoid traces of barium mixed with mucus.

Preliminary films : Crowded longitudinal rugae in the contrcted iliac and descending portion. Comparatively few circular rugae.

Conclusions : Marked instability, particularly of descending and iliac colon. No evidence of inflammatory changes.

Remarks

The post-evacuation film supplies no adequate information as regards the condition of the mucosa, esp. at the distal half of the colon. The spasticity with marked predominance of the longitudinal folds was revealed only in the preliminary films. The rather narrow lumen of the colon and its good contraction in length after evacuation helped to differentiate radiologically this condition from atonic constipation, radiologically, and the occurrence of well-defined regular folds ruled out the possibility of a chronic colitis with rigidity of walls.

4. Post-dysenteric disturbances of the colon.

Case 18, Dr. B. Repeated attacks of *amoebiasis*. Improvement after recent treatment. Still somewhat irregular bowel action with tenderness over the caecum. Sigmoidoscopy N.A.D.

Barium enema : Insufficiency of ileo-caecal valve. Caecum tender, shows marked spasticity with ragged contours.

Post-evacuation radiograph: Normal mucosa of ascending colon. Descending and iliac portions empty.

Preliminary films : Marked spastic contraction of descending and iliac colon with well-defined predominantly longitudinal rugae.

Case 19, Mrs. D. History of *amoebiasis* with recent amoebic *hepatitis*. Still a few cysts of E. H. in stool after treatment. Slight tenderness over decending colon. Sigmoidoscopy : Patches of mild colitis alternating with normal mucosa.

Post-evacuation radiograph : Descending and iliac portions contain too much barium for satisfactory visualisation of the mucosa.

Preliminary films : Rugae appear normal in iliac portion, but somewhat crowded and slightly irregular in arrangement, partly oblique, partly curved, within the descending colon, the tender area. The post-dysenteric irritability led to marked transient spastic contractions in one of the films.

Remarks

In many post-dysenteric cases the mucosa could only be scrutinized in perliminary films. Common features in this kind of disturbance were crowding of rugae and minor irregularities of the mucosal pattern and tendency to localised transient spastic contractions.

Organic changes

1. Catarrhal colitis.

Case 20, Mrs. L. *Acute dysentery*. Sigmoidoscopy : Mucous membrane thickened, velvety and red. Rectal Swab : Veget. forms of E. H., large number of pus cells, R.B.C.'s and macrophages.

Post-evacuation radiograph : Transverse, descending, iliac and sigmoid colon completely empty due to hypermotility.

Preliminary films : Broad prominent, preponderantly circular rugae in iliac and descending colon and sigmoid, suggestive of oedematous swelling of the mucosal lining due to catarrhal colitis.

Case 21, Mrs. B. Pain in right and left iliac fossa, occasionally loose stools.

Barium enema : Marked tenderness over the caecum.

Post-evacuation radiographs : Marked Segmentation at the lateral aspect of the caecum. Normal mucosal pattern of ascending, transverse and descending colon. Iliac colon contains too much barium for visualization of the mucosa.

Preliminary films of the iliac colon : Broad prominent circular rugae. Normal mucosal folds higher-up in the descending colon. The swelling of the mucosal lining of the iliac colon indicates a circumscribed catarrhal colitis. With the co-existent tenderness and spasticity of the caecum, this findings arouses suspicion of dysentery. This radiological diagnosis was confirmed by the presence of E. H. in the stools and the complete cessation of symptoms after anti-amoebic treatment.

Case 22, Mr. F. *Amoebic colitis and proctitis*. Sigmoidoscopy : Signs of active inflammation in rectum and sigmoid with several ulcers. Rectal Swab : Large number of cysts and veget. forms of E. H.

The mucosal pattern of the sigmoid was not traceable in post-evacuation films. The preliminary film of the sigmoid revealed broad circular rugae indicative of catarrhal inflammation. An opaque dot, about 2 inches below the sigmoid flexure, which shows the same position in 2 successive spotfilms, is highly suggestive of a small ulcer crater, consistent with the sigmoidoscopical finding.

After completion of anti-amoebic treatment the patient was free from symptoms and follow-up sigmoidoscopy disclosed no abnormality.

Case 23, Mr. N. *Catarrhal colitis and proctitis*. Sigmoidoscopy : Velvety pattern of the mucosa with fine granulations in rectum and sigmoid. Stool test negative.

Post-evacuation film : Colon nearly empty, particularly the transverse, descending and iliac portions.

Preliminary films: Broad prominent circular rugae of the sigmoid, iliac, descending and left side of transverse colon typical of catarrhal colitis.

Remarks

In catarrhal colitis the post-evacuation films were often inconclusive as regards the condition of the mucosa due to the marked hypermotility of the colon. The preliminary films, however, allow to establish the diagnosis and to differentiate between inflammation and functional disorder. In one of these cases it was possible to visualize an amoebic ulcer which was confirmed by sigmoidoscopy.

2. Ulcerative colitis.

Case 24, Mrs. S. History of loose sanguinal stools since 1 year. Sigmoidoscopy : Marked proctitis and sigmoiditis with coarse granulations. Mucosa easily bleeding on touch by sigmoidoscope. Finding highly suggestive of "active chronic ulcerative colitis".

Barium enema : Loss of haustration and narrowing of lumen in sigmoid, iliac, descending and transverse colon. Exaggerated segmentation of ascending portion.

Post-evacution film: A few shallow hazy longitudinal rugae in descending and left side of transverse colon. Excessive amount of barium and mucus in iliac portion.

The preliminary film of the iliac colon reveals scarce shallow blurred longitudinal rugae. An area of fairly regular honeycombing at the juncture of sigmoid and iliac portion. After air inflation these granulations are again well seen, and the diagnosis of chronic ulcerative colitis is therefore enhanced.

Considerable transient improvment after treatment with Deltacortisone.

Case 25 & 26. In 2 other less advanced cases of ulcerative colitis the radiological diagnosis was established on the strength of the finding of a complete disorganisation of the mucosal stucture seen in the preliminary films only.

Remarks

It is usually rather difficult to obtain a satisfactory visualisation of the atrophic mucosa in ulcerative colitis. Any contribution to the diagnosis by preliminary films may be therefore of valuable assistance as in these 3 cases.

3. Diverticulitis.

Case 27, Mr. C. Diverticula in sigmoid, iliac, descending, transverse colon and caecum.

Post-evacuation film : Normal mucosa of transverse and descending colon. No visualisation of the mucosal relief in sigmoid and iliac portion.

Preliminary films : At proximal end of sigmoid rugae appear very crowded and irregular in distribution ; at the iliac colon still somewhat crowded, but fairly regular. This finding indicates diverticulitis at the juncture of sigmoid and iliac portion and quiescence of the diverticula at the descending colon.

Case 28, Mr. B. Since a few years occasional attacks of pain in left iliac fossa.

Routine enema films : Presence of a few small diverticula near the juncture of sigmoid and iliac colon.

Post-evacuation films : The folds appear normal in descending and upper part of iliac colon, but cannot be traced in lower part of iliac colon and sigmoid.

In preliminary films the mucosal pattern is distinctly visualised in this area, with

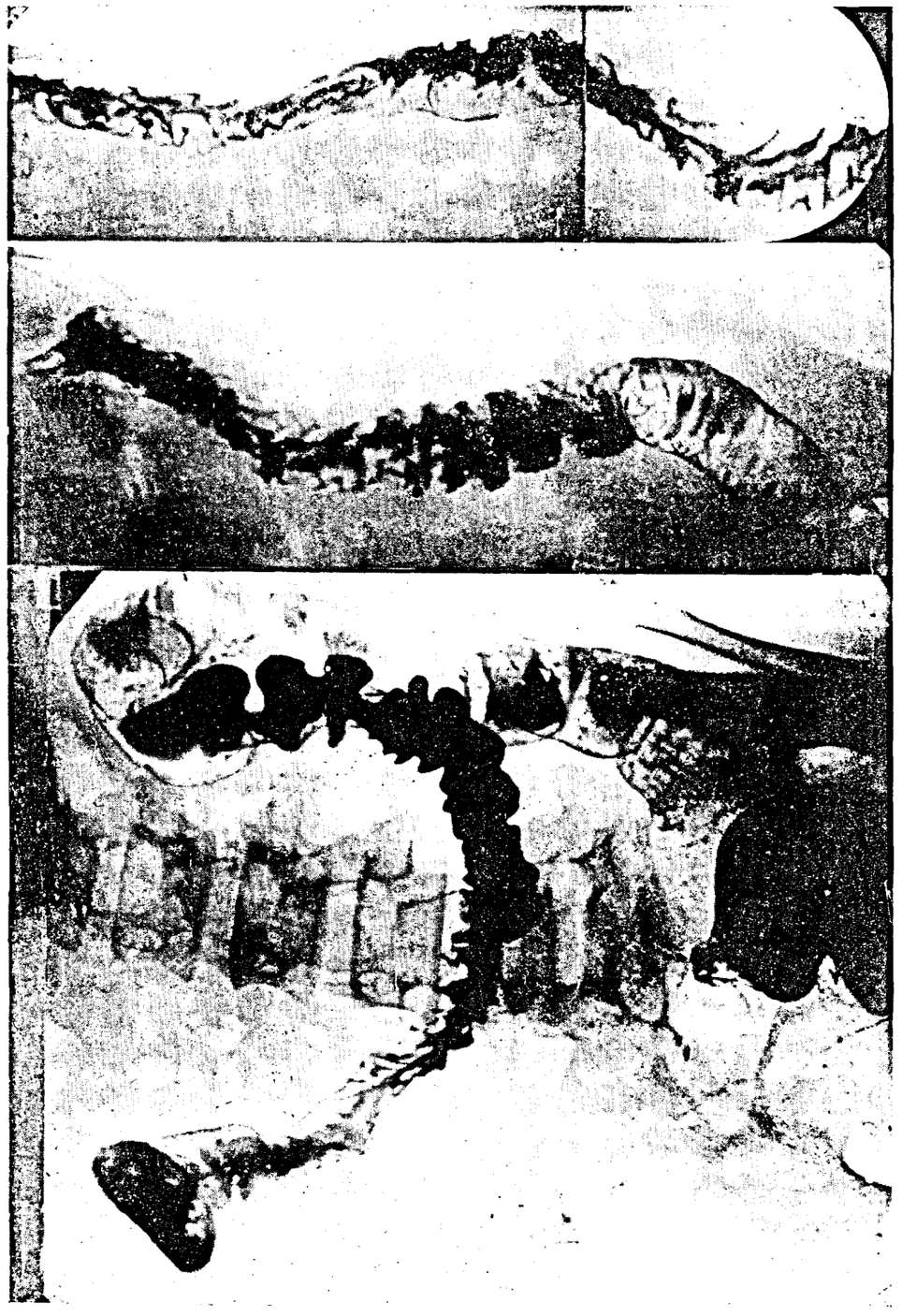

Fig. 3—(A, B, C & D)
Case 15. Hypermotility of colon in ileo-caecal tuberculosis (A). Post-evacuation film ; no visualisation of rugae in descending portion (B) & (C).
Great variability of rugae of descending colon in preliminary films and on compression, preliminary spotfilm (D).

Fig. 4—(A & B)
Case 23. Catarrhal colitis (A). Post-evacuation film: Transverse and descending colon completely empty (B).
Preliminary radiograph: Broad prominent circular rugae in descending colon and left flexure.

broad somewhat irregular circular rugae, indicative of inflammatory changes.

Case 29, Mrs. B. Frequent loose stools and pain on left side of abdomen. Stool test negative. Sigmoidoscopy N A. D.

Follow-up films 24 hours after barium meal and barium enema reveal nearly 50 diverticula along the colon.

Post-evacuation film: Transverse, descending, iliac and sigmoid colon empty due to marked hypermotility.

Preliminary films: Broad, prominent circular rugae at sigmoid; crowding of fairly regular folds in iliac portion; normal mucosal pattern in descending colon. The preliminary films indicate marked inflammatory changes of sigmoid, slight irritability of iliac portion and quiescence of the diverticula in the descending part.

Remarks

In 8 cases of diverticulitis, 3 of which are demonstrated in this paper, the mucosal pattern of the affected part of the colon was better delineated in preliminary than in post-evacuation films, and it was possible in each case to differentiate between active inflammation and a clinically silent diverticulosis and to determine exactly the extension of the inflammatory lesion, an important fact for the surgeon if operation is considered.

4. Ileo-caecal tuberculosis.

Case 30, Mr. K. Slightly tender lump in right iliac fossa.

Routine enema film: Defective filling of the caecum, widening of the lips of the ileo-caecal valve suspicious for tuberculosis.

Post-evacuation film inconclusive as caecum and ascending colon are nearly empty.

Preliminary films: Normal mucosal pattern of transverse colon and upper 2 thirds of ascending portions. Persistent narrowing at the level of the ileo-caecal valve. Caecum highly narrowed with crowding of rugae and very irregular contours of the wall.

Remarks

Whereas the barium enema film only suggested a suspicion of ileo-caecal tuberculosis and the post-evacuation radiograph was inconclusive, the preliminary films allowed a definite diagnosis and indicated the exact extent of the lesion.

5. Polypi.

Case 31 & 32. In 2 patients a single polyp, one 6 mm, the other 2 cm wide, was well visualised in the preliminary radiograph and subsequently confirmed by air inflation and by laparatomy. Neither of them was delineated in the conventional "single contrast" film.

6. Carcinoma.

Case 33, Mr. A. Routine enema film: marked stenosis at proximal limb of sigmoid loop. Only a small amount of barium trickles through it into the iliac portion.

Post-evacuation film revaled no details as sigmoid was practically empty.

The preliminary films exposed with a small amount of barium disclosed the lobulated outlines of the filling defect indicative of malignancy of cauliflower type. The operation confirmed the diagnosis of adeno-carcinoma. The photograph of the resected specimen gives the same appearance of lobulation as seen in the preliminary film.

Remarks

In this case the preliminary films contributed to the diagnosis of tumour and showed its type and extension.

7. Post-operative anastomosis

After operation of Case 33 the folds the end-to-end anastomosis are well visualised in preliminary spotfilms. They could not be traced in the routine post-evacuation radiographs as the iliac colon contained too much barium.

Case 34, Mr. D. Colectomy for adenocarcinoma of sigmoid 9 months ago. Patient free from complaints except for a slight intestinal haemorrhage a few weeks ago.

The rugae in the region of the anastomosis are well demonstrated in a series of preliminary films and much more distinct than in the post-evacuation radiograph and after air inflation. They appear completely normal. A small diverticulum is seen in the preliminary film somewhat higher-up in the descending colon, possibly the cause of the slight haemorrhage. It was not detectable in the conventional radiographs.

Remarks

The mucosal pattern of the anastomosis was in several cases better visualised by the preliminary than by the routine films.

Discussion

In 160 cases the mucosa of the colon has been studied by fluoroscopy and radiographs after administration of a small amount of barium prior to the routine barium enema. As a rule, these "preliminary films" allow a much better visualisation of the mucosal pattern of the colon than the conventional post-evacuation radiographs. An adequate delineation could be achieved in practically all of our cases provided the patient had the necessary preparation. This method of investigation appears to be of particular importance in various kinds of motor disturbances in which the post—evacuation films often supply insufficient information. Particularly in cases of hypermotility in which the colon is practically void of barium after evacuation this method can be easily employed for a good demonstration of the mucosa. Even in comparison with satisfactory evacuation films, the preliminary examination usually discloses more details, particularly in the iliac and descending portion. This is because after evacuation a marked contraction of the colon occurs which produced a predominancy of longitudinal folds in the descending colon. In the preliminary films the large bowel is often more relaxed with the resultant regular alternation of circular and longitudinal rugae. Furthermore, the the appearance of the mucosa can well be observed by fluoroscopy and assessed by a series of successive spotfilms, so that we do not depend on transient findings which are sometimes deceptive in the post-evacuation examination. In some instances, the relevant features of the mucosal pattern could be reproduced in a 2nd examination of the patient after some days.

The results obtained by the new method will usually enable the radiologist to distinguish between functional disorders of the colon and inflammatory changes, a differential diagnosis of great importance for a successful treatment, particularly in tropical countries where motor disturbances occur so frequently.

The 160 cases include all of the more common abnormalities such as spastic and atonic constipation; disturbances of the neuromuscular mechanism of the colon due to extrinsic lesions of stomach, small intestine or gallbladder, or due to post-dysenteric disorders; spastic, catarrhal and chronic ulcerative colitis; diverticulitis; ileo-caecal tuberculosis; tumours and post-operative conditions. In practically all cases of inflammation and in many

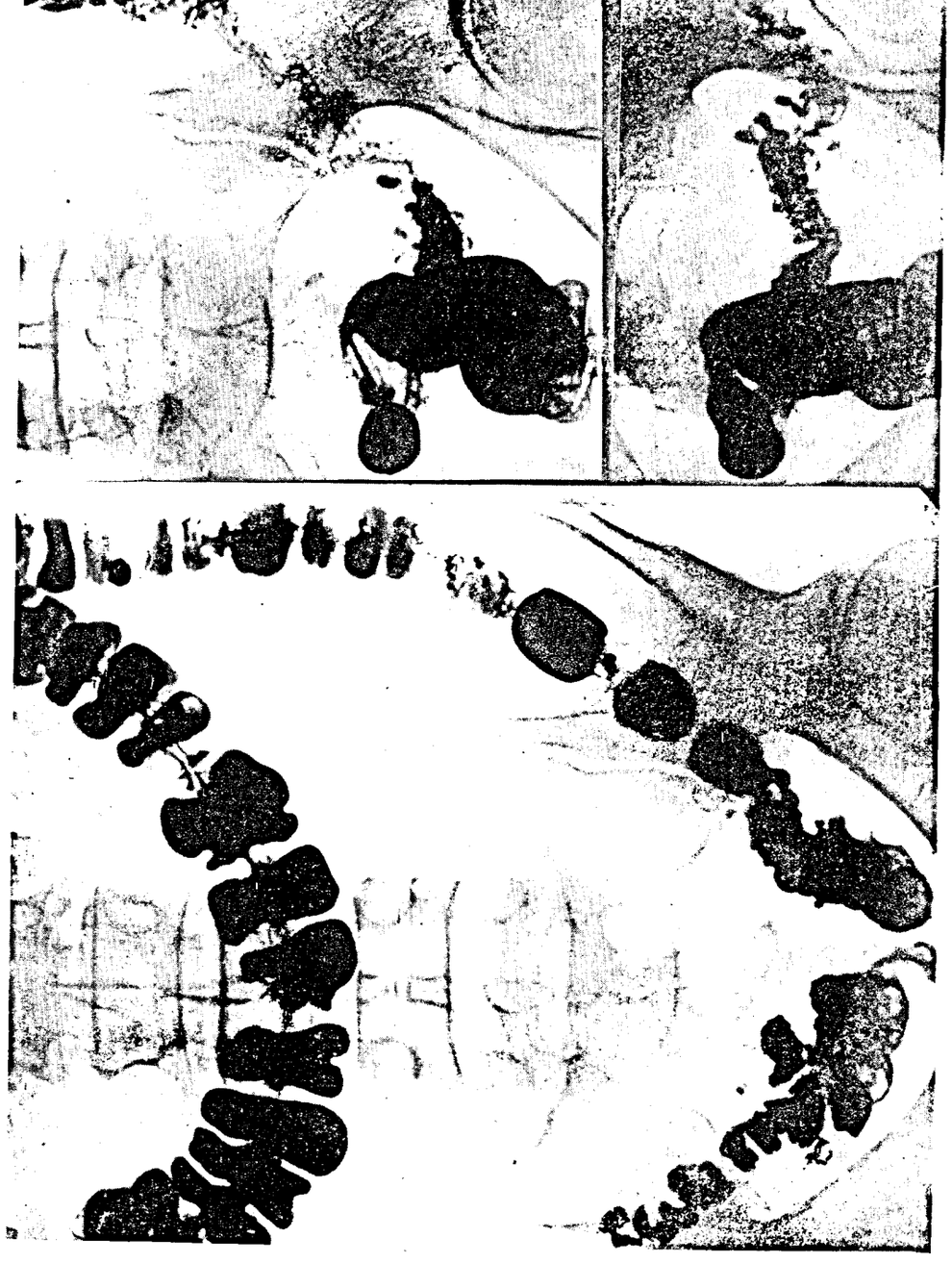

Fig. 5—(A, B & C)
Case 27. Diverticulitis. (A). Post-evacuation film: Diverticula in sigmoid and descending colon. No satisfactory visualisation of mucosa (B) & (C).
Preliminary films exposed in p.a. and oblique views: rugae irregular and coarse in sigmoid indicative of

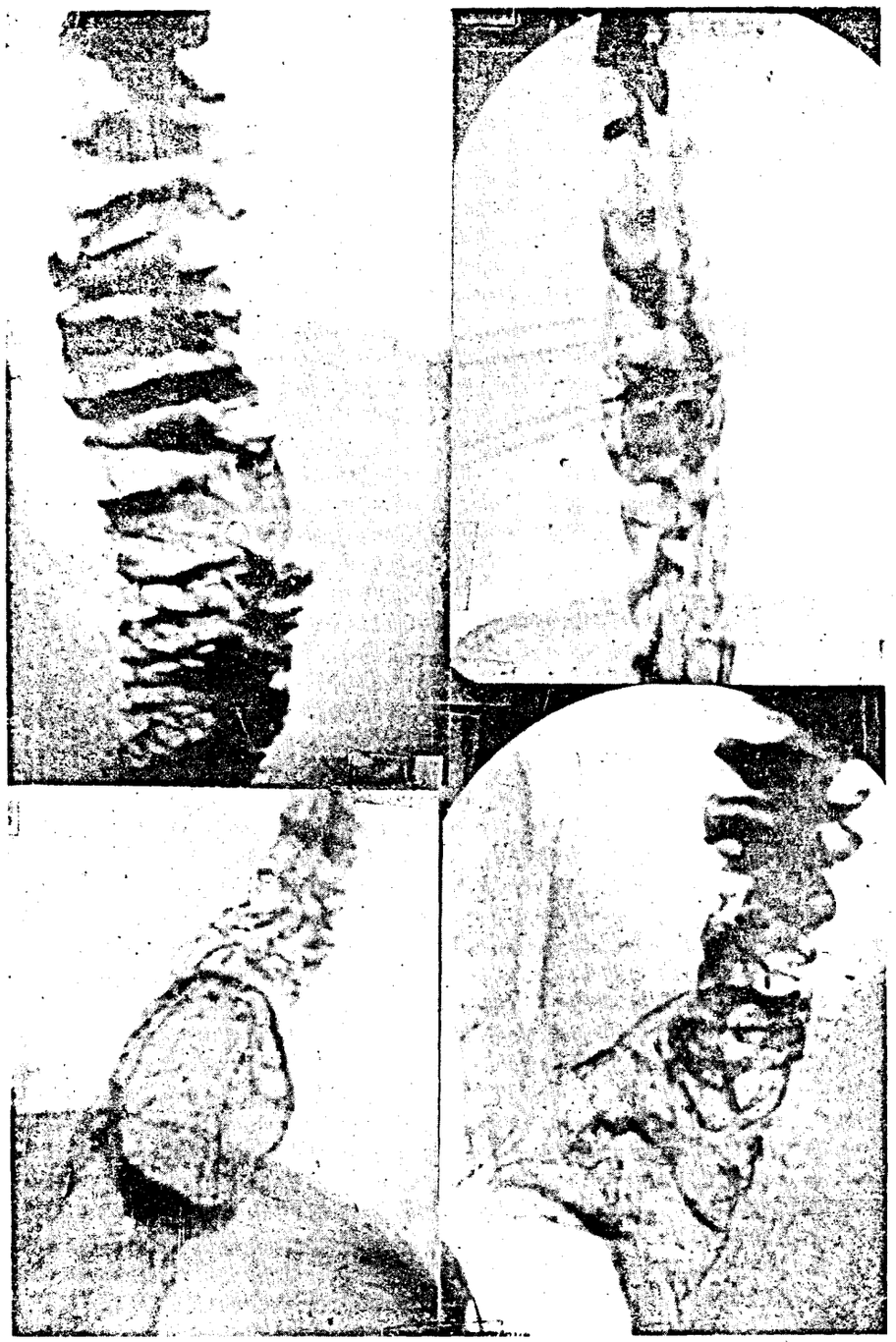

Fig. 6—(A, B, C & D)

(A) Case 20. Acute amoebic dysentery. Broad prominent circular rugae in descending colon. They were not visible in the post-evacuation film due to hypermotility. (B) Case 31. Single polyp in descending colon. Note the normal mucosal pattern at the wall opposite the polyp and above and below it. (C) and (D) Case 25. Ulcerative colitis. Preliminary films: Complete disorganisation of the mucosal pattern presenting broad short irregular rugae and deep crevices. The post-evacuation film revealed only streaks of barium in the contracted colon, not characteristic of ulcerative colitis.

other abnormalities, the radiological findings were compared with those of sigmoidoscopy carried out by a proctologist. The detailed results of these combined examinations will be published later—on in a separate paper. As regards diverticulitis, ileo-caecal tuberculosis and tumours, the outlines and extension could be better scrutinized by the preliminary films than by the routine examination. In two cases, one of them demonstrated by me at the Indian Congress of Radiology in 1956, a small polypus, not visible by enema and post-evacuation film, could be detected by this method and confirmed by air inflation.

Loss of haustra is often erroneously interpreted as sign of chronic colitis. In reality it may be also produced in a normal colon due to overdistention by the enema or in certain functional disorders such as atonic constipation or spasticity of the colon. By means of this new technique it will be possible for the radiologist to arrive at a proper differential diagnosis as shown in the previous chapters.

Finally, this technique throws some light on the mechanism of the causation of the mucosal pattern; the colonic folds were shown not to be persistent in their course, but to be constantly moulded by peristalsis. When a peristaltic narrowing of the lumen occurs, they are predominantly longitudinal, and in the state of relaxation they tend to be more circular within the broad haustra. This phenomenon could be observed under normal as well as under pathological conditions, and in cases of overactivity of the colon it could be easily demonstrated in spotfilms and occasionally also noticed under the screen. It seems that contractions of the circular muscular coat contribute to narrowing of the lumen and a predominance of longitudinal rugae. Observation in atonic constipation on the other hand suggest that the action of the longitudinal muscular coat may have some influence on extension and shortening of the colon, the formation of haustra and the stimulation of circular rugae.

The conception that the mucosal relief shows constant changes is indeed supported by statements in the radiological literature[3] and in anatomical textbooks. In the opinion of Bockus[4] these movements of the mucosal lining "may have great physiological importance, both in absorption and in assisting the bowel to grasp the faecal bolus". This new method allows us to study the motility of the normal and the diseased mucosal membrane. Furthermore, it may be employed to assess the effect of drugs on the movements of the mucosal relief. "We are no longer content to study anatomical structures, we are delving in the direction of evaluation of physiological processes" (K. P. Mody, Souvenir No. of Indian Journal of Radiology).

Summaries

The post-evacuation films after barium enema often do not supply sufficient information about the conditions of the colonic mucosa, particularly at the descending and iliac portion. A new technique has been suggested, in which a minimal amount of barium is introduced into the sigmoid under fluoroscopic control prior to the routine examination.

This method has been tried in 160 cases including normal conditions and practically all of the common functional disorders and organic lesions of the colon.

Details of the method are fully described and 34 cases are persented with clinical, pathological and sigmoidoscopic data.

As a rule, the mucosal relief is far better visualised by the new technique than by

conventional films, particularly in cases of hypermotility and hypomotility of the colon. Even in cases in which the post-evacuation films are satisfactory, radiographs exposed with the new method often disclose far more details of the mucosal pattern or provide some supplementary evidence.

The analysis of the mucosal pattern as it appears in a series of spotfilms helps in the differential diagnosis between functional disorders and inflammatory lesions of the colon which is often not feasible by the conventional examination.

This technique is particularly suitable for the exploration of the mucosa in circumscribed portions of the colon, for example in ileo - caecal tuberculosis, diverticulitis, tumours and for the study of the region of the anastomosis following colectomy.

Observations by means of this technique may stimulate research as regards the mechanism which leads to formation and transformation of colonic rugae and the influence of normal and abnormal peristalsis on the mucosal pattern.

It does not require an expensive special equipment, but may be employed by any radiologist interested in a thorough investigation of the colonic mucosa.

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Welcome Address

BY

Lt.-Col. E. R. F. REBELLO, A.M.C.

Professor of Radiology, Armed Forces Medical College, Poona, Chairman of the Reception Committee, 13th Indian Radiological Congress 1959, Poona.

Ladies and Gentlemen,

It is my privilege as Chairman of the Reception Committee to extend to you a hearty welcome to the 13th Indian Congress of Radiology. This occasion is unique in many ways. It is the first time that the Congress of Radiology is being held in this historic city of Poona. Service radiologists have collaborated with their civilian colleagues since June 1943 when the Annual Bombay Medical Congress was first inaugurated at the Grant Medical College Bombay for the express purpose of maintaining close liaison between the citizen and the soldier in the various fields of medicine. It is in the present Congress however, that medical and dental officers of the Services have been afforded an opportunity of playing a significant part in the deliberations and we thank the Indian Radiological Association. Finally this occasion is unique because for the second time in five years we have been honoured by the presence at our Annual Congress of Shri. Sri Prakasa, a great patriot, educationist and scholar. I take this opportunity of expressing the sympathy of Indian radiologists on the recent loss of his father the late Dr. Bhagwandas, famous Sanskrit scholar of Benares.

On a previous occasion Shri. Sri Prakasa had disapproved of the practice of experiments on living animals for the purpose of advancing medical knowledge. He had also disapproved of the conflict between various systems of medicine in this country and the conflict which existed between the general practitioner and the specialist in our system of medicine. He also noted the tendency of doctors to concentrate in large cities ignoring the mass of the people who live in the villages and form the back-bone of India. With the improvement of road and water communications under the Five Years Plans the spread of electrification and the consequent rise in the general standard of living of our people modern medical care will soon be available in our villages. I express the hope that the present Congress may find some solution to these problems as well as our own technical problems such as the regulation of radiological practice, protection from the ionising radiations that are being used in this country for industrial, agricultural, medical and research purposes, the problems of radiological education in diagnosis and therapy, education of radiographers and hospital physicists, the indigenous manufacture of X-Ray equipment and accessories, X-Ray films and chemicals including radiographic constrast media and last but not least medical research in its many facets including radiological statistics, museums and libraries.

It should hardly be necessary for me to emphasize the important role that the Services have played in the development of Indian Radiology. The first institute of Radiology in this country was established by

the Army in Dehradun in the early twenties. The Army also had a school of radiography in Lucknow. Both these institutions merged into the Army school of Radiology at Secunderabad in 1944. After the war this school was moved to Poona and was merged into the Armed Forces Medical College which is now affiliated to the University of Poona. The first mass miniature radiography centre in India was established at Kunraghat in Utter-Pradesh in December 1944. At the beginning of the last war there were ten radiologists authorised for undivided India. By January 1946 the number had increased to 133 Indian and 24 British radiologists and in addition, 67 other X-Ray departments were run by general duty medical officers. It is interesting to note that today the Indian Radiological Association has a total membership of about 250 serving a country of 360 million people.

War in a sense is perhaps a greater challenge to medicine than to other sciences because the original motive that guides men and women into the field of medical research or indeed into any research is a desire to reduce human suffering. We have not been slow to accept this challenge because a task which faces all Service branches during post-war year is the study of lessons learned during the war. We look to the development of nuclear power for peaceful purposes such as motive power for the transport of war casualties and the casualties of civilian defence, the cold sterilisation of surgical instruments and dressings, the preservation of food and supplies by gamma rays and last but not least the use of these new and powerful tools in the alleviation of human suffering. Service specialists are members of three professions, the profession of soldiering, the profession of doctoring, and the profession of radiology. Unless they attain a reasonable standard of proficiency in all three professions thay have failed in their duty. Similarly our civilian colleagues will have failed in their duty if they are not doctors first and radiologists afterwards.

In a poorly developed country like ours it is but natural that we should look to the State to organise large medical centres and provide employment for doctors. In this matter the contribution of the private sector should be no less than that of the public sector and the duty of the State should be restricted to that of inspection and supervision and the provision of financial assistance wherever necessary. In the United States of America we have the example of Mount Sinai Hospital in New York City, which is a private institution and also one of the finest medical centres in the world. In our country the House of Tatas, long known for their patriotism and generosity have established the well known Tata Memorial Hospital in Bombay. In Calcutta the Chittaranjan Seva Sadan and in Vellore the Christian Medical Centre are further tributes to private enterprise. In the latter case however the motivation is controversial. Although it is true that the priest comes in only when the doctor gives up there is a school of thought which says that the physician who would look after the somatic walfare of an individual should also have an insight into his spiritual welfare. This may also be the back-ground of some of our ancient systems of therapy such as Yoga. I express the hope that private agencies may establish a large number of medical centres evenly distributed for the maximum benefit of the population living far from the State capitals.

The present status of Indian radiological literature is reflected in the Souvenir number of the Indian Journal of Radiology published in 1956 on the occasion of the diamond-jubilee of the discovery of X-rays. There are 63 original articles on every conceivable aspect of radiology all contributed by well-known authors from a large number of foreign countries. The only Indian contribution would appear to be the preface by Dr. K. P. Mody of Tatas and the foreword by Rajkumari Amrit Kaur. This is in striking contrast to the status of Indian literature in phyiscs as reflected in the book called "Nuclear Explosions and their Effects" written in 1956 by Dr. D. S. Kothari and his colleagues in the Defence science Organisation. The book speaks for itself because it is already in its second edition within three years. In this context one cannot fail to mention the monumental work of the Japan Society for the Promotion of Science published in Tokyo in 1956. There is not a single foreign contributor in this work entitled "Research in the Effects and Influences of the Nuclear Bomb Test Explosions" covering the subjects of "meteorology," "physics," "chemistry," "genetics," "agriculture," "fisheries science," "economics" and "medical science."

I am proud to welcome Dr. K. P. Mody the first Indian radiologist and the second Indian to be awarded the Acharya Jagadish Bose Memorial Medal, Dr. R. F. Sethna who has recently returned from Burma where he was assigned as a Consultant Radiologist, by the World Health Organisation and Dr. Manjunath Rai who was my post-graduate teacher in surgery in the days when radiology was not yet an attractive speciality. Time does not permit me to mention all the distinguished visitors, respected teachers, colleagues and friends who are present here today.

I hope, ladies and gentlemen, that your visit to this city which is not as attractive as some of the cities of our vast country may yet be both profitable and enjoyable and that you may take back with you pleasant memories of your short stay among us.

—★—

Presidential Address

BY

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

13th Indian Congress af Radiology, Poona—1959.

Your Excellency, Shri. Sri Prakasa, Dr. D. P. Sethna, Surgeon-General to the Government of Bombay, Distinguished delegates Ladies and Gentlemen.

Shri. Sri Prakasa, it gives me great pleasure to thank you for graciously consenting to inaugurate the 13th Indian Congress of Radiology by specially coming from Bombay in spite of your multifarious activities. I extend to you a hearty welcome on our behalf. This is the second time, that the Association has been so honoured as you had also inaugurated the 8th Session of our Congress in Madras in 1954.

In hope that your link with our Association for the 13th Congress will prove very auspicious and fruitful in the year to come.

I am sincerely grateful to all my colleagues and appreciate the honour they have bestowed upon me by electing me to the highest office of this Association.

I am happy to beholden to my colleagues for this honour, not for my humble self, but for the profession of Radiology. In my 30 years of association with the science of Radiology, I may state that it has not made the progress it should have made. We have to face many obstacles, wait and just keep on working—or fighting for its betterment. To-day we have reached a respectable standard, (still far behind), and it is my cherished desire to work for, and see the progress of this greatly advancing branch of science in our country.

Natural and Man-Made Radiation Hazards

The advent of Atomic Age has brought in its wake highly complex problems for the human race of which the subject of somatic and genetic hazards has aroused great interest in the public.

In the WHO publication of January, February 1959, under the heading "FEAR —Disease of the Atomic Age" appears the following :—

> "Thus, the risk of being killed in an automobile accident, which is immediate and visible, and the danger from tobacco, which is delayed, both appear as much real and credible threats than the dangers of radiation, yet most people continue to drive and smoke without apprehension. It has been suggested that the peculiar qualities of radiation are that it is invisible, unheard, unsmelt, untasted and unfelt, apparently infinitely powerful, yet springing from an almost infinitely small source, and—as far as the individual in concerned—uncontrollable."

The National Academy of Sciences of U.S.A. and the Medical Research Council of Great Britain published their reports on the subject in 1956, both of them are in general agreement regarding their ultimate findings. The Report of International study group convened by WHO, on "Effect of Radiation on Human Heredity" was

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

President, 13th Indian Congress of Radiology, Poona—1959.

published in 1957. Medical and Radiological Journals have been flooded with articles on this subject. The news agencies, not to be outdone, have been in the forefront and have aroused great public interest and anxieties, fears and confusion in the public mind by scare-headlines, such as 'Atomic Suicide,' 'Danger to Generation Yet Unborn' and 'Radio-active danger to Water and Food supplies'. In this respect as purveyors of news, sensational or otherwise, journalists hold a very responsible position as connecting links between the scientists and the public, and though public education is highly desirable, the news that is liable to produce public concern and adverse effects on their morale and mental health should receive rational treatment.

A special number of WHO publication on "The challenge of Atomic Energy" states, 'The peaceful potentialities of nuclear energy are immense, but so are the dangers inherent in its misuse'.

The dangers exist to an appreciably greater degree in this country from man-made radiations. The indiscriminate practice of Diagnostic Radiology by untrained physicians and lack of appreciation, and ignorance of realities of radiation hazards call for bold and timely action by the Radiologists with the help of the Central Government, in the form of legislative control for the safety of the public.

The most important radiation hazards to the human race are derived from artificial or man-made radiations. The list comprises of:

(*a*) The Radio-active fall-out from the explosion of nuclear devices.

(*b*) Occupational exposure of medical practitioners, radiologists, dentists, nurses and certain workers engaged in industry, education and science dealing with radio-active materials.

(*c*) Medical use of X-Rays and radio-active substances in the detection, diagnosis investigation and treatment of human diseases.

Of these three groups, the medical use of radiation is of utmost importance to the medical profession in relation to somatic and genetic hazards.

Somatic ill-effects

Some authors have stressed the importance of increased incidence of leukaemia amongst Radiologists and in patients treated for ankylosing spondylitis. Others have reported the development of thyroid cancer in children treated by X-radiation for thymic enlargement and occurrence of bone sarcomas. Other ill-effects produced following ill-considered radio-therapy, are chr. radio-dermatitis years after irradiation, marked keloid formation as a result of irradiation for acne and severe oedema of face shortly after irradiation for mycosis fungoides. Lastly, there has been a big controversy regarding ageing effect of radiation amongst Radiologists and shorter life expectancy resulting from it.

The radio-therapists have now restricted treatment of ankylosing spondylitis to those cases which have failed to respond to any other form of treatment. The radiation treatment of enlarged thymus has been given up and recent advances in radiation technic have practically eliminated all other radiation hazards.

Court Brown states, "Recent work has demonstrated a significant increase in the mortality from leukaemia amongst persons treated with X-Rays for ankylosing spondylitis." It is therefore very desirable that X-Ray therapy in this condition is restricted

to those cases which have failed to respond to any other form of treatment.

Genetic ill-effects

The possible consequences of genetic ill-effects of increased mutation rate have been described as gross mental and physical defects in infants and embroyonic, infant and early childhood death.

Some of the measures adopted may be enumerated for the benefit of untrained physicians practising Radiology.

(*a*) All out-of-date open type of X-Ray tubes especially those with lead-glass protective bowls should be discarded.

(*b*) More careful and rigorous use of multi-leaf diaphragms, filters (3 mm. total filtration in the tube window) and protective shields for gonads especially in children and young adults.

(*c*) X-Ray examination to be restricted according to requisite indications, and performed only when essential in cases of pelvis and hip-joints in age groups extending from infancy to the age of 40 years. Repeat examinations to be avoided.

(*d*) Fluoroscopic examination of children to be discontinued as a routine procedure in all cases, as the time taken to perform a proper study of struggling children increases gonadal exposures.

(*e*) Fluoroscopy should only be done after proper adoptation of the eye to darkness. To a skilled Radiologist, the period of screening should not exceed per patient more than 10-15 seconds in chest work.

(*f*) The question of pelvimetric examination of pregnant women has to be performed only when absolutely necessary. However, in many cases in this country, the information gained outweigh the genetic radiation hazards. If performed judiciously, three radiograms suffice to obtain all necessary information. Al. filtration, Brass-wedge filters for lateral views, fast intensifying screens, high speed films and high K. V. technic has reduced exposure to the surface of the patient by 85 per cent. prior to introduction of these modifications.

For further information, all those who are interested should make a thorough study of an article entitled " Practical suggestions for Reducing Radiation Exposure in Diagnostic Examinations " by L. S. Taylor, published in 'Radiology'—(December 1957, Vol. 78, No. 6).

The widely circulated Indian Medical Journal will be conferring a great boon on the public if the article is reproduced in one of their issues for enlightenment of its members practising Radiology, the majority of whom are untrained in this subject.

In this country radiation hazards from radiation therapy are considerably less than those prevailing in highly developed foreign countries. The reasons are not far to seek. Radio-therapy is practised exclusively in large towns by skilled radio-therapists in medical institutions and in private practice, and offers no glittering reward of easy monetary gains to un-trained physicians, due to very high cost of the Therapy Units and the limited field of its application.

In this respect, diagnostic radiology attains paramount importance as it affects both the Radiologist and much more important, the patient, especially the age group from infancy to about the age of 45 years. The fully trained skilled Radiologist, fully conscious of his responsibilities has taken all precautions and devised measures to protect his patient from radiation hazards in all countries, so that the public need entertain

no fear to their health. In very few cases, the small attendant risk are far out-weighed and justified, because without these diagnostic aids the patient's health and life would otherwise be jeopardised. Wendell Scott very rightly remarks, " Without diagnostic radiology, medicine would descend behind an impenetrable curtain."

Radiological Education

In the forefront of the urgent problems confronting Radiology, is the one relating to pre-clinical, clinical and post-graduate training. There are two distinct trends in post-graduate training. One school of thought advocates the modern trends of separation of Radiodiagnosis and Radiotherapy for training and practice. The other school still clings to the out-moded methods of combined course of study and practice, especially in this country.

Prof. Gosta Forsell (Sweden) one of the most famous pioneer Radiologist initiated this reform about 25 years ago. To-day as a result of his deep foresight into the future, Sweden ranks as the most advanced country in the world in both Radio-diagnosis and Radio-therapy. U.K. followed suit in 1945, and for that reason Radiology enjoys a very high status in the medical profession and the public has benefited by the very high pitch of efficient service in Radio-diagnosis as well as therapy. According to Prof. Forsell, the man who can practise both branches of Radiology must be a genius. Speaking about Radio-therapy, he stated emphatically, " A medical man who devotes his services to Radio-therapeutic clinic must forsake all else and be willing to devote life and soul to Radio-therapy." Since then Radiology has made phenomenal progress in both its branches. On that calculation, the man who can practise both branches of science efficiently must be classified a super-genius.

In U.S.A. and other foreign countries, the duration of the combined course is of four years in well established Radiology Departments in large medical Institutions. Even then, after qualifying as Radiologists, a large majority of them practise either in diagnosis or therapy. Dr. Leo Rigler, President of North American Society of Radiology and a world famous Radiologist, who visited this country with WHO team in 1953 in a personal communication, states, " I am in agreement, that radiation diagnosis and therapy should be separated. In United States, we have not yet accomplished this because of practical considerations. There are so many small hospitals and institutions which require a Radiologist, but cannot afford two, so that the two specialities are combined in one. In recent years, the American Board of Radiology has taken some steps, which will tend to increase the separation of the two fields even from an educational standpoint. I am confident that this trend will continue in the future. "

In this country, majority of small town hospitals do not even possess an X-Ray Unit—let alone a Radiologist. If the small town hospitals do install a unit, it is of small capacity, partly run by medical men in the grade of Assistant-Surgeons and sometimes by self-trained technicians. Radio-therapy is concentrated in few large towns. For genuine Radio-therapy, which means both X-Ray, Radium and Radio-isotope therapy, all the following factors are essential :—

(1) Radio-therapy needs the help of a specialised team of non-medical personnel and technicians, of whom a 'Radiation-physicist' is indispensable.

(2) A Radiation-biologist is another important link. Radio-therapy requires centralisation to big towns serving substantial

population groups from surrounding country side.

Radio-diagnosis on the contrary requires decentralisation to provide on the spot service to patients, some of whom cannot be moved to some distance without jeopardising their lives, and so are an essential asset in any small town hospital for efficient medical service.

This is the crux of the whole problem, why so many in every country specialise in, and practise Radio-diagnosis as campared to Radio-therapy. The scope of service in Radio-therapy is extremely limited and offers limited future prospects of advancement.

The recent appointments of D.M.R.D. (Eng.) and other foreign trained Radiologists to the Government Hospitals, will bear testimony to marked improvement in Radio-diagnosis and also in training. The D.M.R.E. (Bombay Univesity) students have repeatedly complained very bitterly, that they have perforce to devote sometime to Radio-therapy, which valuable time they could devote better by concentrating solely on Radio-diagnosis if the Diplomas are split up.

Since Radio-diagnosticians are in great demand the syllabus of study of two years duration, which passed the Bombay University Senate stage, should be introduced at an early stage, if we have to meet the supply of such well-qualified Radio-diagnogticians. Since this address was completed, I am very happy to state that the Bombay University which is the pioneer University in the country in the introduction of modern methods of education has finally decided to split the Diploma for which it is to be heartily congratulated. During the recent Congress Session, every national leader agreed that quality should not be sacrificed to quantity. Radiologists of poor quality are mass-produced. If the Radiologists of sub-standard quality are mass produced, the quality of radiological service to the public will remain low, and continue so for successive generations. It will lag behind still further as this Science is advancing at a phenomenal rate. One does not expect mass-produced poor quality teachers to improve quality of training and practice.

In his Presidential Address to the 64th Session of the Indian National Congress. Shri Dhebar remarked, " The colossal task of levelling up of those who below the standard of life was awaiting India." Continuing his speech he declared, " Time is running aginst us, and we have to make good the back-log of an age, and catch up with the world which is not running, but flying at a terrific speed."

The Indian Prime Minister in a recent speech declared, " We have to catch up not only with the progress that has already been made by other countries, but also to keep abreast of the leaps of progress they are making every day."

Since there is a very great demand for skilled Radio-diagnosticians in this country, it would be essential to concentrate on this particular branch of Radiology, to render efficient diagnostic service which is rarely available to clinicians in small towns where X-Ray Units are being installed in greater numbers. It is very unfair to hold Radio-diagnosis to ransom by Radio-therapy, and check its natural progress because of paucity of facilities for training in therapy and lack of trained personnel.

Those who are genuinely interested in Radio-therapy in all its aspects, should either be selected from the rank of Surgeons or must have at least some requisite surgical skill as a last resort. They should be sent abroad to famous Radio-therapy centres for at least a period of three years to receive intensive training in all the modern methods of Radio-therapy including Radio-active isotopes. But unless a job is assured and the remuneration paid to them on their return after receiving training is adequate, and future prospects of advancement bright, no good student will ever take up this career just for the love of it.

Two Surgeons from each of the big towns in the country where all available material for practice of Radio-therapy has already been installed will meet the want of future trainees, on their return, to this country, and a solid foundation laid for research and treatment on the most scientific basis. One can quote the case of Neuro-surgery in this respect, which has recently made slow but very sure progress in Bombay and some other centres in the country.

Another important point to remember is that Radio-therapy will not progress along right lines, unless and until Radio-therapy Department is allotted beds in an institution, where the Therapist can pick and choose his cases independently of any interference from his surgical colleagues, free from dictation as to the amount of dose to be administered and how best to treat the case. The Radio-therapist will certainly need all co-operation from the physician and the pathologist. The team will be completed by Radiation Physicist and Biologist. The former is indispensable in any Radio-therapy centre. Radio-therapy cannot be conducted as an out-patient treatment in a large majority of cases in cancer hospitals, as many of them (75%) well advanced, and beyond the scope of radical or mostly mutilating surgery, are sent to the X-Ray Department for whatever palliation is possible. As long as surgeons who are wedded to the art of surgery as the only panacea for all human ailments, especially in cancer patients, and control the choice of treatment, the status of Radio-therapy will never advance in this country to that obtained in highly advanced foreign countries.

It is deplorable that the wrong policy of the State Government of limiting the retiring age of Post-graduate teachers to 55 years is still persisted in, even when it is realised that there is great dearth of experienced and mature teachers keenly felt in all educational institutions. There is no denying the fact that medical men, in practice and teaching, reach their zenith at or just before that age and therefore the age of retirement in all highly developed foreign countries has been fixed at 65 years. If the Central Government and State Government ministers are deemed capable of discharging their highly responsible tasks upto the age of 70 years and more and the High Court Judges upto 60 years of their age, it is difficult to understand the reasoning why the same sane policy is not pursued in the case of other Government service personel.

Another very important point stressed by Dr. Jivraj Mehta, the Finance Minister to the Government of Bombay at the recently concluded Medical Education Seminar held by the Medical Council of India, of appointing the post-graduate teachers, especially the Professors in their respective branches, on a full-time basis requires serious consideration. In that case, it is felt that to attract the right type of persons to hold these highly responsible posts on which depends the future progress of medical science, the remuneration should be attractive or as high as that paid to the Chief Secretaries to the various Government Ministries. It is very well to sermonise to the Medical Profession in and out of season, about the nobility of

their profession and the need to sacrifice for the progress and medical relief the country. The object is very laudable but it is very difficult to understand why medical profession should be particularly singled out for that purpose. Medical men do continually sacrifice a lot without any advertising but there should be some reasonable limit to that.

The great barrier to the rapid progress of overdue educational programmes in this country has been the introduction of unhealthy party-politics, institutional jealousies, and personal rivalries. It happens sometimes therefore, that long overdue reforms, however beneficial, are treated on party-lines and spiked.

Education in radiation hazards

The WHO, in its publication, "Challenge of Atomic Energy" commentating on the great need of spread of knowledge of radiation hazards, emphasizes, "there is at present an insufficient number of institutions where an adequate training in genetics can be given." The group believes that "Medical under-graduates should all receive training in genetic, and the teaching should be co-ordinated with that in Radiology, and in the use of radio-active substances in medicine, so that the genetic hazards of diagnostic and therapeutic procedures are throughly understood." "Medical men trained as Radiologists should have specific, more advanced instructions in genetics."

The group also emphasizes the necessity of such training to all Health Physicists, Radiological Physicists and Technicians and others involved in the use of radio-active material and other forms of radiation.

Other authorities on the subject have advocated the great need to include the study of this subject for medical officers of health and their staff and those responsible for environmental health. It already forms part of the curriculum for the Diploma of Public Health in U.K. and wherever, it is not included in Diploma of Public Health Courses, its urgent introduction is essential, especially in Bombay due to the erection of Atomic Energy Reactor at Trombay. Constant and efficient monitoring of the atmosphere for accidental release of radioactivity and speedy detection of contamination of water, food and milk supplies is vital for the population, and for that work local health authorities should be mainly responsible.

Radiological Practice

General Ne Win, Prime Minister of the Union of Burma addressing the 7th Burma Medical Conference about Radiological practice, said, "District Medical Officers had asked for good equipment, yet many were unable to use it properly. It was sheer waste for a doctor who knew nothing about such a precision instrument as an X-Ray plant to manipulate one." Concluding, he remarked, "Don't tackle a job that you do not know because you are dealing with life."

However, there is no denying the fact that the population faces grave dangers from some untrained physicians, be they consultants or general practitioners, by the abuse of Radiological practice performed by them. This menace is ever growing in this country as there is no legislative control of indiscriminate practice of this highly specialised Science. In many such cases, X-Ray examination is totally un-necessary, and very often of poor diagnostic quality. Medical profession is not exempt from including amongst its members those who succumb to lure of making easy money, since a small investment in an X-Ray Unit which is easy to manipulate brings in a good return directly and indirectly as the illiterate and semi-literate class of people are dazzled

by its presence which is sometimes freely advertised by various dubious means. Possession of an X-Ray Unit by one general practitioner arouses competition in another one in the same locality, so that if Dr. A has it. Dr. B must have it also and then Dr. C, and so the vicious pattern is repeated in different localities, totally unchecked and un-controlled by any legislative measure. That does not mean that Chest Consultants and Orthopaedic Surgeons and others, genuinely in need of X-Ray Units should not install them, to give them aid, which is essential in their particular line of work, and who know the limited potentialities of their X-Ray Units, and restrict themselves to their own field of work, and also are fully aware of the radiation hazards. But the number of such genuine Consultants is strictly limited who do not abuse the practice of Radiology, but use it for the purpose of welfare of their patients.

Radiology Bill

"To regulate the profession of Radiology and make provision with respect to radioactive substances and certain apparatuses producing radiation", commonly known as "Radiology Bill", framed by the Indian Radiological Association at the request of the Health Ministry, Government of India in 1952, was indefinitely shelved due to the stiff opposition from the Indian Medical Association, on the very flimsy plea that "the Bill encroached on the fundamental rights of medical men to practise any branch of medicine". The paramount interests of the patient which should be uppermost to every medical man were thus relegated to the background, and the narrow selfish professional interest of medical men given preference. A most unfortunate and untenable stand indeed!

Dr. K. P. Mody, one of the most respected members of this profession, a Past-President of this Association and an ex-Editor of the Indian Journal of Radiology, commenting on this subject in the November 1956 issue of the Journal, remarked, "It was the tragedy of the first magnitude and a sad chapter in the history of medical profession in our country, that opposition should have come from a responsible body like the Indian Medical Association. Instead of pulling their weight in favour of the Bill, they presented strenuous opposition and brought about its downfall."

However, there are signs that the Indian Medical Association now realises the grave urgency of the problem, and is willing to withdraw its opposition to the legislative measures. Commenting on the imperative need to appoint an All-India Body for Control of Radiological practice and installations, the official organ, Journal of the Indian Medical Association remarks in an Editorial published in 1956, (Vol. 27, No. 2), "The Body must see that it is only the qualified who are allowed to install and run X-Ray apparatus". If "Qualified" means qualified Radiologist, then the Journal deserves hearty congratulations, for so graciously admitting the wrong stand taken by the Indian Medical Association. It is presumed from press reports that the Medical Council of India has also taken notice of the desirability of legislative measures.

Those who still cling desperately to their untenable opposition by publishing extensive irrelevant statistics of conditions prevailing in foreign countries which are highly advanced in this science, appear to be in a minority. These laboriously collected statistics serve no useful purpose, since the knowledge and awareness of the radiation hazards bear no comparison to the blissful ignorance of this science, to the large mass of illiterate and semi-literate population,

and which also prevails amongst some untrained physicians practising Radiology. It is equally futile to reach highly misleading and unfounded conclusions based on those foreign statistics when it is realised that elementary medical relief is non-existent in vast areas of this country.

It is quite immaterial to this Association if any other medical Association now desires to claim the dubious distinction in proclaiming, "We did it", if the most cherished desires of the Radiologists to protect the public from the abuse of its practice are fulfilled in the shortest possible time. The question brooks no delay since the hazards are ever increasing at a fast rate.

The Medical Division of the Atomic Energy Establishment has been rendering very useful service of "monitoring" to check radiation received by the staff of X-Ray Departments at a norminal cost. It is, however regrettable, that very few hospitals in Bombay are taking advantage of these excellent facilities provided to protect their staff against radiation hazards. In all about 65 hospitals only take advantage of it in this country. It should be made compulsory in hospitals managed by the Government and the Municipal authorities. Outside Bombay State, "monitoring" system for the personel must be practically unknown. It would be very useful information if the authorities of Atomic Energy Establishment widely publicise to all hospitals the urgent necessity for it to protect their staff from ill-effects of excessive radiation.

Manufacture of X-Ray Equipment

After the conclusion of extended preparatory work, three Indian Companies having the assurance of collaboration with established and experienced foreign manufacturers, have received the required Manufacturing Licence from the Govt. of India. That means work in connection with actual construction of X-Ray Equipment in this country is about to start. It is well known that X-Ray Equipments have a rather wide range of types according to performance and ways of application. In order to come to visible results as soon as possible and to meet the immediate requirements of the country, if was decided by the Government of India to establish a so-called phased-programme of manufacture which is to secure economical results together with an organic development of this new industry.

The idea behind the phased programme is also to invesigate the possibilities which of the initially imported materials and components can gradually be manufactured in the country, respectively to encourage work on designs for this equipment with an emphasis to use materials and components already available in the local markets.

As quite a number of components (Such as Tubes, Screens, H.T. Cables, etc.) are generally products of specific industries the manufacture of these parts can be introduced at a later date only. A considerable number of components should be increasingly manufactured in the country in the next about 5 to 6 years and it can be expected that the three Manufacturers with the help of the Government will be in a position to introduce this new industry with the double purpose of supplying Indian made X-Ray Equipment and at the same time saving substantial amounts of foreign exchange.

The three firms in question are Messrs. Radonhouse in Calcutta, Messrs. Escorts in Delhi and Messrs. Siemens in Bombay, Radonhouse, this old Indian Company is increasing its activities and has made arrangements with a French company in order to make certain types of units. Messrs.

Escorts too have established relations with the U.S.A. firm Westinghouse Electrics. The well known Siemens Equipments will be introduced by the third Indian Company. "Siemens Engineering." The assistance of the same gives us the promise that the units manufactured here will be of up-to-date design and of the required high and reliable quality.

It is therefore to be hoped that with the efforts of these three companies only, equipments for specialized used will have to be imported from abroad not before long.

So many important subjects have been discussed that it is apt to conclude this address with a question from Edmund Burke:

> "Those who would carry on great public schemes must be proof against the worst fatiguing delays. the most mortifying disappointments, the most shocking insults, and, worst of all, the presumptuous judgment of the ignorant upon their designs."

Lastly, I offer my sincere thanks to Dr. M. S. Dikshit and the members of the Reception Committee and all others who have worked so hard to contribute to the outstanding success of this Congress.

Association Banquet

Message from the President: Dr. R. F. Sethna

Read by Miss. J. R. SETHNA.

Lt. Col. Rebello, Distinguished Delegates, Ladies and Gentlemen,

It gives me great pleasure in addressing you all on my father's behalf. I offer my sincere thanks to the Reception Committee and the Central Council for granting me the permission to address you all.

My father has sent the following message :—

"I am very keenly disappointed that I have been unable to welcome you all in person and to address you on this festive occasion—but my thoughts are all with you.

May I put in an earnest plea that we close our ranks, bury our personal differences and work in unison for the sole purpose of the welfare of Radiology. I may have made some mistakes, no one is immune, but my sole intension in all that I have done during my close association with the Profession and the Association has been the betterment of this Science. Radiology can only progress along the right lines if we are prepared to devote some of our time and energy for that purpose.

It is extremely difficult, and takes a long time to build up anything from scratch. It is very, very easy to destroy the same, in a moment. Those who work with a single-minded purpose to advance the good of Humanity, always leave behind grateful memories—cherished for generations to come.

I heartily welcome the presence of the Armed Forces Medical Services, and for their valuable contribution to make this Congress an outstanding success. I can assure them that we, civilian Radiologists will always look forward to their participation in all such future Congresses.

I offer my sincere apologies to all of you for the cancellation of my dinner, and for the inconvenience caused to you. Some day I hope I may be in a position to make amends for this unavoidable lapse.

I close this message to you all with a fervent prayer that Radiology in this country, in the near future reaches the same high standard that prevails in highly developed foreign countries, and that the Association prospers, and some day we may be in a position to hold an International Congress of Radiology in our Country."

THANK YOU.

Abstracts of Radiological Literature

Tuberous Sclerosis: MacCarty & Russel : Rad. Dec. '58, pp. 833.

It is a rare familial disease of defective ectodermal development affecting many systems. The classical triad consists of mental deficiency, epilepsy and sebaceous adenomas of the face, In 1880 Bourne-Ville first described 'potato-like' nodules throughout the brain cortex. They are pale, slightly firmer than the cortex, and upto 3 cms in size and consist of giant nerve cells, glial elements and large astrocytes. Others lesions are subepidymal tumour masses, usually in the lateral ventricles, may fill them and consist mainly of glial cells and giant astrocytes. Malignant degeneration in the form of glioma has been recorded. Congenital tumours of the retina, 'phacomas', are also seen. Besides face, (a) thickened skin (shagrin skin or peau de chagrin), over lumbosacral region, (b) subungual fibroma, small red proliferations at the sides of the nail, (c) Cafe-au-lait spots and vitiligo, and (d) subcutaneous nodules resembling fibromas, are also seen. Other congenital anomalies seen in the families of tuberous sclerosis are hairlip, polydactylism, spinabifida and congenital heart diseases.

Radiologically intracranial calcifications are seen in 60% occupying the cortical nodules and frequently in subepidymal masses. Rounded sclerotic patches in the inner table may be seen in 40%. Ventriculograms shows filling defects. Hands and feet show characteristic cysts in the phalanges and new periosteal bone in the metatarsals. Sclerotic patches are also seen in vertebrae and innominate bones. Rarely pulmonary involvement occurs with overgrowth of connective tissues and cyst formation giving retilcuar pattern and honeycombing. Chronic hydrocephalus may develop and if acute, malignant change may be suspected.

B. N. Khanna, Kanpur.

"Recurrence After Resection For Bronchiectasis". Chesterman, J. T. The British Journal of Surgery. September, 1957. Vol. XLV, No. 190, P. 155-159.

The paper is based upon 245 consecutive cases involving 273 resections, all of which were followed up for at least three years. Postoperative bronchograms were taken in clinically suspicious cases. There were 19 cases of recurrence in 203 resections, making an incidence of 9 per cent. All these 19 cases occurred below the age of 18 years. No recurrence occurred in the series in cases above the age of 18 years which comprised about half the total number of resections. Recurrence always occurred on the operated side. Recurrent bronchiectasis was nearly always cystic in nature rather than cylinderical, whatever was the cause. The sex distribution was not significant.

Collapse due to airlessness (8 cases) or fibrosis (4 cases) resulting in incomplete postoperative expansion, chronic infection in fully expanded lobe (2 cases), acute necrotising infection (2 cases) and postoperative tuberculous infection of the pleura (3 cases) were thought to be the causes of recurrent postoperative bronchiectasis. The two cases with acute necrotising infection died of acute widespread tuberculosis after further surgery. The three cases of tubercular empyema and the two other cases who developed tuberculosis after further surgery did not show evidence of tuberculosis in the first resection for bronchiectasis.

Prevention lies in selection of cases for operation, in the operation itself and in the postoperative treatment. There should be very strong reasons for operating on children with allergic manifestations or gross deformity of chest wall. The operative technique should be precise and also operation time should not be long and collapse should be treated by vigorous physiotherapy, correct antibiotic treatment and bronchoscopy.

M. L. Aggarwal.

"Bronchospasm In Bronchograpy": Hewlett, T. H, Puglisi, A. J. and Bowers, W. May 1957. The Journal of Thoracic Surgery, Vol. 33, P 609.

Little attention has been directed toward the possibility of bronchospasm occuring during bronchography which suggests that it is rare. The experience at Brooke Army Hospital demonstrated that bronchospasm may account for a bronchogram which is interpreted as showing bronchiectasis. In a group of 79 bronchographies, 7 patients (8·8 per cent) showed bronchospasm and their bronchograms were interpreted as showing bronchiectasis, usually bilateral. The diagnosis was not accepted on clinical grounds and the repeat studies showed normal bronchograms. Three of these seven patients were diagnosed to have asthma and the other four gave histories which were entirely negative for any factor which would suggest the possibility of asthma. Increased sedation and improved topical anaesthesia were used in repeat bronchographies. Allergic response to drugs, inadequate sedation, anaesthesia and irritation of bronchoscopy were felt to be important factors in production of spasm in the nonasthmatic individual. The bronchographic picture attributable to bronchospasm shows—(1) bronchial dilatation of a hydrostatic nature occurs within the primary and portions of the secondary division bronchi, (2) Spasm of the tertiary and distal bronchi produces a horizontal obstruction to the flow of the contrast medium. Consequently the spastic bronchi do not fill, (3) The normal space relations are maintained between the first and second division bronchi indicating the existence of aerated lung parenchyma, (4) Bronchiolar and alveolar filling is only patchy when evident distal to the zone of dilatation and (5) Proximal narrowing of a major bronchus is never visualised.

Characteristics essential to the bronchographic recognition of bronchiectasis are (1) Cylindrical dilatation of marked degree with complete loss of normal tapering tendency, (2) Saccular areas in direct continuity with the dilated bronchus, (3) Crowding of the bronchi resulting from decreased space occupied by pulmonary parenchyma of that individual area, (4) A decreased or absence of bronchiolar and alveolar filling, and (5) proximal bronchial narrowing may or may not be evident.

M. L. Aggarwal.

The Differential Diagnosis In The Examination Of The Biliary Ducts After Cholecystectomy By Rolf Kohler. Acta Radiologica, January 1958, Vol. 49, page 42.

The introduction of intravenous cholegraphy has made possible the examination of the bile passages even after the gall-bladder has been removed. During this examination large number of conditions can cause a shadow lying besides the common bile duct. Amongst these the most important one is that of cystic duct remnant, because this may be one of the important causes of post-cholecystectomy symptoms. Cholegraphy permits study of the stump of cystic duct provided the extrahepatic ducts become filled and passage to the stump is unobstructed. Forty ml Biligrafin 20% are generally injected and skiagrams taken in oblique position with the left side raised about 20°. A rounded or oblong accumulation of the contrast medium present lateral to the common bile duct is produced by cystic duct remnant. At the time of operation the cystic duct is tied as close as possible to the common bile duct but if there is severe inflammatory changes, profuse bleeding or poor visibility, a cystic duct stump is left behind, The shadow of the cystic duct should be carefully scrutinised as it may contain stones in it.

Another shadow that may be found alongside the common bile duct during the cholegraphic or cholangiographic examination is due to duodenal bulb. As the dye enters the duodenum it spreads in both directions upwards and downwards and may outline the bulb. But when the patient is sufficiently rotated the two structures are separated. Barium meal examination and appearance of the mucosal folds may further help.

Other rare possibilities are duodenal diverticula particularly if the diverticulum is situated at the duodenal convexity; diverticulum of the common bile duct; and filling of the remaining portion of incompletely removed double gallbladder.

V. P. Lakhanpal.

Experiments with Cholecystokinin in Cholecystography by Bror Broden. Acta Radiologica January, 1958, Vol. 49, page 25.

Ivy and Goldberg in 1928 discovered a gall-bladder contracting factor named "Cholecystokinin" in extracts from the intestines. Subsequently many authors carried experiments showing the effect produced by injecting this substance in man *e.g.*, Ivy in 1955 showed films demonstrating the action of cholecystokinin.

The method is quite simple. Cholecystokinin 2-3 mg. is dissolved in about 20 cc of physiologic saline solution and injected I/v taking 20-30 seconds or more. During this period the patient is placed in oblique supine posture with the right side down and this position is maintained during the entire investigation. A series of films are obtained until at least 20 minutes after the injection. The contraction of the gall-bladder and contrast filling of the ducts began during the first few minutes after the injection and lasted for a maximum of 20 minutes. This also occurred in cases with gall-bladder concretions. No severe secondary reaction was observed, in some cases there was slight reaction *e.g.*, sensation of heat in the face or facial blush, general sensation of warmth, pain in the gall baldder region. The reaction seems to have occurred when large amount has been injected quickly. No reaction should appear with the dose mentioned and when injected slowly.

V. P. Lakhanpal.

Use of Air as a Contrast Medium in the Diagnosis of Intestinal obstruction of the New-born. By John W. Hope, M.D. and A. Edward O'Hara M.D. Radiology, March 58, Vol. 70, page 349-61.

Obstruction of the upper G. I. tract in new-born infants is an emergency and earlier it is diagnosed better is the prognosis. The authors calculate that indiscriminate use of fluoroscopy and skiagram taking does not lead to any diagnosis, rather it gives far more irradiation than a set method of examination given by them. Unnecessary use of radiopaque material has been

condemned. Air is the most useful contract medium in these cases. Most of these cases have duodenal atresia may be due to annular pancreas and they present with projectile vomiting since birth. In such cases plain film of the abdomen should be taken in supine and erect position. In most of the cases you will find air-fluid filled stomach and duodenum filling upto the site of obstruction. Skiagrams may be taken in lateral and upside down position if necessary. In cases the skiagrams taken in supine and erect position show little or no air it means stomach is full of fluid. In such cases fluid may be aspirated from the stomach with the help of a soft red rubber catheter No. 8 and equal amount of air injected, 50 cc of each. Another set of films should then be taken. Five cases of duodenal atresia have been quoted in the article illustrated with skiagrams. These were diagnosed by this technique. Sixth case again diagnosed by the same technique showed sudden stoppage of air in a dilated loops of jejunum, indicating thereby "atresia of jejunum". The 7th case reported by the authors presented with a slightly different history. Here main feature was distension of the abdomen in spite of having passed two muconeum stools. Vomiting was not a main feature. In such cases where you suspect obstruction lower down, air injection is not necessary. Supine and erect films showed multiple fluid levels with dilated loops of bowel. Because of early age atresia of small gut was suspected and it was confirmed at surgery. However the problem is different where there are multiple big loops of gut and it is difficult to distinguish between the small and large gut. In such cases after seeing the supine and erect skiagrams one may have to resort to barium enema to know the condition of the colon.

Airless abdomen however does not necessarily mean high intentinal obstruction, the authors quote their 9th case as seven days old female child who presented with vomiting and abdominal distension. Supine and erect films revealed airless abdomen. 40 cc of fluid was removed from the stomach and same amount of air injected. No obstruction was found. Child died two days later of staphylococcal septicemia with multiple pulmonary and abdominal abcesses. Air as a contract medium thus serves the dual purposes of demonstrating the site of the obstruction and its absence.

27 skiagrams with discription.

V. P. Lakhanpal.

Relation between Cardiac failure and Gastric ulcer in the older age Group-Michall M. Klein and Engene L. Walsh, 672-83, Radiology, Volume 70, No. 5, May, 1958.

The authors saw in six years time 1187 new cardiac cases in their hospital and out of these 370 (31·2%) cases showed gastro-intestinal symptoms which were subjected to x-ray examination and out of these 115 cases (31%) were positive for gastric ulcer. The ages of patients examined were between 27 and 92 years with an average are of 63 years.

The types of cases exhibiting gastro-intestinal symptoms were tabulated. Out of 193 patients of Hypertensive heart disease, 17·1% had gastro-intestinal symptoms with positive findings of gastric ulcer in 3·6% of cases.

Of 333 patients with arteriosclerosis, 29% complained of gastro-intestinal symptoms with 8·6% with positive findings for gastric ulcer.

In 343 patients of coronary heart disease 37·3% showed gastro-intestinal symptoms with positive radiological finding in 11·7% of cases. Out of 318 cases of cardiac failure, irrespective of basic cardiac lesion, 29·6% had gastro-intestinal symptoms with 12·4% having positive findings.

For comparison, 53 consecutive cardiac failure cases were examined irrespective of basic cardiac lesion and regardless of gastro-intestinal symptoms and 28·3% had gastric ulcer.

The gastric ulcer, in these cases improved following treatment of the cardiac condition, without any specific ulcer treatment.

Discussing the etiologic factors the authors are of the view that as the majority of gastric ulcer appears in persons of fifty years or older, which is the age for arteriosclerosis, therefore it was safe to say that arteriosclerosis was an important etiologic factor. Moreover, in such cases of cardiac failure gastric haemorrhage is not un-common and in chronic failure gastric ulcers may develop but no bleeding or ulcer was found in cardiac failure resulting from rheumatoid or valvular heart disease.

Y. P. Bhandari.

John W. Hope and Harry R. Cramer. The Significance of Post-operative Pneumo-peritoneum in Infants and Children. Radiology, Dec. 1958, 71 : 797-805.

Post-operative Pneumo-peritoneum is a normal finding in adults and persists for 7-14 days after laporotomy. There is no record in the literature about these findings in the infants and children. Three cases of infants were seen during 1952-1954 which showed free air under the domes after laporotomy. Taking adult standards into consideration, these infants were watched, but subsequent further distension of abdomen necessitated second laporotomy and it was found that they all had a continuing leak from the bowel. In order to evaluate the problem of post-operative Pneumoperitoneum in infants and children, 19 cases were examined 30 minutes after a complicated and lengthy operative procedure. Only 3 out of these had any air in the peritoneal cavity and in none of these 3, any air was visualised after 24 hours.

In order to test the adequacy of Radiological methods of investigation, some air was introduced experimentally into the peritoneal cavity following surgery in some infants and children and it was found that as little as 10 cc of air can be demonstrated in erect or left horizontal decubitus films.

In conclusion, the authors feel, that any appreciable quantity of air in the peritoneal cavity twentyfour hours after operation in infants and children, should arouse suspicion of a continuing leak and a second laporotomy is probably indicated.

13 Radiographs.

2 Tables.

S. Grover, Delhi

Edward A. Ten Eyck. Fixed Defects in The Gall Bladder Wall. Radiology Dec. 58. 71 : 840-846.

Single or multiple fixed filling defects are seen sometimes in the G. B. wall after oral cholecystograms. A short review of the literature is presented. The term papilloma is reserved for true neoplastic lesions of the Gall-bladder wall and not applied to cholestrol polyps and inflammatory hyperplasias.

From 1952-1957, 2544 cholecystectomies were done, many had pre-operative cholecystograms done and 22 of these showed one

or more fixed filling defects. 18 out of these had cholestrol polyps but total patients of cholestrolosis were 121 in this series. So only 15% were demonstrated cholecystographically. Polyps are seen only, if not less than 3 mm. size. Other causes of fixed filling defects are true papillomas but only 1 case was diagnosed pre-operativaly as mostly they get masked by associated calculi. Inflammatory polyps can also give this picture. One case was diagnosed on x-rays. Rare causes of fixed filling defects are large, thick-walled asteriosclerotic vessel, varices with associated mucosal cyst and gall-stones fixed to the Gall-bladder wall. These cases had a preponderance of women over men as 8 : 1. Radiological examination was done in all these cases with oral Telepaque and a post-fatty meal and an upright film, fluoroscopy and spot films in upright position were taken in all. Tbe following diagnostic points are considered when attempting to identify polypoid lesions.

1. Good concentration within the Gall-bladder.
2. Smooth, round or oval defect.
3. There is no Calcium.
4. No change in postion on repeated examinations.
5. When there are two or more filling defects, their relation remains constant on repeated examinations.
6. Size is less than 0·5 cm. and rarely greater than 1·0 cm.
7. In upright position, no movement of the defect.
8. Tangential view shows the attachment of lesion to Gall-bladder wall.

7 Radiographs.

8 Sections.

S. Grover, Delhi.

Willard J. Howland Jr. and C. Allen Good. The Radiographic Feature of Tracheopathia Osteoplastica. Radiology, Dec. 1958. 71 : 847-50.

Tracheopathia Osteoplastica is a rare, benign, tumorous condition of trachea and major bronchi. Multiple osteo. cartilaginous tumors are formed in the tracheal wall and project into it, causing variable obstruction. It is a benign process but could be precancerous.

A case is reported in detail with its x-ray findings in plain chest and tomograms of trachea. 4 other cases are presented who had tomographic and bronchoscopic proof of diagnosis. Gilbert and co-workers found in the literature total of 546 cases of primary tracheal tumours upto 1955. Out of the 503 lesions in adults, 50% were benign consisting of chondromas, osteomas and tracheopathica.

On tomograms, Tracheopathica osteoplastica presents a characteristic picture of multiple, flat, nodular tumors involving the lateral and anterior walls of the trachea. These involve a long segment of trachea and main bronchii and may show calcification. Ossification is not visible on x-rays.

The condition is differentiated from defects caused by external pressure, calcified paratracheal nodes, carcinoma and fibromas of the trachea by tomograms.

6 Radiographs.

**S. Grover, Delhi.*

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Advances in Chemotherapy of Malignant Diseases Edith Paterson :—The Practitioner Oct. 1957-1072-179. Pages 473-480.

Chemotherapy in certain forms of Malignant Disease has a real place especially in disease of Lymphoreticulum. There has been a steady multiplication of chemical compounds designed for the chemotherapy of cancer. Their mechanism of action is still hypothetical. In a patient in whom palliation is the best that radiotherapy can offer, this may still be the treatment of choice. The compounds which are effective against cancer are potentially dangerous and great care and experience are needed in using these agents.

The author classifies these compounds into three classes.

Alkylating Agents :—A highly selective list of the compounds used in United Kingdom are, *bis* form of Nitrogen mustard (Mustine), Tretamine, 'TEM', 'Thiotepa', chlorambucil, 'Leukeran', Busulphan, 'Myleran', 'Melphalan'. They are mainly used in chronic Leukaemia and in certain solid tumours of Reticuloendothelium. Mitotic division is inhibited and chromosome aberrations and genemutations occur. Real differences exist in the suitable mode of administration of these compounds and this determines the choice in certain diseases. Slight selectivity has been demonstrated with some compounds. Stress is made on the careful adjustment of dosage.

The Antimetabolites :—The major field of use of these compounds are in the management of Acute Leukaemia. The limitations to treatment are two-fold. Due to a fairly high turnover of nucleic acid in alimentary epithelium and bone marrow, toxic effects on such tissues occur. Resistance to these compounds develops in neoplastic cells.

Miscellaneous Substances :—They are mainly of vegetable origin. Demecolcin ('Colcemid') by its inhibiting action on the cells of myeloid series may be successfully used in Chronic Myeloid Leukaemia. A few cases of Hodgkins disease have been found to respond well Actinomycine C.

The effect of treatment by the combination of chemotherapy with irradiation is still *sub judice*. Corticosteroids in combination with antimetabolites initiate a good chemical response.

In late cases of Hodgkins disease where the Alkylating agents are contraindicated due to leukopenia, the corticosteroid treatment has a real place. Following the administration there is a genuine improvement in the well being.

Acute Leukaemias.—In patients under age 21, mercapto purine, an antimetabolite, 2·5 mg/kg. daily by mouth gives good response. The dosage may be combined in the initial stage with prednisone. The treatment should be maintained continuously. If resistance to the drug is shown, change to one of the antifolics. Toxic effects to the drugs should be carefully watched. Treatment in older patients are usually not satisfactory. The value of Blood Transfusion preferably of platelet rich blood has its own place.

Chronic Leukaemias.—Myeloid Leukaemia can be treated with busulphan or demecolcine. They seem to have a specific action on the Myeloid cells. A maintenance, dose after the cell count is reduced to a reasonably normal level, is advised. For Lymphoid form tretamine, chlorambucil and mustine are indicated. Chlorambucil has certain advantages.

Polycythaemia Vera.—Pyrimethamine controls the disease. Leucopenia or thrombocytopenia occuring during treatment are only transient.

Solid Reticulosis.—Radiotherapy is the treatment of choice especially in localised cases. In Hodgkins mustine and tretamine are found to be satisfactory. Follicular lymphoma and generalised lymphosarcoma do not respond well to chemotherapy. Chlorambucil and tretamine are effective on occasions.

Malignant Epithelial Tumours.—ovarian cancer and Seminoma testes–The compounds most favoured at peresent are 'melphalan' and 'thiotepa'. Melphalan is used in doses of 25 mg. daily for three or four days. Dosage of 'thiotepa' is 1·8 mg/kg for two or three days.

Malignant Effusions.—'Mustine' after removal of fluid by paracentesis, dose of 0·4 mg/kg dissolved in water to a concentration of 1 mg per cc., injected into the pleura has been found successful.

Dr. S. V. Krishnan,
Nungambakkam, Madras.

The Radiological diagnosis of papillomatous cholesterosis of the gallbladder. Samuel Eric, and Komins Cecil. Br. Jour. Radiol. July 1957, Vol. 30, Page 356.

The diagnosis of cholesterosis is seldom made radiologically, its incidence varies from 8·8 per cent to 38·5 per cent. The association of infection and of gallstones with it is said to be high, but the features are those of the associated complications rather than the specific radiological signs of cholesterosis.

According to Feldman and Feldman, cholesterosis of the gallbladder occurs as one of 2 types (*a*) diffuse (*b*) localised. The diffuse form has given rise to the apt name of Strawberry gallbladder. In the localised form, the lipoid deposits occur around the base and neck of the gallbladder.

The diffuse form of cholesterosis shows no diagnostic radiological features, showing normal concentration and normal emptying.

The localised or papillomatous cholesterosis shows normal concentration, shows filling defects, shows normal emptying. The filling defects may be single or multiple, varying in size from a pinhead to that of a pea, and are fixed to the gallbladder and do not vary in position in the gallbladder. It is possible that localised areas of calcification in the gallbladder represent calcification in cholesterol plaques.

The differential diagnosis from gallstones, which can be shown to gravitate to the most dependent portion of the gallbladder whereas the filling defects do not vary their position in gallbladder. The radiological appearances are identical with those of papilloma and adenoma, and differentiation may be only possible by histological examination with the use of special fat stains to demonstrate cholesterol deposits.

Six illustrative cases are recorded.

12 radiographs. 2 photographs. 1 microphotograph.

S. N. Deboo.

Ochronosis. Thompson, M. M. Jr. Am. Jour. Roentgenol. July 1957, Vol. 78, Page 46.

It is a severe generalized arthritis, with discoloration of cartilages within the body, pigmentation of eyes, the skin over the bony prominences and the intima of large blood vessels, by deposition of ocher coloured granules. The authour presents one case. There is a fairly high incidence of cardiovascular disease associated with it related to the metabloic anomaly.

In the spine, there was osteoporosis and accentuation of the normal kyphosis of the dorsal spine, with ankylosis of the articular facets, the space between the vertebral bodies of dorsal and lumbar spine was narrowed and there was calcification of intervertebral discs, most pronounced in the lumbar vertebrae.

In the pelvis, advanced osteoarthritic changes were present in both hip joints, with almost complete obliteration of the joint spaces and marked sclerosis of the femoral heads and the acetabula. The symphysis pubis was fused, also the sacroiliac joints were fused, and there were flocculent calcifications inferior and lateral to each ischial tuberosity. The costal cartilages were markedly calcified.

The knees showed very extensive osteoarthritic changes with osteocartilagenous bodies posterior to the knee joint on the left side. The hands showed narrowing of joint spaces of the phalanges and the metacarpals and there were many small cystic areas in the proximal phalanges adjacent to the proximal articular surfaces. There was extensive calcification of the cartilages of both ears.

11 radiographs.

S. N. Deboo.

The Radiologic aspects of operable heart disease. IV. The variable appearances of constrictive pericarditis. Heinz Randall., Abrams Herbert L. Radiology, July 1957, Vol. 69, Page 54.

21 cases, all proved at surgery and all studied intensively both clinically and radiologically, were analyzed.

In 5 cases, tuberculosis was the cause. In 14 cases, there was no history of tuberculosis. chest injury or acute pericarditis. The early symptoms were ascites, dysponea, ankle oedema and orthopnoea. A paradoxical pulse was noted in 7 cases, and in 11 case, the heart sounds were diminished. Liver was enlarged in every instance.

Analysis of the radiological findings in constrictive pericarditis demonstrated that there is no characteristic roentgen picture, and a significant number of cases did not appear to have a small heart, so that in spite of frequent descriptions of a small heart, the cardiac silhouette may appear enlarged in many cases, and normal pulsation may be noted fluoroscopically and kymographically. Pericardial calcification was demonstrated in half the cases reported, the commonest sites were the anterior, diaphragmatic, posterior, right and left atrial surfaces. Its presence is certainly helpful, when constrictive pericarditis is suspected. Commonly the right ventricle pulmonary artery segment, and the hilar pulmonary arteries are enlarged, and pulmonary engorgement is apparent.

Despite the weight of opinion and evidence against rheumatic fever as an etiologic factor in constrictive pericarditis the question is by no means closed. Two patients had well documented histories of rheumatic fever and had rheumatic valvular disease.

12 radiographs. 2 kymograms.

S. N. Deboo.

Cystic angiomatosis of bones. Gramiak Raymond, Ruiz Gilberto and Campeti Frank L. Radiology, September 1957, Vol. 69, Page 349.

The authors present one case of a rare form of generalized hemangiomatosis, producing cystic changes in the skull, pelvis, ribs and femora. In 4 of the 5 cases including one of their own, the humerus, tibia and scapula contained lesions. Other organs may also be involved, the spleen is the most frequent site.

The diagnosis is difficult to be established clinically, even though the bone changes may be evident. The bone is weakened and pathological fractures may occur. Blood chemical studies are normal. The diagnosis is established by biopsy, excision of a costal lesion is the procedure of choice.

Two varieties of benign angioma are generally recognised; capillary and cavernous. Hemangiomas occuring in bones are almost exclusively cavernous; the capillary type is rare.

Most frequently recognised are the hemangiomata of spine, showing increased vertical striation of the vertebral body. In hemangioma of the skull, a well circumscribed area of rarefaction, with a peculiar honeycomb appearance is usually seen. In flat bones such as the scapula or pelvis, a sunburst appearance of bony trabeculae extends from the bone into the soft tissues. When cylindrical bones are involved, small loculations containing a fine fibrillary network are seen. The lesions are identical regardless of the bone involved, and the cystic spaces show no evidence of trabeculation. Each is ringed by a sharply demarcated rim of sclerotic bone, with no evidence of reactive bone formation or periosteal lifting. The epiphyseal cartilage is not affected. Fractures through the cysts may produce bony deformity.

As surgery may be dangerous because of hemorrhage, deep x-ray therapy is the treatment of choice for the deep seated hemangiomas of bones. Depth doses of approximately 3000r delivered in from 3 to 19 weeks have been used successfully. Curettage has been employed for accessible solitary lesions.

6 radiographs. I table. I microphotograph.

S. N. Deboo.

The value of irradiation in ankylosing spondylitis. Howard N. Br. Jour Radiolo. July 1957, Page 371.

The author presents results of Radiotherapy on 455 cases, of ankylosing spondylitis, seen in the Radiotherapy department of University College Hospital Between 1940 and 1953, followed up more than 2 years.

The cases were staged into 4 stages, according to the x-ray findings.

Localised x-ray therapy was employed and the technique of treatment was roughly the same in all cases; 220 kV, 2·3 mm Cu H.V.L., 50 cms. F.S.D., one field to cover both sacroiliac joints, 16×12 cms. or 10 by 15 cms. and 3 spinal fields 6×15 cms. or 6 × 20 cms. according to the length of the spine. 2 fields were treated daily to 150 or 200r skin dose, 5 days a week for 3 or 4 weeks, giving a total skin dose of not more than 1500r to the whole spine.

The effects of irradiation on blood, ovaries and gonads was noted. The effects were studied in 100 cases chosen at random, of these only 18 per cent had white cell counts (below 4000/- cu. mm.) during or immediately after treatment. A certain proportion of the does will reach the ovaries, and may case a temporary or permanent irregularity of the periods or amenorrhoea, therefore irradiation should only be undertaken when other methods of treatment have failed, provided that the patient and her husband if married should be fully aware of the possible sequelae. The total dose received by male gonads, when they are are protected by a lead shield is in the region of 5r, which is unlikely to affect either libido or fertility. The genetic effects of irradiation on the gonads is of great importance, and their irradiation is to be avoided as far as possible.

The overall beneficial effect is in the region of 70 per cent, in cases followed for atleast 2 years. The incidence of leukaemia is perhaps ten times that of the general population, and in this series of cases, the risk of leukaemia was 1 in 225. It is considered that this treatment is still justified in typical cases of ankylosing spondylitis in spite of the increased incidence of leukaemia after irradiation of the whole spine.

5 tables. One figure.

S. N. Deboo.

Protection by diethyldioxystilbenedipropionate against leucopenia due to roentgen therapy. Bellesia L., Lusvarghi E., Pasquinelli C. and Dardari M. Jour. Fac. Radiolog. April 1957, Vol. 8, Page 239.

Leucopenia resulting from roentgen therapy often necessitates the interruption of a course of treatment before the desired dose has been reached, so that work on the protection of the leucopoietic function from the effects of the radiation is important.

Storti and his colleagues showed that many physical and chemical agents produce a leucopenia both by depressing leucopoiesis and by reducing the life of the leucocytes. They have also shown that a healthy woman in the ninth month of pregnancy shows a remarkable increase of "leucocyte resistance" which constantly precedes the antepartum leucocytosis. This suggested the idea of using the synthetic oestrogen for the purpose of preventing and treating the leucopenia caused by the more common antiblastics. This idea led the authors to investigate its effect during roentgen therapy.

They carried out trials in patients with lymphogranulomatosis, lymphosarcoma and malignant epithelial new growths. They present a series of ten cases, using the oestrogen every time there was a fall in the leucocytic count during roentgen therapy or at the beginning of therapy when the leucocytic count was very low as to stop the therapy.

From these clinical experiences, it appears that the oestrogen can prevent radiation leucopenia, besides it association with roentgen therapy has permitted the use of higher doses with satisfactory results, in cases of treatment in which the leucopenia would otherwise have compelled the premature interruption of treatment. The mechanism of protection against leucopenia by the drug is still uncertain.

16 diagrams and graphs.

S. N. Deboo.

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