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PREVENTIVE ASPECTS IN THE TEACHING OF PATHOLOGY

Seventh Report of the Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel

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EXPERT COMMITTEE ON PROFESSIONAL AND TECHNICAL EDUCATION OF MEDICAL AND AUXILIARY PERSONNEL

Geneva, 27 October - 1 November 1958

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PREVENTIVE ASPECTS IN THE TEACHING OF PATHOLOGY

Seventh Report of the Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel *

The WHO Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel met in Geneva from 27 October to 1 November 1958. Dr James Bertram Collip was elected Chairman; Professor G. H. Cooray, Vice-Chairman; and Professor G. Payling Wright, Rapporteur.

Dr P. Dorolle, acting for the Director-General, opened the meeting and welcomed the members of the Committee. He explained that WHO is anxious to see the introduction of the preventive aspects of medicine at an early stage into the undergraduate curriculum, and that last year a study group was held to explore the possibilities of bringing these aspects into the teaching of physiology. The task before the present Committee was to continue these deliberations by discussing the introduction of the preventive aspects of medicine into the teaching of pathology.

1. INTRODUCTION

The Committee discussed at length the meaning that it should attach to the word "pathology", in view of the many different connotations given to it, both in the past and in the present, in various schemes of medical education. It was decided that for the present purpose the term should be interpreted broadly, and that, in addition to pathological anatomy, it should include all relevant knowledge from experimental pathology, microbiology, radiobiology, immunology, and biochemistry that might aid

* The Executive Board, at its twenty-fourth session, adopted the following resolution:
The Executive Board

1. NOTES the seventh report of the Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel (Preventive aspects in the teaching of pathology);

2. THANKS the members of the Committee for their work; and

3. AUTHORIZES publication of the report.

(Resolution EB24.R12, *Off. Rec. Wld Hlth Org.*, 1959, 96)

in throwing light on the causation and mechanism of disease. It was believed that only through this liberal conception of the scope of the science could its full potentialities in making a contribution to the idea of prevention in medicine be realized.

Before considering the more specific problem of recommending methods for introducing greater interest in the prevention of disease into the teaching of pathology, the Committee examined the gradual evolution of the idea of prevention that took place during the last century. Many of these changes have been reviewed by Grundy and Mackintosh in their recent book.[1] The Committee noted that, for a variety of reasons, during this very formative period in the development of medical education, preventive medicine came to be closely associated with environmental public health, while in the university teaching hospitals the emphasis continued, as before, to be placed almost wholly upon the distinctly diagnostic and therapeutic aspects of clinical medicine. It was felt that many of the obstacles that today face medical educators who wish to lay greater stress on the complementary aspects of etiology and prevention early in undergraduate courses can be traced back to their source in these two long-standing historical associations. The Committee considered that its principal task was to propose some measures that might lessen the unfortunate results of this dichotomy.

The present century has seen an increasingly widening acceptance by pathologists of the view that one of their main contributions to the future progress of medicine lies in the search for etiological factors and the exploration of pathogenic mechanisms. With the conquest of so many of the graver infectious epidemic diseases, however, the character of the problems has undergone a striking change, for diseases of other kinds, especially those of a more chronic kind that affect elderly persons, are yearly attaining greater proportionate importance in all countries. This remarkable transformation in the relative significance of diseases of essentially different natures is often insufficiently appreciated by pathologists and can indeed only be followed by constant reference to national morbidity and mortality statistics. It is for this reason that the epidemiologist is singularly well fitted to point out the problems, while the pathologist can seek to throw light on them, not only through his own researches but also through the guidance that he is so well placed to give to investigators in other medical sciences. As an *entrepreneur* in the medical sciences, his position is unrivalled. Moreover, today there is no teacher in undergraduate medical education who is better situated than the pathologist to focus the student's attention early on the growing potentialities of the preventive approach to the control of disease.

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[1] Grundy, F. & Mackintosh, J. M. (1957) *Teaching of hygiene and public health in Europe*, Geneva (*World Health Organization : Monograph Series*, No. 34).

2. THE EDUCATION OF MEDICAL STUDENTS IN PATHOLOGY

Before proceeding to consider the various aspects of pathology into which the concept of prevention might profitably be introduced, the Committee felt that it should set out briefly and in general terms its views as to the character and scope of undergraduate education in this very important medical science. The details of the present arrangements in different countries vary for historical and other reasons, but running through all the systems now in use is a common thread, and it was on this unifying element that the Committee concentrated its attention. While no attempt was made to undertake a systematic consideration of the place of pathology in the curriculum or of the arrangements for its teaching, both of which must vary with different national systems of education, the Committee was able to formulate certain general principles that met with wide approval among its members.

2.1 The scope of pathology

The Committee believed that pathology should be regarded as the scientific study of the dynamics of disease and that such teaching should therefore begin with a systematic examination of both the background of the causation of the disease and the evolution of its distinctive lesions. By employing such an approach, the subject is introduced logically with a general review of the many etiological factors, both hereditary and environmental, which may operate either singly or synergistically to cause serious injury to the body. Then follows the examination of the operation of these factors in disturbing the normal structure and function of the tissues—in short, the investigation of the pathogenesis of lesions. Studies on etiology and pathogenesis form the principal content of that branch of the science that has long been known as " general pathology ". The Committee were unanimous that this fundamental aspect of pathology, together with its complementary science, " experimental pathology ", deserves the fullest consideration in the undergraduate curriculum. It believed that if the ideas of causation and the dynamics of development of lesions were both fully covered during this early phase of the student's studies, the concept of prevention, when it is taken up later in the context of specific diseases and injuries, would be much more readily appreciated. In the opinion of the Committee, in any future changes in the medical curriculum, the study of general pathology should receive more rather than less attention, particularly because of the many opportunities that it affords for the early inculcation of that scientific habit of mind—the collection and weighing of evidence

and the drawing and testing of inferences—upon which the proper practice of all forms of medicine will increasingly depend.

Once the undergraduate has been well grounded in the main principles of general pathology as a science of processes rather than of states, he will have been prepared for the study of those distinctive organ lesions that characterize specific diseases—the branch of pathology to which the name " special pathology " has been applied. In the past, much of the teaching in special pathology has centred round the morphology of established, and often advanced, lesions, but the increasing application of physiological and biochemical techniques to the study of abnormal states is throwing more and more light both on pathogenesis and on the functional adjustments usually to be found in injured structures, together with the compensatory adaptations later made vicariously by other organs.

The key role of the teacher of pathology in promoting concepts of prevention is to trace the complete evolution of lesions, paying special attention to their causation, their progressive development, and the disturbances in function that they bring about. He is, moreover, in a particularly advantageous position to point out to his students the stages in the progress of the disease at which the changes are still reversible, and hence the limits beyond which efforts at prevention and cure become increasingly less effective.

2.2 Teaching methods in pathology

Although the terms of reference of the Committee made no mention of the methods of instruction to be used in the teaching of pathology, its members felt that it could contribute usefully to its recommendations if some brief consideration were given to these questions.

It was widely accepted by members that the senior teacher in the department should devote particular attention to the introductory courses given to his undergraduate student body, for first impressions of a new subject are likely to be enduring. A successful initiation thus depends very greatly on the width of experience and sense of perspective of the instructor—both qualities that ordinarily mature slowly. Varying opinions were expressed by members of the Committee, however, as to the desirability of placing the introductory course in the hands of a single teacher or of entrusting it to a group of men each responsible for some particular field of general pathology in which they possessed specialized knowledge. The consensus of opinion was that the whole teaching course should be designed and supervised by a single senior teacher, but that he should at his discretion have freedom to seek support for particular aspects of pathology from other teachers both within and outside his own department. This assistance might properly be sought, for instance, in such subjects as biophysics and genetics. An alternative, which appears to combine some of the advantages

of both the single and multiple teacher methods, was described to the Committee as the " fractionate lecture ". In this mode of instruction, the senior teacher is responsible for the design of the lecture, but introduces during the course of his presentation a contribution on some limited aspect of his subject by some expert of his choice. Such a procedure ensures the continuity of the presentation of pathology while permitting the student to benefit from the usually more up-to-date instruction of the specialist.

The Committee welcomed the increasing tendency in most medical schools to make the teaching of pathology less formal and didactic and to incorporate more and more practical features in its study. It valued, too, the closer integration between pathology and other subjects, both in the earlier and in the later years of the curriculum, which is being encouraged in many medical schools. It felt that this was particularly advantageous towards the end of the medical course, when, at clinical pathological conferences, the salient features of appropriate cases could be reviewed from a variety of angles. On such occasions, when the etiology and pathogenesis of a disease are under discussion, pathology can contribute most effectively in inculcating the idea of prevention in the student's mind.

2.3 The preventive concept in modern pathological teaching

There are many broad questions in which all pathologists, irrespective of country, can find a common interest in their teaching. Everywhere, increasing industrialization is bringing in its train characteristic diseases and injuries—some of a previously unfamiliar kind, others the sequel of growing urbanization—while in most countries the rising average age of the population is throwing the problem of cancer into sharper and sharper relief. In some communities, too, the diseases of famine and malnutrition, which from time immemorial have haunted humanity, have receded before those of plethora, with its rising tide of deaths from vascular and degenerative conditions. If pathologists are to seek to introduce the concept of prevention more fully into their teaching, it is to these types of disease—common today, but almost certainly becoming still more common within the professional lifetimes of their present students—that they should direct particular attention.

In the following sections are set out briefly some examples of present-day medical problems, in discussing which teachers of pathology might with advantage emphasize the many far-reaching contributions that their science has made, and can continue to make, towards prevention. The topics considered are illustrative and far from exhaustive. They could well be supplemented by other diseases having a high regional incidence, some of which may arise as the result of local traditional habits and customs with which the student is familiar. All such reviews, irrespective of whether they are of world-wide importance or merely of local interest, could be

used to orientate the student towards the idea of prevention in his future professional work, during a period when he is still at a malleable stage in his education.

3. THE PREVENTIVE APPROACH IN PATHOLOGY

3.1 Diseases of industrialization

That particular trades and occupations might prove hazardous to health was known early in civilization, but any detrimental association that might become apparent between them was completely overshadowed by the more immediate and pressing problems of recurrent pestilence and famine. In Italy towards the end of the Middle Ages, however, two social developments took place, rendering it no longer possible to overlook such associations. The first was the growing range of skills of the northern Italian craftsmen—their gilding with the use of hot mercury and their glazing of porcelain with the help of lead ; the second was the rising interest in etiology that had been one of the fruits of later Renaissance medicine. The result of this combination of circumstances was the epoch-making book on *Diseases of tradesmen* that was published at Padua in 1700 by Bernardo Ramazzini. How deeply this work impressed successive generations of medical men may be judged from the frequency with which the original text and the translation made from it were issued during the succeeding century.

In England during the late eighteenth and early nineteenth centuries the problems of industrial diseases attained unprecedented proportions. In mediaeval Europe, the crafts were often followed under very unhygienic conditions, but the number of persons engaged in them was small, and those who pursued them were occupied either in their own homes or in small ateliers. In England, the discovery of the great resources of steam power brought about the Industrial Revolution with its attendant evils—consequences of the creation of huge factories and the growth of the manufacturing cities, in which human beings were herded together in overcrowded quarters. The history of this period of industrialization has been so frequently recounted, amongst others by the Hammonds and by Paul Mantoux, that there is no need to recapitulate it here. But the warning of the dangers of uncontrolled industrialization is for all to read, and other countries that embark on such developments may not be so fortunate as to produce philanthropists like Edwin Chadwick, Southwood Smith, or Lord Shaftesbury to infuse a more humanitarian spirit into national legislation.

For the pathologist concerned with preventive measures, the diseases of industrial life fall into two broad divisions. First, are those which were already widely endemic in a country before industrialization, but increase

greatly in prevalence as a result of the urbanization that is seldom separable from factory development. Amongst these diseases, tuberculosis is probably the gravest when considered globally, and many instances of a correlation between a rise in its incidence and the progress of industrialization might be given. But others, too, notably the venereal diseases, have an association with industrial development that is far from unimportant, especially in the immigrant populations of mushroom cities. In each part of the world, industrialization provides its own distinctive medical problems—essentially those of lives in drab surroundings in overcrowded, ill-developed cities, in contrast to the more natural life in rural communities.

The second group of diseases of industrialization includes those which, as Ramazzini pointed out, are the direct outcome of some particular trade or occupational hazard. At the present time, the increasing complexities of technology are bringing with them a whole legion of new maladies about which medical men often have no previous knowledge or experience.

Organic chemistry is daily introducing new materials into industry and agriculture—many of them with powerful and distinctive toxicological effects that may be either rapid or long-delayed in their appearance. The development of certain forms of cancer, such as those that follow the use of arsenical insecticides, is a warning example of the insidious nature of some of these poisons. Modern metallurgy, too, provides many instances of industrial diseases that have appeared through the introduction of such elements as beryllium, zirconium, and americium for the preparation of new, strong, heat-resisting alloys. These have such diverse uses as missile nose-cones, industrial crucibles, and atomic-reactor lining materials. In the process of mining, extracting, and alloying these metals, it is necessary to handle them in the form of molten fluorides, oxides, sulfates, etc. Gases from heated batches may be lost into the surrounding atmosphere. With beryllium, for example, small quantities may be inhaled by the workers in the plants, still smaller quantities by clerical staff working some distance away, and minute but definite amounts by people living in the neighbourhood of the plant. The case-fatality rate in berylliosis is approximately 20% and the morbidity rate of those exposed is some 80%. It is believed that with continued follow-up of patients the case-fatality rate will reach 80%-90%. This disease is thus not an obscure problem of minor importance, and the beryllium registry in the United States alone now contains over 600 cases. Many people may thus be expected to die of a man-made disease, due to a metal that has been in use for a period of only 20 years.

Lastly, the rapidly extending employment of atomic power and the industrial applications of radioactive isotopes are introducing problems that for the most part are entirely new.

If teachers of pathology are to assume their proper responsibility for preparing students for practice in an era of development in which the scope of preventive medicine was never greater nor its opportunities for service

to the community better, they must familiarize themselves with the potential dangers inherent in modern industrialization and technology. Many of these problems will necessarily only possess a local significance, but with the increasing complexity of industrial methods and techniques and their introduction into parts of the world which in the past have been mainly engaged in " primary production ", the need for pathologists to be prepared to encounter new syndromes and diseases grows greater yearly.

Although it is often desirable, especially in highly industrialized countries, to have specialists in occupational diseases in medical schools, it is more important that the student learn about these conditions during his course on pathology and from his teacher in that subject. For example, lectures on the pathology of cancer of the bronchus should not be limited to descriptions of its morbid anatomy and common complications, but should also embrace the etiology in relation to substances employed in industry, such as chromium, nickel, arsenic, asbestos, and coal tar products, as well as in relation to the ionizing radiations, and to air pollution.

3.2 The pathology of trauma

The progress of mechanization, with the concomitant year-by-year increase in the mechanical power at the disposal of men engaged in industry, transport, and agriculture, is followed inevitably by a parallel rise in the incidence of traumatic injuries, especially among young adults. The uninterrupted rise in the number of persons killed or injured on the roads—a trend manifest in every country in the world—reflects most clearly a hazard in civil life that is virtually peculiar to the present generation; that its gravity will increase in the future may be predicted with little hesitation.

In the home, too, accidents cost the health and lives of many women and children. The nature of the injuries depends to a large extent upon the domestic customs and the construction and equipment of dwellings, all of which vary widely from one country to another. One of the most serious forms of trauma is the accidental burn—especially common in tropical countries where clothing is flimsy—that results from contact with open fires and cooking stoves. In the past, these injuries often became extensively infected, and among the survivors, serious disabilities commonly followed the development of contractures in the scars. Modern pathological investigations into the source of these infectious have led to valuable preventive measures employing a bacteria-free atmosphere in treatment and so have much reduced the likelihood of such complications.

The pathology of trauma is a subject of much complexity, and all its ramifications, both morphological and metabolic, bear on the education of the medical practitioner. Much knowledge has been gained from the study of the clinical developments that may follow any severe injury, particularly

from observations made on soldiers wounded in the last war. While it is unnecessary to discuss these findings here at length, it may serve a useful purpose to review briefly some of the manifold problems that have come to light.

Today, the hazards of serious wound infections are largely overcome. The time has passed when, as in pre-Listerian days, the surgical amputation of an injured limb was more likely to be followed by death from " hospital gangrene " or secondary haemorrhage than by recovery. The general acceptance, first of antiseptic and later of aseptic surgery, supplemented by the use of chemotherapeutic and antibiotic compounds, has almost eliminated the likelihood of such complicating infections. Although these resources are now widely employed by surgeons with skill and success, one agent of long-recognized value, tetanus antitoxin, is still used too frequently in an uncomprehending way which robs it of much of its great value. Many lives must be lost yearly through failure to realize the limitations of this potentially protective inoculation.

Pathologists have long been familiar with the principal changes that take place in the cells of the soft tissues during the processes of inflammation and repair in a traumatized area, and there is no reason to believe that teaching in this field, or morbid histology, calls for any material changes. Less satisfactory in general has been the attention given to fractures of bones—especially in those countries where patients may first consult an inexperienced bone-setter—and the measures, both mechanical and nutritional, that can be employed to accelerate their healing. The importance of this aspect of traumatic pathology may be more realistically appreciated when the handicaps to subsequent employment that are imposed by delayed or maladjusted union of the fragments comes to be considered against the broader background of medicine in society. For, taking the world over, the great majority of mankind still rely for the livelihood of themselves and their families on their capacity for daily physical labour in factory or field.

Only in recent years have enlightened surgeons come to recognize that for the attainment of a successful result in their operative work, biochemistry may possess an importance that is second only to bacteriology, and that any form of severe trauma, irrespective of whether it is incurred accidentally or inflicted surgically, exerts far-reaching effects upon the metabolism of their patients. Hitherto, most of the studies along these lines have been carried out by endocrinologists, and their clarification of the successive parts played by the hypothalamus, the hypophysis, and the adrenal cortex has only lately come to illuminate certain aspects of post-operative surgical treatment and to provide a scientific explanation for some of the failures of the past. In the teaching of his subject to students, the pathologist must take his proper share in the exposition of these new developments. He should not, in the mistaken belief that his own responsibility is limited to purely morphological considerations, seek to divest

himself of the duty of presenting the pathology of trauma in its broadest terms. Instead, he should welcome the opportunity of incorporating the main findings of modern endocrinological and nutritional research in his general teaching and seek to encourage his students to appreciate the possibilities inherent in such functional pathology for the care of injured patients. He can hardly expect his students to become properly acquainted with this developing field of surgery unless he is prepared to master the underlying pathological principles involved.

3.3 Iatrogenic diseases in modern medicine

Many of the most valuable therapeutic advances that have been made during the last few decades have entailed the administration of new substances of great pharmacological potency. Often, however, the administration of these valuable drugs is complicated—and may even occasionally be contra-indicated—by the occurrence of side-effects on the patient that may range in degree from the trivial to the fatal. The employment of such agents in treatment may indeed lead to the development by the patient of a new group of symptoms and signs that are quite different from those for which he first came under treatment. These secondary disorders now pass current in medical literature as the " iatrogenic diseases ". No stigma can attach to the clinician when these disorders first make their appearance; their occasional occurrence is the inevitable sequel to the employment of new and powerful therapeutic agents, not all of whose biological effects can be fully ascertained by tests on animals. While regrettable in themselves, these iatrogenic diseases must be accepted as a small price that the community pays for the great benefits that such medicaments confer on the generality of patients.

It is impossible to do more here than to mention a few of the many types of iatrogenic diseases that are now found yearly in the ward and the post-mortem room. Many are frankly allergic in character, such as the hypersensitivity that sometimes follows the use of penicillin and the sulfa drugs. Others are supposedly allergic, such as the agranulocytosis that occasionally follows the administration of chloramphenicol. In infectious diseases, the employment of antibiotics may be succeeded by the selection of resistant strains of the causative organism—the staphylococcus is a notable example—whose subsequent eradication may prove difficult or impossible. Sometimes, too, when the ecology of the microbiological flora of the skin and mucous membranes has been much modified by the differential destruction of certain species of normally commensal organisms, fungus infections may assume an importance that they would never otherwise have attained.

Comparable troublesome or dangerous side-effects may follow the prolonged use of hormones. These physiologically potent substances may

in time bring about a gross imbalance of the whole endocrine system of the patient. The flaring of latent tuberculous lesions in the lungs, the development of osteoporosis, and the perforation of peptic ulcers are all instances of complications that may follow the use of steroid hormones.

Many of these iatrogenic diseases first come to light in the post-mortem room and the pathologist may be the first to appreciate their pathogenesis and significance. For this reason, he may often be the person who can exercise a valuable role in prevention by drawing attention to any untoward sequels to the administration of new drugs; and thus, in collaboration with the clinicians, he may ensure their modification or withdrawal from therapeutics. Caveats regarding the unrestrained uses of new drugs may well be among the most important lessons in prevention that the pathologist can impart to his students.

3.4 Radiation injuries

The rapidly widening employment of radioactive materials and of electrical equipment, often of a powerful character, for the emission of radiant energy presents the teacher of pathology of today with problems of a wholly novel character. The injurious effects of exposure to these ionizing radiations are many and varied, and in no satisfactory course of general pathology can they be adequately covered in a brief summary, but require an exposition of a detailed and comprehensive kind.

The problems that confront the teacher of pathology who wishes to embark upon a proper consideration of the biological effects of radiant energy resemble in many respects those of his predecessors two generations ago, when the concepts of microbiology were beginning to throw a new light on the etiology of many pathological processes. Now, as then, the pathologist must seek a better acquaintance with a hitherto unfamiliar science and adapt himself and his teaching to the new responsibilities before him. In retrospect, it can be seen that the solution to the earlier problem lay in the collaboration of pathologists and microbiologists in the presentation of their respective teaching courses; and so mutually valuable did this association become that today these two subjects are linked together more intimately perhaps than any two others in the whole medical curriculum. In the immediate future, the presentation of the pathological effects that can be brought about by exposure to ionizing radiations will require a comparably close measure of association with the teachers of physics. No exposition of the biological actions of such radiations can be comprehensible to the student unless its foundations are laid in the physics and chemistry of particulate and electromagnetic rays. In those medical schools in which academic departments of medical physics or of biophysics are already in existence, collaboration should be readily attainable. It is in universities where the institutes or departments responsible for the instruction of

medical students in these basic sciences are situated away from the medical school and inadequately represented in its faculty that close co-operation may prove difficult. Few aspects of medical education display more conspicuously the drawbacks and difficulties that accrue when a medical faculty allows itself to become dependent upon outside bodies for the education of its students in those fundamental sciences that are daily becoming more closely integrated with both medical practice and research.

In almost every medical curriculum as at present arranged in segregated courses, an interval of one or more years separates the courses in physics from those in pathology. Although it is to be hoped that in future many teachers of physiology and biochemistry will bring more prominently before their classes the great potentialities for advances in their sciences made possible by the use of radioactive isotopes, it remains unlikely that the student will have retained over this long interval a sufficiently detailed recollection of the physical nature of ionizing radiations for the purposes now in mind. The teaching of radiation pathology should therefore be preceded by a short, but none the less comprehensive, account of the physical background of the medical problems with which the student will be presented. Only when he is aware of the very different characteristics of alpha, beta, gamma and X radiation will he acquire a proper comprehension of the biological significance of the great variations in their depths of penetration into the tissues and the intensities of their ionization tracks. For the present, in most medical schools, the greater part of instruction on these matters must devolve upon the physicists ; in time, as more and more pathologists undertake research into the pathogenesis of the lesions brought about by exposure to these radiations, the members of the staff of the pathology department may themselves become sufficiently informed in these aspects of physics to undertake this teaching. But whatever arrangements the particular school makes, it is becoming increasingly evident that for the immediate future at least there is the need for collaboration between pathologists and physicists of a much closer kind than appeared to be necessary even a decade or so ago.

There is no need to refer here to the very diversified nature of the medical problems created by exposure to particulate and electromagnetic radiations. Many of them were reviewed at some length in the fourth and fifth reports of the Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel.[1]

In this connexion reference should also be made to the report of the Medical Research Council of Great Britain [2] and to the report of a study group convened by WHO and published in 1957 under the title of *Effect of radiation on human heredity*.

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1958, **154**; 1958, **155**

[2] Great Britain, Medical Research Council (1956) *The hazards to man of nuclear and allied radiations*, London, H. M. Stationery Office

It will suffice here to mention the more serious sequelae of exposure: the production of neoplasms, including leukaemia, the syndrome of " radiation sickness ", and the potential genetic hazards. Others will come to the minds of teachers of pathology. But the picture presented to the student should not be wholly a sombre one, for the value of various types of radiation is well recognized in therapeutics, and no consideration of radiation pathology should omit suitable reference to this encouraging aspect of the subject and especially to the applications of irradiation in the treatment of cancer.

3.5 Diseases of faulty nutrition

The histories of the human race in all countries record all too frequently the tragedy of famine and its usual aftermath, pestilence. When the knowledge needed for the storage of food against possible future dearth was lacking, and when even the supply of the immediately needed food was itself often deficient, it proved impossible to tide a community over a succession of bad harvests without widespread loss of life. Only as the methods for the preservation and transport of food on a large scale have been developed and organized have the fears of famine been largely, though not entirely, removed. Today, the diseases of faulty nutrition are less often of this acutely devastating kind, but are rather of a chronic character arising from foods that contain toxic constituents or are inadequate in their composition to meet human needs. This kind of fault leads less often to a sudden mass mortality than to a decline in capacity for physical labour. The resulting stultified social conditions are moreover often associated with widespread infestations with metazoan parasites whose ravages add greatly to the debility of the population.

In combating the diseases brought about by chronic malnutrition, it is desirable to attempt to draw a line of demarcation between the responsibilities of the medical profession and those of the administration, for only if there is mutual recognition of their respective duties can their collaboration lead to effective action. In the case of most of the diseases in which faulty nutrition has been incriminated as an essential factor, the etiology and means of prevention have already been largely elucidated, and the task before the pathologists is mainly to advise the administration on those means that lie within its competence and will best meet the exigencies of the situation.

In many countries considerable economies could be achieved by paying more attention to the prevention of nutritional and infectious diseases. The financial resources made available through the reduced need for hospital services could be more advantageously applied in other directions, with the aim of raising the general levels of living.

In the ultimate issue, the responsibilities for health in the less economically developed countries do not fall on the medical profession, although its members—particularly those specializing in pathology and biochemistry —can frequently offer valuable contributions to social betterment. Their role is primarily advisory, but from their reserves of technical knowledge and their high prestige in most communities, they are in a position to exercise an unequalled influence for good. Often, too, by instruction and persuasion, they can promote the introduction of new kinds of food into a country and do much to overcome the natural conservatism of many primitive peoples.

For the greater part of the world the diseases of faulty nutrition are those associated with poverty and ignorance, but evidence is growing that in certain countries the rising incidence of some diseases may be attributable to excessive consumption of certain kinds of food, especially those of animal origin. The rise in the expectation of life at birth, which has been so typical a feature of the vital statistics of most countries during the past century, has been mainly brought about by revolutionary changes in mortality in infancy and childhood. When the statistics for adults are examined, prolongation of life has proved much less spectacular, and certain diseases, of which coronary arterial disease has been the most conspicuous, have shown an alarming rise. This is true especially for professional men, on whom as a class the stresses both of work and of plethoric personal habits fall heavily.

It seems likely that the pathologist concerned about the prevention of disease may in future have to utter warnings about the dangers inherent in diets that err on the side of generosity. Numerous studies on the relative incidences of vascular diseases in groups of persons who differ ethnically, geographically, and in economic status have concurred in supporting the belief that a close correlation exists between diet and arteriosclerosis. Furthermore, from animal dietetic studies, evidence has come that suggests strongly that too liberal a supply of food in early life, while accelerating the rate of growth, has a detrimental effect upon longevity. Also, with strains of animals that ordinarily develop spontaneous tumours, an overadequate diet accelerates the appearance of the neoplasm and a spare one correspondingly retards it.

The effects of variations in the amount and composition of diets on human beings are much more complex than has commonly been supposed. In both human and animal studies in the past, great emphasis has been laid on the results obtained with different diets during the period of growth, the unjustifiable assumption being made that the greater the rate of growth the better the nutrition may be presumed to be. What the effects of such diets are in later life once the phase of growth has passed has hardly yet been studied, although in a world whose corporate welfare is coming to depend more and more on the physical and mental vigour of men past middle

age, such knowledge is becoming increasingly important. The pathological features of plethora may thus prove as important a study for the human race in the long run as the much more obvious disorders of malnutrition.

3.6 Infections, infestations, and venomous animals

A large proportion of ill-health in tropical countries is due to infections and infestations. Emphasis on prevention has enabled the health authorities to exercise a certain degree of control over plague, smallpox and cholera by effective though expensive quarantine measures. Malaria, too, has been almost completely eradicated over wide areas. While these successes give ample justification to the medical teacher to emphasize the preventive approach to these diseases, it must be realized that preventive measures taken against certain other diseases have not met with the same degree of success. This is partly due to the fact that other factors such as faulty nutrition often undermine the resistance of the people, with the result that once an infective agent gains a foothold it spreads relentlessly amongst the community.

Epidemics of typhoid fever and dysentery occur from time to time in the less developed countries, and infective hepatitis, long endemic in many temperate countries, has recently occurred in epidemic form in many tropical areas. Poliomyelitis, previously regarded as a disease of temperate climates, is now taking its toll of tropical peoples, while influenza in epidemic form swept over many countries of south-east Asia in 1957. There are many opportunities for the teacher of pathology to lay stress on the preventive measures that may be taken against diseases, the etiology of which is no longer obscure. The use of vaccination against some of these diseases, especially tuberculosis, also needs emphasis.

The role of numerous intestinal parasites in the causation of a wide variety of less well recognized clinical syndromes must be stressed by medical teachers in the tropics in their instruction of medical students on prevention. The failure to eradicate intestinal parasitic diseases, especially ankylostomiasis, is mainly due to the absence of efficient disposal of excreta. However, much can be done in the way of prevention by laying emphasis on personal hygiene, clean habits, and control measures against flies.

The major infectious diseases provide some of the most important features in teaching and practice in most parts of the world, but in tropical countries these diseases become additionally complicated by the frequent presence of infestations and nutritional deficiencies that add to the hazards of infection. In some of the more densely populated areas, moreover, the outbreak of an infectious disease is promptly followed by widespread dispersal of the affected population.

Bites and stings of venomous animals cause many deaths in certain parts of the world. As an example of the scale of this problem it may be noted that in Ceylon alone some 300 persons die annually from the bites of venomous animals, and the relative incidence of death from this cause is almost certainly much higher in India. Prevention of such accidents is administrative rather than medical, but in many instances intervention by a properly instructed medical practitioner may prevent the intoxication from becoming fatal.

The problem of rabies—a disease of world-wide prevalence—also provides a good example of the value of preventive measures at different stages of a disease. Of primary importance is the destruction of stray dogs and other animal vectors. But even if infection has taken place in man, the development of the disease can often be halted by immunization, either actively with attenuated virus or passively with high-titre antiserum.

3.7 Pathology and human genetics

In 1883, when Francis Galton introduced the word " eugenics " into the social sciences, he presented explicitly to the medical profession concepts which until then had been merely implicit in the nebulous ideas of " diathesis " and " constitution " that had long been current in medical literature. That diseases, like other human characteristics, might appear in successive generations of a family had long been recognized. Nearly a century before Galton, Otto had described the inheritance of haemophilia, and soon afterwards, Nasse had drawn attention to the distinctive pedigrees of families with seemingly healthy mothers and haemophilic sons, and had enunciated the law still known by his name. But Galton was the first to point out forcibly that the findings of the then infant science of genetics might be applied to the control of disease, and that if employed intelligently such knowledge might add greatly to the welfare of the human race by drawing attention to the dangers inherent in the mating of persons who are the bearers of undesirable physical or mental traits. Such suggestions, injected into the already heated atmosphere of the controversy created by the theory of evolution by natural selection, proposed shortly before by Galton's cousin Charles Darwin, naturally led to lively polemics into which it is no longer necessary to enter. But once the opposition excited by the early strident and often over-confident proponents of the application of eugenic theories to human populations had subsided, it was apparent that considerations had been brought into open discussion that could not fail to imprint themselves firmly upon the future development of medical opinions.

Since the resurrection of Mendel's quantitative studies on heredity at the end of the last century by De Vries and Bateson, the science of genetics has progressed rapidly along its present quasi-mathematical lines, and

normal characteristics and abnormal traits have alike been shown to be subject to its laws. The application of these laws to human beings has proved uniquely difficult, however, owing to the exceptional length of a human generation, the small size of the families, and the relative rarity of homozygous individuals. It is for these reasons that the phenomena of Mendelian inheritance in man have for long been illustrated rather unimpressively by numerous pedigrees of uncommon and usually unimportant anomalies of the skin or peculiarities of vision.

In recent years, although the analytical difficulties inherent in the study of inheritance in man have increased rather than diminished—because of still further reductions in family size and the falling frequency of consanguineous marriages—the scope of human genetics has broadened in directions that seem likely to prove of greater moment to pathologists. This has become notably apparent in the pathology of neoplasms, for although the number of kinds of tumour believed to be wholly conditioned genetically is small, and the frequency with which they are encountered is low, the realization of the possibility that a neoplastic transformation can be closely linked to a distinctive genotype has encouraged the search for some hereditary influence in the pathogenesis of the more common tumours. The important studies on the familial incidence of cancers of the breast and of the uterus that have been made in Scandinavia, the Netherlands, and elsewhere provide models for future investigations of this kind.

The pioneer studies of Garrod on the " inborn errors of metabolism "—presented as a Croonian Lecture in London just fifty years ago—opened the way for the exploration of essentially biochemical abnormalities along the lines of classical genetics ; but only recently have the full possibilities opened by his approach come to be regarded as a fertile field for research. Such a development has, of course, been made much easier by the comparatively recent introduction of the techniques of electrophoresis and chromatography which have enabled abnormal catabolites to be identified in blood and urine with much greater ease and certainty than formerly. The abnormal forms of the haemoglobin molecule found in sickle-cell anaemia, the association of particular blood-group substances with certain pathological conditions in the alimentary tract, and the excretion of phenylpyruvic acid by patients with a distinctive form of mental deficiency are all examples of inherited peculiarities of a metabolic kind. Such combined biochemical-genetic studies may well revolutionize neuropathology—a branch of the subject that has too long retained an almost exclusively morphological approach to problems that clearly demand a broader front for their attack.

Many years ago, Galton contrasted the supposed operation of " nature " and " nurture "—implying thereby factors that are inherited and those that are environmental—as formative influences during the development of every human being. With the missionary fervour of a new convert, he was

prone to favour " nature " too strongly, and his writings on hereditary genius and other aspects of inheritance introduced polemical elements into a controversy that might have been more productive had it been conducted with less emotion. Most pathologists in the past, while not being wholly oblivious of the importance of " nature " in pathogenesis, have naturally stressed the importance of environmental factors in disease—the revolutionary successes of the parasitic concept of the infective diseases could hardly have failed to encourage this tendency. But the growing body of material that is now available for analysis by human geneticists can no longer escape fuller consideration by teachers of pathology. Although the old *Konstitutions-Lehre* of German medicine in its original and often uncompromising form is now of little more than historical interest, the doctrine embodied in it contained elements of permanent value that will find their proper place in medicine when they have been subjected to the more rigorous scrutiny of Mendelian analysis.

If we consider the pathological genes to be the result of definitive changes in normal ones whose structural stability had become altered by mutagenic agents in the environment, the search and eventually the identification of such effects acquires an outstanding value in prevention. Experimental genetics has demonstrated the existence of a number of such agents, among which ionizing radiations are the most important. It was formerly supposed that cosmic radiation was one of these factors, but it soon appeared that, if cosmic radiations were the only cause of mutation, the mutation rate of the human species should be lower than that actually observed. This fact leads to the conclusion that some of the spontaneous mutations must be due to factors other than cosmic radiations, such as chemical substances introduced into the organism from its environment, or metabolic products formed in the cells, which are capable of altering the structure of the genes.

As stated in the fifth report of the Expert Committee on Professional and Technical Education of Medical and Auxiliary Personnel: [1]

> Few scientific questions during the last few years have given greater concern or aroused more apprehension in the intelligent public than the possibility that grave genetic injuries may be caused to future generations by the undiscriminating application of radioactive materials to both civil and military uses. Many people who themselves would have little hesitation in incurring such risks as an individual personal danger view with alarm the augmentation of hereditary defects and diseases—especially those of a mental nature—that any serious increase in the present mutation rate for human beings would inevitably entail. Whereas no damaged somatic cell can survive the individual person, a mutilated germ cell is potentially immortal. There is much in Waddington's remark: " Even if we cannot discover a cure for the ills that we may be inflicting on future generations we ought at least to take trouble to find out so that we can decide how far we shall go in running up biological debts which our descendants will have to pay."

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1958, **155**, 17

3.8 The pathogenesis of congenital abnormalities

For over a century, scientists have sought to gain an understanding of the origin of congenital deformities. An important advance was made when the etiological role of German measles was first detected in Australia some twenty years ago. None the less, experience has shown that this maternal infection does not necessarily account for all foetal malformations. Indeed, it may well prove that other disturbances in the health of the mother during early pregnancy can exert similar detrimental effects. Whether this is so or not can only be determined by retrospective studies upon possible maternal infections that might have been correlated with foetal abnormalities.

It has gradually become clear that these foetal malformations can be brought about not only by specific maternal infections but also by nutritional inadequacies. This was well exemplified by a study carried out in Germany after the Second World War, at a time when undernutrition was prevalent: the statistics showed that congenital abnormalities—especially of the central nervous system—had become more frequent. Comparable lesions can also be induced experimentally in animals by subjecting them to deficiencies of oxygen and vitamins; the abnormalities produced closely resemble those that occur naturally in man.

3.9 The precancerous state

In all countries in which the average age of the population is rising, the incidence of deaths from various forms of malignant disease shows a more than proportionate increase. In England and Wales, which from this standpoint may be accepted as a typical example, about one death in every four is now attributable to cancer. Furthermore, high death rates from cancer are far from being confined to the elderly, for they are becoming increasingly prominent in the mortality returns for persons in middle life. In the age-group from 20-65 years, the period of greatest bodily and mental activity, cancer in recent years has been recorded as the cause of death in about one third of all persons dying—women accounting for a rather higher proportion than men. In highly industrialized countries, cancer of the bronchus and leukaemia stand out as the two great public health problems of the present day; the only rival is cardiovascular disease.

In spite of sustained endeavours by innumerable skilful and devoted investigators in many parts of the world, knowledge of the etiology of the great majority of " spontaneous " cancers still remains very fragmentary. Many specific carcinogenic agents, both chemical and physical, have been discovered during the two centuries since Percivall Pott described the first recognized occupational neoplasm—the scrotal cancer of London chimney sweeps. Since the end of the last century, much progress has been made

in experimental carcinogenesis—the names of Ehrlich, Borrel, Yamagiwa, Rous, Kennaway, and many others will always be recalled as pioneers in this branch of medical science—but the circumstances that surround the origins of most human cancers are still almost entirely shrouded in mystery.

But although our ignorance of the causation of most forms of cancer still stands in the way of any solution of the fundamental problem of their pathogenesis, certain lines of thought have emerged from these experimental studies that can hardly fail to appeal to all pathologists who are anxious to promote the idea of prevention. It has been supposed, largely on the basis of the animal studies of Rous and Berenblum on chemical carcinogenesis, that the transformation of a normal cell into a malignant one is not the result of a change effected at a single stage, but takes place as the culmination of a series of alterations in its physiology and metabolism, a process which is sometimes completed only after the lapse of many years.

This long period of latency is well illustrated by observations made on men engaged in the Moselle vineyards. Arsenical compounds had long been used as insecticides, and their employment was soon found to give rise to enteritis and hepatitis among the workmen. As a result, its use was prohibited in 1942. Nevertheless, after a latent period of years, skin lesions began to appear, which ultimately culminated in cancer. In autopsies carried out on vineyard workers affected by arsenic in this way the frequency of cancer of the internal organs, particularly of the bronchi, was unmistakably in excess of the expected rate.

The present is no occasion to attempt a serious review of the commoner precancerous lesions of man, but it might be appropriate to illustrate the concept with a few further examples. In certain parts of the world, notably in Australia, excessive exposure of white persons, especially if fair skinned, to long continued insolation brings about a form of actinic keratosis which, if left unheeded, is often the precursor of basal and squamous carcinoma of the skin. Amongst women, especially those who have borne children, cancer of the cervix of the uterus ranks high in the causes of death in later life. In recent years, the prior existence of a local lesion near the os uteri, termed, perhaps not very happily, " carcinoma *in situ* ", has been recognized with increasing frequency through the application of either a biopsy or, in the case of uterus and lung, by the technique known as " exfoliative cytological diagnosis ". By an operation of minor severity, the women can often be saved from the development of a grave form of cancer. In the lip, mouth and vulva, squamous carcinoma is often preceded for years by the occurrence of the lesion " leukoplakia ", the treatment of which by various palliative measures may delay or avert the further stage of irreversible neoplastic transformation.

Although the teacher of pathology has no direct responsibility in such matters, he might now with justice be reproached with neglecting an

important educational opportunity if he failed to make clear to his students the risk of cancer inherent in many traditional customs. The kangri cancer, the dhoti cancer, the betelnut cancer, and the lung cancer of cigarette smokers are all instances of neoplasms that are brought about by voluntary exposure to injurious agents. The fact that exposure is not invariably followed by the typical neoplasm, or that when this does develop the latent interval may be half a lifetime, is no reason for any teacher to omit the appropriate consideration of the hazards of such customs during his review of the pathogenesis of the neoplastic diseases.

The prevention of cancer must naturally remain the ultimate objective, although this goal probably lies far in the future. Meanwhile, however, there are other aspects of neoplasia in addition to the recognition of the various forms assumed by precancerous lesions which deserve more consideration from both teachers and investigators. In clinical discussions on patients suffering from cancer, much of the student's attention is naturally directed to the tumour itself, its cells of origin, its rate of growth, its degree of encapsulation, and its possible pathways of dissemination to other parts of the body. Too little consideration appears at present to be given to the concurrent changes in the organs and tissues of the patient. From the time of its inception to the day of radical excision or death, the tumour is week by week encroaching relentlessly on the nutritional and metabolic resources of its bearer. In the later stages of its growth, the condition of cachexia often makes its appearance: what is still too little appreciated both by teacher and student is that for months beforehand the nutritional requirements of the tumour—its behaviour as a " nitrogen trap ", to use Mider's phrase—have been remorselessly imposing demands upon the body's reserves that render the patient less and less capable of enduring successfully the further very considerable metabolic stresses of a major surgical operation.

3.10 The growing importance of immunology in pathology

The early triumphs of immunology were almost without exception the achievements of bacteriologists. The almost complete eradication of the scourge of diphtheria in many countries through prophylaxis with the specific toxoid must always be viewed as one of the outstanding conquests of preventive medicine. But in recent years the scope of immunology has widened greatly from its early origins, and in many of its newer developments it no longer retains any of its former intimate connexion with the sciences of microbiology and epidemiology.

First amongst these broader developments was the contribution that immunology made to haematology, and particularly to the technique of blood transfusion. In the long and controversial history of this treatment, reverses have repeatedly been experienced which for long delayed its exploita-

tion as a resuscitation procedure. It was not until the existence of immunologically distinctive blood groups in man was recognized early in the present century that the technique of blood transfusion attained a degree of safety that permitted its wide employment in the treatment of grave haemorrhage. Indeed, it would be no exaggeration to maintain that, together with chemotherapy and the discovery of anticoagulant drugs, blood transfusion has gone far to render possible many of the remarkable successes of modern surgery and especially of the surgery of the cardiac and pulmonary systems.

A decade or so later, largely through the genius of Karl Landsteiner, advances were made in the biochemical aspects of immunology which have since come to provide a rational explanation of many formerly ill-understood allergic disorders, especially those known as " contact dermatitis ". The widespread introduction of a multitude of new and often highly reactive chemical substances into industrial and domestic life has led to a great increase in the frequency of a variety of eczematous disorders, the origins of which lie in the progressive sensitization of the patient to the " haptens " or " pro-antigens " to which he is exposed. Indeed, in many industries today there is a distressingly large turnover of the employees as a result of the allergic dermatitis that follows their sensitization to the materials used.

Quite recently, doubts have been cast upon Ehrlich's long accepted concept of " horror autotoxicus ". From a variety of sources, among them the observations on certain forms of haemolytic anaemia, of some destructive disorders of the thyroid gland, and possibly of some forms of encephalomyelitis, evidence has come that tissue extractives may under some defined circumstances operate as auto-antigens and bring about the formation of antibodies in the very animals from whose organs these extractives have themselves been obtained. Perhaps the most remarkable instance of this auto-antigenicity is the production of fatal anaphylactic shock in the guinea-pig by protein obtained from the lens of one eye after previous sensitization by the injection of protein derived from the lens of the other. New concepts in pathogenesis are beginning to take form, and even though at present they are still in many respects nebulous, there seems little reason to doubt that in the minds of the next generation of experimental pathologists they will acquire greater precision and lead to further progress in our ability to prevent disease.

It seems inescapable that teachers of pathology must concern themselves increasingly with this expansion in immunological knowledge. Indeed, the time seems to be near when members of the staff of a pathology department will have to take over from their bacteriological colleagues a large—perhaps the major—share in the instruction of students in a medical science that by long custom has come to be regarded as a sub-division of microbiology and epidemiology. Immunology is now to be ranked amongst the more

rapidly expanding of the biological sciences, and it would be matter for regret if pathologists proved unable to visualize the enlarging horizon that is now opening before them. If they fail to welcome the advent of these new immunological concepts and incorporate them in the main body of pathology, they will be depriving their science of an invigorating stimulus, the operation of which in the foreseeable future might revolutionize our ideas on the nature of some diseases whose etiology and pathogenesis is at present obscure.

4. THE LESSONS TO BE LEARNED FROM GEOGRAPHICAL PATHOLOGY

By the beginning of the twentieth century, the advances that had taken place in tropical medicine and the need to organize world-wide measures to prevent the spread of particularly dangerous epidemic diseases had led to the acquisition of a very large mass of information on diseases that were prevalent in particular regions of the world. It was not, however, until the twenties and thirties of our own century that the term " geographical pathology " was internationally recognized and the first societies founded for its study.

The preventive aspects of pathology in relation to geographical problems have been developed very extensively in Soviet Russia. In discussing these problems the Committee was presented with the following interesting information.

The development of the health services in the USSR enabled Soviet pathologists to accumulate much material on hitherto unknown or ill-understood diseases. Some of these, first described as purely localized phenomena, were afterwards found in other geographical areas. For instance, what was known as Far Eastern tick-borne encephalitis is actually found throughout the forest areas of Siberia and in some districts in the European part of the USSR, as well as in Czechoslovakia, depending on the natural reservoirs of the virus and the geographical distribution of the vectors. Far Eastern haemorrhagic nephroso-nephritis was first described in Manchuria and Korea. A similar disease has recently been found in Czechoslovakia and Norway.

When an outbreak of *trichodesmotoxicosis* occurred in Uzbekistan, it was first considered to be an infectious disease. It is now established that the disease is not a virus infection, but is due to poisoning by the seeds of a weed—*grey trichodesma*—which sometimes contaminates food grains.

Heliotrope liver dystrophy, which at first was called " toxic hepatitis with ascites " has now been discovered to be due to contamination of grain with seeds of *heliotropum lasiocarpum*. Diseases of a similar type have been described in Africa under the name of Senecio disease ; recently

Vanék in Czechoslovakia described a similar type of poisoning in horses.

A disease noted for the first time in the nineteen-thirties and described just after the war under the name alimentary toxic aleukia has now been found to be caused by the germination of *Fusarium sportrychoides* on grain which has been stored throughout the winter.

Extensive campaigns for the education of the public on questions of health have almost eliminated the diseases described above. Success has also attended the introduction of the use of iodine in previously goitrous areas, with much the same results as have been obtained in other countries.

One regional disease, the etiology of which is not yet known for certain, is the so-called Urova disease (Kaschin-Beck disease), first described about a hundred years ago in the Transbaikal area. This is a form of severe endemic chondro-osteoarthritis which arrests development and causes marked deformation of the joints and extremities. The disease occurs in areas of permanent frost, with undrained valleys and stagnant air, where the water is heavily contaminated with organic substances. Laboratory investigations by A. P. Vinogradov showed that the soil and water in the foci of the disease were markedly deficient in calcium, potassium and sodium, and contained some excess of strontium. The effect of shortage of minerals on the bone-tissue may be responsible for the severe forms of the disease found in manual workers.

Both fluorosis and dental caries resulting from fluorine deficiency are serious problems in geographical pathology. In the Ukraine and Kazakhstan, extensive work has been undertaken to discover potentially active foci of fluorosis. Large quantities of fluorine in underground waters are encountered, as a rule in areas where phosphorite deposits exist in the water-bearing strata, although not all minerals which contain fluorine are equally soluble.

The acute and protracted cases of dyspepsia observed in the central Asian republics in summer-time are connected not with an infection, but with an unbalanced diet rich in carbohydrates. Urolithiasis is found in the Soviet Union, in the trans-Caucasian republics, and in central Asia. The hot climate and high mineral content of the water may possibly have something to do with this phenomenon.

For a number of years, there has been an Institute of Regional Pathology in the Kazakhstan Academy of Sciences, and recently in Kirghizia and Uzbekistan similar institutes have been set up which are known as Institutes of Regional Medicine.

The Committee felt that natural factors in geographical pathology should not be studied in isolation from social factors, such as the living conditions of the people, the character of their contact with nature, and particularly their knowledge of the possible harmful effects of certain natural features. Moreover, the preventive work carried out by the health

services to improve local health conditions and the conditions under which people live and work may completely eliminate or sharply decrease the danger of the spread of many regional diseases.

For all these reasons, the opportunities for using geographical pathology to emphasize the preventive aspects in the teaching of pathology are quite considerable. Future doctors should learn as early as possible in their courses of pathological anatomy and pathological physiology that the study of the geographical distribution of certain diseases may often throw light on the causes of these diseases and be of help in devising schemes for their prevention.

Geographical pathology is organically linked with the preventive aspects of general medicine, and its subject matter can, to a great degree, enrich the teaching of general and special pathology and encourage the development of scientific research which will be of practical use in the control of many diverse diseases.

5. RECOMMENDATIONS

The Committee was fully aware that the organized arrangements for undergraduate teaching in pathology differ substantially from one country to another. In making its recommendations on the development of preventive aspects in the teaching of pathology, it therefore confined itself to those that appeared to be generally applicable, *mutatis mutandis*, irrespective of the detailed structure of the curriculum followed. It felt, moreover, that its views could be conveyed better by exemplification of possible lines along which such teaching of the subject might be directed than by offering any specific proposals whose implementation in an established curriculum might be difficult to bring about. Much of its report is thus occupied with illustrations that display this attitude of mind, and the Committee hopes that these will prove of value to teachers of pathology who wish to further the preventive outlook among their students.

5.1 General: the place of the idea of prevention in pathology

The Committee considers that the teaching of the idea of prevention should not be confined to any special course, or limited to any particular period of time, in the undergraduate curriculum. Today, the aim of all medical educators should be to create in the student during his formative years a progressive attitude of mind—the realization that prevention can and should be woven into the pattern of every form of medical endeavour. In the inculcation of this mode of thinking, the teacher of pathology is particularly well placed to take a prominent part, because it is usually through him that the student first becomes aware of the great possibilities

inherent in modern medical science for the reduction or elimination of many grave diseases.

5.2 The integration of teaching in pathology

The Committee felt that the presentation of pathology as an undergraduate subject should not be confined to any single year; on the contrary, it should be spread over the greater part of the entire curriculum. It believed that during the earlier parts of the course in this science, the main emphasis should be on general and experimental pathology. By ample treatment of these subjects, the teacher can lay a proper foundation for the two fundamental studies of etiology and pathogenesis, on a proper understanding of which the scientific application of preventive measures depends. Once a proper grounding in these principles has been achieved, the student will be well placed to benefit from the study of special pathology as it is met with in the post-mortem room and at clinical pathological conferences.

It was agreed that pathology should no longer be taught as an isolated discipline, but should form part of a course which is closely integrated with the associated sciences of microbiology, radiobiology and immunology on the one hand, and with clinical medicine and surgery on the other. At all stages in such a comprehensive course, the possibilities of prevention should be emphasized—an object that could still more readily be attained if a close working association was developed between teachers in pathology and those in social medicine and industrial health.

The Committee felt that the teaching of the preventive aspects of pathology gains much if it is depicted against a historical background of concurrent social and medical advances. Examples of the successful application of scientific measures could be drawn from various diseases first encountered in the early years of the modern industrial era and subsequently eliminated when once the hazards of certain types of occupation had become recognized; other examples are provided by devastating epidemic diseases, such as cholera which were conquered once the etiology of the disease had been discovered. Such illustrations could not fail to impress the student with the possibilities inherent in a preventive approach, both to the problems already solved and to those still outstanding in medicine.

5.3 The contribution of the hospital autopsy service

The Committee felt that although modern pathology now has a very broad scientific basis and gains support from a wide range of kindred sciences, the morphological aspects of this discipline still retain a central position. As Ludwig Aschoff used to remark: " The autopsy is the basis of pathology."

A comprehensive autopsy service makes an invaluable contribution to the health of any community, not only by assisting clinicians to improve their diagnostic skill but also by providing a body of information upon which a coherent scheme of prevention can be constructed. The latter function renders the post-mortem examination one of the most appropriate stages in the medical course for the inculcation of ideas of prevention in the minds of clinicians and students alike. For these and other reasons, the development of an effective autopsy service should be encouraged in all countries as an adjunct to both medical teaching and practice. It offers unrivalled possibilities for the recognition of new diseases—many of which are likely to appear in the wake of industrialization.

In many medical schools, the less formal examination of the case in the post-mortem room is followed subsequently by a more formally prepared clinical pathological conference at which the history of the patient, the clinical and laboratory observations made on him while in the wards, and the findings at autopsy can be reviewed synoptically. Such conferences provide a valuable opportunity for discussing those aspects of etiology and pathogenesis which are believed to have been related to the patient's disease. They thus lead naturally to a consideration of preventive measures that might have obviated the provocative cause of his illness and death.

5.4 Collaboration between pathologists and epidemiologists

In order to be in a better position to inculcate the idea of prevention, every teacher of pathology should make himself familiar with the official vital statistics of his own country as well as with the secular trends in its more important diseases. This information provides an irreplaceable guide to the waxing and waning of particular diseases. Collaboration between pathologists and epidemiologists is not solely to the advantage of the former, however, for in all countries the epidemiologist depends for the correct assessment of the value of his statistics on the care observed in the national pathological services.

In the course of time, social changes in many countries, especially those now relatively undeveloped, will demand that increased attention be given to epidemiological records ; by aiding in the collection of reliable statistics the teacher of pathology can contribute effectively to this necessary work. His close co-operation with the epidemiologist is required if effective national schemes are to be prepared for the reduction or elimination of some particular epidemic or endemic disease. While much of this help can be given directly, valuable assistance can also be given indirectly through his influence on the education of his students.

Finally, it should be borne in mind that in most countries the great majority of medical students become general practitioners. In that key position they are always close to the patient, and it is through their diag-

nosis and medical care that statistical information on morbidity and mortality is mainly compiled. It is therefore of the greatest importance that the teacher of pathology should train the undergraduate student in accurate recording, so that in his practice he will have a proper respect for accuracy. Further, the teacher of pathology in its broader aspects of epidemiology has a large contribution to make in giving his students a keen appreciation of the preventive element in medicine.

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Midwifery Training, Expert Committee on First report	**93**	1/9	0.30	1.—
Nursing, Expert Committee on Report on the first session	**24**	1/6	0.20	0.80
Second report	**49**	1/3	0.15	0.60
Third report	**91**	1/9	0.25	1.—
Fourth report (" Public Health Nursing ")	**167**	1/9	0.30	1.—
Nursing Education, Working Conference on Report	**60**	1/6	0.20	0.80
Occupational Health, Joint ILO/WHO Committee on Second report	**66**	1/6	0.20	0.80
Third report	**135**	1/9	0.30	1.—
Organization of Medical Care, Expert Committee on First report (" Role of Hospitals in Programmes of Community Health Protection ")	**122**	1/9	0.30	1.—
Second report (" Role of Hospitals in Ambulatory and Domiciliary Medical Care ")	**176**	1/9	0.30	1.—
Paediatric Education, Study Group on Report	**119**	1/9	0.30	1.—
Professional and Technical Education of Medical and Auxiliary Personnel, Expert Committee on Second report	**69**	1/6	0.20	0.80
Third report	**109**	1/9	0.30	1.—
Fourth report (" Post-graduate Training in the Public Health Aspects of Nuclear Energy ")	**154**	3/6	0.60	2.—
Fifth report (" Introduction of Radiation Medicine into the Undergraduate Curriculum ")	**155**	1/9	0.30	1.—
Sixth report (" The Foreign Student and Post-graduate Public Health Courses ")	**159**	1/9	0.30	1.—
Seventh report (" Preventive Aspects in the Teaching of Pathology ")	**175**	1/9	0.30	1.—
Psychiatric Nursing, Expert Committee on First report	**105**	1/9	0.30	1.—
Public-Health Administration, Expert Committee on First report	**55**	2/3	0.30	1.20
Second report (" Methodology of Planning an Integrated Health Programme for Rural Areas ")	**83**	1/9	0.25	1.—
Public Health Training of General Practitioners, Conference on Report	**140**	1/9	0.30	1.—
Rehabilitation, Expert Committee on Medical First report	**158**	3/6	0.60	2.—
School Health Services, Expert Committee on Report on the first session	**30**	2/–	0.25	1.—
Water Fluoridation, Expert Committee on First report	**146**	1/9	0.30	1.—