FIFTY YEARS OF RADIOLOGY

BY

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When one attempts to survey the achievement of diagnostic and therapeutic radiology in the past half-century it is appropriate to project the story five years back into the nineteenth century, and to consider that late afternoon, so heavy with importance for mankind, of Friday, November 8, 1895. The time of discovery was ripe, for already it was known that cathode rays could excite a fluorescent screen and blacken a photographic plate. Any one of half a dozen physicists might have made the discovery of x rays, for all must have been on the verge of it. Indeed, Crookes returned to the makers some photographic plates because they were fogged; fogged, had he but known, by x rays emitted during his cathode-ray experiments. If only he had stopped to ask why! And so the questing spirit and the fortune of blind chance together placed the name of Wilhelm Konrad Röntgen on the roll of the immortals of science. Chance decreed that there lay on a near-by bench a platinocyanide screen, and that dusk had fallen during Röntgen's experiments on the cathode rays—dusk that made visible the tell-tale gleam from the screen on the bench in a position beyond the reach of the cathode rays themselves. But the lucky concurrence of circumstance was unavailing without the inquiring mind. Crookes, absorbed in another research, failed to ask why. Röntgen did ask, and humanity was in his debt thereafter.

Röntgen made his classic observation on November 8, and his first paper, "Über eine neue Art von Strahlen," appeared only seven weeks later, on December 28. It seems that he realized the urgency in staking his claim to the discovery; that he knew many of his colleagues must be hard upon his heels. And in those seven weeks he had elucidated in a remarkable way the properties of x rays; their capacity to penetrate substances opaque to light, to affect a photographic plate and a fluorescent screen; that they could not be reflected by a prism or a magnetic field or focused by a lens; and that the opacity of substances to them depended on the density (or atomic weight) of the substance. Thus from that small Ruhmkorff coil and that primitive Hittorf-Crookes tube, in the hands of a great man, has come an entirely new specialty—a method of investigation now so important that one out of every two patients attending hospitals is subjected to it.

Apparatus

The advances in diagnostic radiology in the past half-century would not have been possible without revolutionary improvements in the apparatus used for producing x rays. The early workers were immensely handicapped by the primitive feeble machines of the turn of the century. Exposures of 5 to 30 minutes were often necessary to produce any photographic effect on the x -ray plate, and x -ray burns of the skin nearest the tube were not uncommon, and gave the first warning of the potent dangers of x rays. There are certain landmarks in the development of x -ray apparatus since 1895. The Wimshurst static machine, with its huge glass case filling up half a room, and its feeble output of 1 mA, rapidly became the first x -ray museum piece, and favour returned to the induction coil. Already

in 1896, 12-in. (30-cm.) coils were available, and for the next twenty years coils up to 32 in. (80 cm.) were in common use in this country. In 1907 the American "Snook" interrupterless transformer made available a high-voltage current of 50 mA and switched the problem to that of the x -ray tube. The gas tubes then in use were rapidly ruined by a current of that magnitude, and the next great advance came when Coolidge in 1913 introduced his hot cathode tube. With this tube relatively high-speed radiography of the chest was possible. Still heavier loading was possible when Bauwers introduced the line-focus tube; and when in 1929 he introduced the spinning target the pattern was set for the modern rotating anode tube with its great output. Ray-proof and shock-proof tubes were soon to follow, and now the modern unit is an instrument of precision, with an output up to 500 mA and a time-switch accurate down to 0.02 second.

It was not until 1920, when Seitz and Wintz, of Erlangen, introduced 200 kV deep therapy in place of the previous 100 kV, that specialized radiotherapy apparatus was developed. Before then radiotherapy was given with diagnostic apparatus, and the Erlangen technique marked the beginning of a new specialty—radiotherapy. The first deep-therapy apparatus gave an output of 2–5 mA at 200 kV. Now the milliamperage may go up to 30 and the voltage to two millions. And beyond that are the betatron, the synchrotron, the linear accelerator, and doubtless further machines with even more astronomical voltages attached to them.

Clinical Radiodiagnosis

The First Five Years

The clinical applications of the new rays followed very quickly on their discovery. The first x -ray picture taken for clinical purposes is generally accredited to Campbell Swinton, F.R.S., the date being January 7, 1896. He was a distinguished British electrical engineer who devoted much of his life to scientific research and in 1911 became President of the Röntgen Society (now the British Institute of Radiology), the oldest radiological society in the world. Professor Pupin in the same month took the first radiograph in the United States in a case of multiple gunshot wounds of the hand. The exposure was *one hour*. To reduce this time Pupin tried the effect of interposing a fluorescent screen—the first application of the use of intensifying screens in radiography.

One of the earliest radiographs taken in this country is that shown on page 7 of the special illustrated supplement to this issue. This is the first x -ray picture taken of a patient of University College Hospital, by J. Norman Collie, Professor of Organic Chemistry at University College, London. Collie is reputed to have said, "If anyone happens to write an obituary of me, I want two things said: I first discovered neon, and I took the first x -rays." Collie was a great Alpine climber, and this statement did appear in his obituary notice in the *Alpine Journal*. The exact date of this picture is not recorded, and so evidence is wanting that it antedates that of Campbell Swinton.

Understandably, the first use of x rays was in the detection of opaque foreign bodies. This was quickly followed by localization of foreign bodies. In 1896 Sir James Mackenzie Davidson introduced stereoscopy in localization, and a year later his famous cross-thread method of localization. And in 1898 Sweet introduced his method of localizing metallic fragments in the eye, which has stood the test of years and is still used to-day. Hard upon this came the radiological demonstration of fractures, followed during

the next ten years by the use of *x* rays in the investigation of tuberculous and other forms of arthritis, of constitutional diseases of bone, and of bony tumours.

The relative ease with which the early primitive apparatus revealed opaque foreign bodies soon led to the successful detection of urinary calculi. John Macintyre, an aural surgeon of Glasgow and an early and enthusiastic *x*-ray worker, was, in 1896, the first to show a renal stone in a radiograph. His classic experiments a year later on *x*-ray cinematography of the frog's leg are quoted by all who write on that subject, notably by Russell Reynolds, who later did so much to advance this subject. In spite of the observations of F. H. Williams on the *x*-ray investigation of thoracic disease in 1897, and the historic experiments of Cannon with bismuth in the alimentary canal in 1898, radiology at the beginning of the century meant in the main foreign bodies, fractures, and urinary stones. An interesting picture of the state of radiology at this time is given in an article by Sir James Mackenzie Davidson. Mackenzie Davidson was one of the great figures in early British radiology. Born of Scottish parents in Buenos Aires, he received his medical education in Edinburgh, Aberdeen, and London. He was in turn assistant to the Professor of Surgery at Aberdeen University, and then Lecturer in Ophthalmology in the same University. He came to London in 1897 as surgeon to the Röntgen Ray Department at Moorfields. This stimulated his interest in localization of foreign bodies, especially in the eye. Shortly afterwards he became radiologist to the *X*-ray Department at Charing Cross Hospital, an appointment he held till his death in 1919.

In the third edition of Quain's *Dictionary of Medicine*, a volume of 1,892 pages published in 1902, there is a section by Mackenzie Davidson entitled "Röntgen or *X* Rays." This short account, of three pages only, can be regarded as the summation of knowledge on the subject at that time. After describing the properties of *x* rays, he states that "the great practical importance of these rays is their utility in medicine and surgery. So far they seem to serve no useful purpose in any other domain."

The picture of diagnostic radiology that he gives us is one in which fractures and urinary calculi are demonstrable, foreign bodies accurately localized, and stereoscopic pictures a commonplace. For the latter he recommends a cassette tunnel covered with "parchment such as is used in the best drums." For renal stones the exposures had to be so long that he devised an automatic cut-out which, placed on the patient's chest, switched on the current in full inspiration and switched off when the patient let go. The patient held his breath for 20–30 seconds at a time, and the method avoided respiratory movement of the kidney during the 1–2-minute exposures. Other uses were, however, beginning to appear. Mackenzie Davidson had already made and used intra-oral dental films. Of aneurysms of the aorta he noted that they produced "mediastinal projections which pulsate." He remarked that tumours of the lung produced a darker shadow than lung or pleural fluid, and he recorded the movements of the diaphragm.

But the abdomen was still a silent area. This is all he says about it: "The abdomen is very difficult to examine by *x* rays. With the exception of gaseous distension of the stomach, renal calculi, and foreign bodies, which can be detected, little information can be obtained." This was to remain true for many years after it was written.

In this article are noted the beginnings of radiotherapy. Already lupus had been treated successfully—the dread late sequelae were then unknown—and rodent ulcer had been

cured. Epilation of superfluous hair had been effected, again without knowledge of the inevitable sequelae. At this early stage, however, something was known of the dangers of *x* rays, and *x*-ray burns and ulcers were on record. Indeed, many workers had become severely affected by the end of 1896, and one of Edison's assistants, Clarence Dally, was the first of a long list of *x*-ray martyrs, dying of cancer secondary to severe *x*-ray dermatitis.

1900–10 Decade

This period was mainly concerned with refinements in existing *x*-ray techniques, extensions in chest radiography, and the beginnings of the radiology of the gastro-intestinal tract. An excellent picture of the achievements of radiology in the middle of this decade is given in a special number of the *Practitioner* published in 1906, and entitled "X-rays in Diagnosis." Of the eleven articles, five were written by men who were later to become famous in British radiology—namely, W. Ironside Bruce, R. Higham Cooper, Sir Archibald Douglas Reid, Edward W. H. Shenton, and John Hall-Edwards. It is of interest that in this volume, purporting to cover the field of *x*-ray diagnosis in 1906, there are articles on bones and joints, two on localization of foreign bodies, one on the lungs, and one on the urinary tract; but none on the gastro-intestinal tract. Peristalsis and the long exposures then necessary combined to prevent satisfactory *x*-ray examination of the stomach or intestines. But this was soon to follow.

In the article on the *x*-ray diagnosis of lung disease David Lawson, senior physician to Banchory Sanatorium, indicates how much was known of chest radiology as early as 1905. The fluoroscopic appearances of hydropneumothorax were already known, including the tilting of the fluid level and rippling thereof on movement. Tuberculous cavities were clearly recognizable, as were pleural effusions. Quite a point is made in that article of the fact that the diaphragm moves up and down on respiration. Hugh Walsham, of the London Hospital, was the first to note this and disprove the previous teaching by physiologists that the diaphragmatic movements were those of lateral contraction and expansion towards the central tendon.

Hard upon this time came the turn of the alimentary tract. Rieder had already in 1904 published his comprehensive monograph in the *Fortschritte*, "Beitrage zur Topographie des Magendarmkanales," and soon after there came the observations of Pancoast, of Holzknicht, and of Pfahler. A. E. Barclay in Manchester, Gregory Cole in the U.S.A., and Haudek in Germany were prominent in founding the new branch of gastro-intestinal radiology. Haudek was the first to describe the niche of gastric ulcer, the barium-filled ulcer crater; while Cole preached the importance of the direct sign in duodenal ulcer.

The Second Decade

In the years immediately before the first world war *x*-ray departments were still primitive and the volume of work in them small. I clerked in a medical ward in the Western Infirmary, Glasgow, in 1913, and in the two wards of the unit did not see a single stomach *x*-rayed in six months. This is noteworthy, since this unit specialized in gastro-enterology; and the detection of peptic ulcer and gastric carcinoma depended on the anamnesis, the stomach-tube (a good stout one, half an inch (1.25 cm.) thick), and the guaiac test for occult blood. In those days the diagnosis depended not on the filling defect or the niche but on sarcinae, the Boas-Oppler bacillus, and Uffelmann's test for lactic acid—all from the

gastric washings. A house-surgeon two years later proved little more fruitful: a few Colles's and Pott's fractures demonstrated in an x-ray plate and one renal stone. During that resident post I assisted at the amputation of a leg for tuberculosis of the ankle in a 12-year-old boy; but no x-ray picture was taken before the limb was lopped off, nor dared anyone (save the wretched child) question the surgeon's decision that off it must come. But in truth, save for fractures of the limbs, x-ray pictures in those days were too often of little help. Frequently have x-ray departments been accused of producing pictures of a November fog. In 1913 such effects were the rule rather than the exception.

Then came the 1914-18 war, and the whole x-ray bias turned to foreign bodies, compound fractures, and gas gangrene. Surgeons demanded that shrapnel should be accurately localized even after the wound had healed, and radiologists responded *en masse* with a host of methods of localization—nearly all variants of the simple triangulation method. There are said to be several hundreds of them. An interesting hangover from this 1914 passion for localization projected itself into the second world war, when the Emergency Medical Service equipped all its hospitals with an admirable x-ray device for localizing foreign bodies, which, so far as I can gather, hardly anyone ever used.

The Third Decade

The first world war ended, and peace again came to the radiologists. Peace, for little then was expected of them. Seniors who, like myself, are immersed in the turmoil that is the modern x-ray department will remember the gentle tempo of the departments of old. To others may I present a picture of my first experience of radiology, as a postgraduate student at Charing Cross Hospital under Dr. Ironside Bruce.

The department was a modern one of its day, for its director was an intelligent, forceful Scot who at that time was one of the foremost figures in a rapidly developing specialty. Alas, in three years he was to die of an agranulocytosis, and radiology of the 'twenties to lose one of its most able exponents. His department was up to date in that it was on the top floor of the hospital instead of the more usual basement—one large room and a cupboard that served as a dark room. The staff consisted of Dr. Bruce, a radiographer (both of whom attended on three afternoons a week), and a sister-in-charge. On an average, ten cases were x-rayed on each of these three afternoons, consisting of fractures, chests, and urinary tracts, with an occasional barium meal. The x-ray diagnosis of chronic appendicitis (whatever that may be) was just coming into vogue, and I noted the guarded phrase "consistent with a chronic appendicular lesion" creeping into the reports. X-ray plates were still in use, the largest size being 12 in. by 10 in. (30 by 25 cm.), and the intensifying screen was still something of a novelty. With it the exposure for a barium meal had been brought down to about a second. The equipment consisted of a 16-in. (40-cm.) coil, gas tubes, a canvas-topped couch, and a primitive screening stand without a screen carriage. The screen was held in the observer's hand against the patient's chest or abdomen.

The double-coated x-ray film, which was in a few years to supplant the glass plate entirely, became available in 1918, and with its introduction two intensifying screens could be used. This greatly reduced exposure times and improved radiographic contrast. In the early 'twenties the Potter-Bucky diaphragm, first devised in 1916, came into general use, with still greater improvement in contrast.

Contrast Media

The decade beginning in 1920 found radiology possessed of only three contrast media—air, barium (bismuth was even then on the way out), and the simple halogen compounds: air in the lungs, barium sulphate in the alimentary canal, and sodium iodide in ascending urography. These left many silent areas, including the gall-bladder, the bronchi, and the central nervous system. In 1924 Graham and his colleagues successfully explored the first of these territories, and, although the blue dye iodophthalein which they used has now been discarded in favour of the less irritating pheniodol, the physiological mechanism involved in the test remains the same as in the original cholecystography. Even the term "dye" has been extended to pheniodol, and has splashed over into the urinary tract to include the next two contrast media to be considered. In 1929 Von Lichtenberg and Swick published their paper on uroselectan and laid the foundations of modern intravenous urography. Iodoxyl and diodone are now both in the *British Pharmacopoeia*, and the latter bids fair to become the universal contrast medium, since it is harmless to nearly all tissues. Sicard and Forestier introduced lipiodol in 1922, and before many years were past this iodized oil came into extensive use as a contrast medium, in the bronchi, the uterus and tubes, in fistulae and sinuses, and in the spinal canal.

Central Nervous System

The first real attack on the problems of neuro-radiology was made by Dandy, who in 1918 undertook the first deliberate ventriculography. A year later he devised encephalography by introducing air via a lumbar puncture. Air as a contrast medium in the skull was to remain supreme for many years, and, although Egaz Moniz introduced cerebral angiography in 1927, it was not till the present decade that it largely replaced the earlier methods in the investigation of intracranial lesions. It is a pleasant thought that the work in many fields of this distinguished Portuguese professor of medicine has been so fittingly recognized by the award of a Nobel Prize. Moniz used thorotrast. The dangers inherent in its radioactivity are real, and in preference to it diodone is now used exclusively in arteriography in any part of the body. One of its latest uses is in abdominal arteriography. A second or two after its injection into the abdominal aorta pictures may be taken of the opaque blood vessels of the kidneys, suprarenals, spleen, and pelvic viscera. By this method a tumour of the kidney may be revealed by disturbance of the normal vascular pattern.

The Fourth and Fifth Decades

In the fourth decade, as the years swept on to the second world war, diagnostic radiology steadily expanded, new techniques were evolved, and old ones were refined. A measure of this is in the volume of work done in x-ray departments, which has since 1920 doubled on an average every five years. A halt was naturally called by the second world war, but at its end the march was again resumed, and the last five years have seen an even greater increase.

In the last decade of this half-century progress in radiological research was at first interrupted by the war, and the preoccupations were those of an army and civilian emergency medical service. With the end of the war there appeared new fields of investigation: cerebral angiography, angiocardiology, diodone arthrography, and radiological studies of the small intestine, all too recently in the minds of readers to require further comment.

Radiotherapy

It is not within my competence, a diagnostician, to discuss in detail the achievements of radiotherapy during the past half-century, massive as they have been. The earliest attempts at radiotherapy were made without any knowledge of the properties of the rays. They were ventures unpiloted by any knowledge of what might come of them. Among those who experimented, thus were E. H. Grubbe, of Chicago, who treated a cancer of the breast in January, 1896, Voigt, of Germany, a cancer of the nasopharynx about the same time, and Despeignes, in France, a cancer of the stomach in the same year. Priorities in such hazardous experiments are of little consequence, and the first serious thoughts of radiotherapy were prompted by the skin reactions which all too soon began to show themselves on the hands of x-ray workers. In the year 1896 Bowles and Crocker, in Great Britain, and Feichenfeld, in Germany, expressed the view that the skin reactions were due to x rays and not to cathode rays, ultra-violet rays, electro-magnetic fields, heat, or other agent. Crocker, in the *British Medical Journal* of January 8, 1897 (p. 8), published a case, with coloured illustrations, of a severe dermatitis from exposure to x rays. Very soon a wealth of clinical and histological information was available about the acute and chronic stages of x-ray dermatitis, including epilation.

Radiotherapy in Dermatology

It was inevitable that with this knowledge workers would soon try to use x rays therapeutically, and it seems that the credit for the first logical experiment, based on knowledge of the biological action of the rays, should go to Leopold Freund, of Vienna. He treated an extensive and disfiguring hairy naevus in a little girl, with the object of removing the hair. The exposures totalled to 42 hours, and epilation began in seven days, followed in due course by extensive ulceration, which required several excisions. Five years later there was still an ulcer present. Soon after this there came a spate of reports on radiotherapy of skin lesions, benign and malignant, and the first dramatic successes in the radiotherapy of malignant disease were in skin cancers.

Many of the pioneers of radiotherapy were dermatologists. Among them there stand out such names as Colcott Fox, Morris, Dore, Sequeira, Adamson, and Macleod in this country, Sabouraud, Noiré, Wickham, and Degrais, in France, and, in America, Pusey and, later, MacKee. MacKee points out that the first wave of optimism in skin radiotherapy was succeeded by one of pessimism, prompted by the increasing numbers of x-ray burns resulting from treatment and by the lack of any means of measuring dosage. Sabouraud and Noiré restored the balance when they introduced the pastille and so established a unit of dosage in superficial x-ray therapy.

At the beginning of the century ringworm and favus of the scalp were common diseases and their cure was difficult. X-ray epilation, if complete, was soon found to be effective as a cure. Schiff and Freund, Kienböck, Sabouraud, and others reported some successes and many failures. Then Kienböck published his five-area technique in 1907, and this, as modified by Adamson two years later, is the basis of x-ray epilation of the scalp to this day. The Sabouraud pastille, although a valuable rough measure of dosage, had too great a variation to be really satisfactory, and MacKee introduced his "electrical constants" technique of dosage, made possible by the use of modern transformers and hot cathode tubes. This is the method still used in skin radio-

therapy, with the added safeguard of periodic calibration of the apparatus by the ionization dosimeter.

Radium Therapy

This may be said to have started with the famous Becquerel burn. This great French scientist, the discoverer of the radioactivity of uranium, sustained a burn on the skin of his abdomen by carrying radium in his waistcoat pocket. Pierre Curie produced experimentally a similar burn on his own arm. The French dermatologist, Besnier, of prurigo fame, recognized the lesion as similar to an x-ray burn, and suggested that radium might be used therapeutically. Acting on this suggestion, Danlos, of the Hôpital St. Louis, began to treat benign and malignant skin lesions, with some limited success. This was carried out by a radium plaque. For irradiation of deeper structures radium needles were devised, and later the radium "bomb," or teleradium therapy.

The first to use radium *en masse* as a bomb was Regaud, in Paris. There soon followed him Sluys and Murdoch in Brussels, Douglas Quick and Janeways at the Memorial Hospital, New York, and Stanford Cade at Westminster Hospital. Another early worker in this field was Howard Pinch, the first director of the Radium Institute of London.

Deep X-ray Therapy

By 1902, attempts were being made to treat deeper neoplasms—particularly in the breast. For the next two decades minor improvements occurred in the treatment of malignant disease, with increasing knowledge and improved apparatus. In 1920 the Erlangen technique, with kilovoltages of 200, introduced a new conception into the treatment of deep-seated growths: radical radiotherapy with the object of effecting a cure. If that were impossible by reason of the clinical stage of the growth there remained what had previously been available—palliative radiotherapy.

Although the massive single-dose technique of Seitz and Wintz was soon to prove so dangerous that it was discarded in favour of the split-dose technique, it was the starting point of notable advances. Regaud, working with radium, evolved the extended technique of small doses daily over long periods. Pfahler adapted this radium technique for x rays in his well-known saturation method. In 1930 Coutard added to these extended techniques the principle of heavy filtration, which greatly improved the depth dose relative to that on the skin. These new techniques were eagerly developed in Great Britain. R. Morton brought the Erlangen technique to London, and gradually there was born in Great Britain a new specialty—radiotherapy.

Diagnostic radiologists were too immersed in their proper subject to have time for the new radiotherapy, and there sprang up in this country radiotherapy centres that were to lead the world, and still do so to this day. Finzi at St. Bartholomew's, Douglas Webster and, later, B. W. Windeyer at the Middlesex, Stanford Cade and Allchin at Westminster; these in London were among those who started the "new look" in radiotherapy; while in the provinces Ralston Paterson had begun to make the Holt-Christie Institute of Manchester one of the most famous radiotherapy centres in the world. It is not without reason that he has been chosen as president of the next International Congress of Radiology, to be held in London next summer.

Any account of the history of radiotherapy, however brief, should have some mention of the great contributions

made by the hospital physicists. It is they who have made possible the scientific accuracy in dosage and beam direction that obtains to-day; and now their work is extending to x-ray diagnostic problems and to the great new field of radioactive isotopes in medical research and treatment. Names that deserve honourable mention as pioneers in this country are Professors Russ, Hopwood, and Mayneord.

Radiological Education

It became clear at the end of the first world war that something would have to be done to train radiologists to serve the expanding specialty. British radiologists took the lead in this, and the efforts of A. E. Barclay, Robert Knox, Stanley Melville, Sidney Russ, E. P. Cumberbatch, and others resulted in the institution of the Cambridge Diploma of Radiology and Medical Electricity, the first of its kind in the world. Since then many others have been established, and, indeed, the original D.M.R.E. of Cambridge is no more; but to the foresight of these men is due the comprehensive system of radiological education now extant in many centres in Great Britain. That radiology in both its branches is worthy of academic training is now recognized in the appointment of a number of professors of radiology in British universities; still too few, but a good beginning.

And What of the Future?

In radiodiagnosis there are new fields imminently presenting. The liver, spleen, and pancreas are still silent areas, but already there are hopes of a contrast medium suitable for hepato-lienography. Placentography is also well within the horizon. But even if all these silent areas are explored, and their gross morbid anatomy laid bare, there remains a great new field, the radiological study of function. At the present time, when we screen a barium meal, we see in a glass darkly. Not until we come to view the still life of the resulting radiographs do we study detail. But if we could intensify the screen image to the same brilliance as that with which we view the x-ray film how much could we learn. The changing picture of the bulb in duodenal ulcer, the peristaltic cycle of the kidney and ureter, these could be cinematographed and studied at leisure, if only we could make the fluorescent screen image bright enough; while to the cardiac cycle could be applied slow-motion cinematography. Research work is already beginning on this, especially using the techniques of television. If these researches are fruitful, new vistas of radiological investigation open before us.

In radiotherapy, in spite of all the improvements in apparatus and advances in technique and all the achievements of surgery, the great majority of cancers still kill the patient. It is a melancholy fact that although nearly all cancers can be palliated and some so treated as to be held at bay for a time, only four types can be classed as curable: cancer of the breast, the skin, the mouth, and the uterus. At least it can be claimed for radiotherapy that it is the method of choice in the last three. The real cure of cancer is yet to come. In the meantime the field for radiotherapy is increasing, and there is every expectation that the new techniques, using voltages of 2-20 mev., will brighten the prospects of many more who are afflicted with this dread disease.

In conclusion the final words of Mackenzie Davidson's article in 1902 are still appropriate: "That the x rays have been of immense value to medical service is unquestionable. It is only a short time since they have been discovered, and we are yet only imperfectly realizing their possibilities."

FIFTY YEARS OF PUBLIC HEALTH LEGISLATION

BY

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Legislation in public health is of ancient origin. One has only to mention that compendium of sanitary law, the Book of Leviticus, and the Hammurabi Code of Assyria to make this plain. In England the first Sanitary Act was passed by Parliament at Cambridge in 1388, and the reign of Henry VIII produced the Plague edicts for the control of plague and the sweating sickness.

Modern legislation on the subject dates from the Public Health Act of 1848, which first provided a central authority, the General Board of Health. But it must be noted from the outset that British legislation does not of itself initiate public health reforms, nor does it necessarily reflect completely the progress that has been effected. It is only when certain methods have been tried and evaluated, or when scientific discoveries have been made and experimentally applied, that Bills are introduced and Acts passed by Parliament to give these reforms the sanction of law. For the most part, therefore, legislation in public health is a legal ratification of medical advance and not its initiation.

Environmental Hygiene

In the nineteenth century particular attention was devoted by Southwood Smith, Chadwick, Farr, and others to the influence of environment upon health. Simon also advanced the study of environmental hygiene, but his outlook was much wider, and he appreciated the importance of personal infectivity before Pasteur and Koch had founded the science of bacteriology. Under Simon's direction and with the aid of other pioneers in epidemiology, such as were John Snow and William Budd, a vast store of knowledge in environmental hygiene had been collected and applied. This work, surveyed and blessed by the Royal Commission of 1869-71, was expressed in the great Public Health Act of 1875, which consolidated all the previous enactments into a compendious sanitary code. This confirmed the compulsory appointment of medical officers of health by local authorities; it aimed at securing the drainage of houses, the sewerage of towns, the scavenging of streets, the removal of house refuse, wholesome conditions within houses, and the isolation of infectious persons.

During the remaining years of the nineteenth century, although much valuable work was done in public health by the medical department of the Local Government Board, there was little special legislation on the subject. Certain infectious diseases were made compulsorily notifiable in 1889, and other Acts of public health significance were passed. Chief of these was the Local Government Act of 1888, which established the large units of local government, the county councils, and the county borough councils.

By 1900 there was a general decline in mortality and an improvement in national health. "The water-borne diseases became negligible, cholera was abolished, small-pox became rare, and typhus disappeared. Port sanitary administration prevented the admission of plague and pestilence." There was still a regrettable cleavage between preventive and curative medicine, a state of affairs which did not accord with the teaching of Simon, Henry Acland, Burdon-Sanderson, and other enlightened pioneers.