smear could probably have discovered it, and at a time when treatment, although undramatic, is effective. When the cancer is left to manifest itself clinically the patient has to undergo sometimes heroic treatment in an effort to achieve the possibility of a five-year cure.

Although cytology could find the vast majority of these early lesions little has so far been done to establish a cytology service, and until its use is as routine in gynaecological and post-natal clinics as is the taking of blood tests in antenatal clinics, women will continue to present in out-patient departments in the late phase of the disease with its consequent high mortality.

Cancer of the cervix must now be regarded largely as a preventable disease, and, with the remedy in our own hands, surely few can fail to be impressed with the urgency of the problem presented to us.

Summary

The results of a trial survey covering 3,366 women attending a gynaecological clinic are given. Thirty-five unsuspected cancers (28 in-situ and 7 invasive) were found, an incidence of 1.04%.

The in-situ cancers were almost all found in patients under 45 years, while the 7 unsuspected invasive cancers were found in those over 45.

An average age difference of 15.5 years between the diagnosis of in-situ cancer and the appearance of clinically obvious cancer is reported.

High parity had no influence on the cancers in this series.

The clinical appearance of the cervix of all the women screened was noted and about one-half were found to be eroded, while the unsuspected cancers were almost equally distributed between the eroded and healthy cervices.

Of 22 patients who had hysterectomy for in-situ cancer of the cervix after diagnostic conization biopsy, 12 had in-situ cancer persisting in the hysterectomy specimen, and a scrupulous follow-up of those treated by biopsy only is advised.

Three patients with widespread in-situ cancer of the cervix, two of whom had vaginal involvement and were later found to have invasive cancer of the cervix, are reported, and it is urged that vaginal involvement should be looked for before hysterectomy for in-situ cancer of the cervix.

I would like to thank Dr. W. A. Horne for giving permission and technical help for this work and the technicians who did all the staining of the smears. I am indebted to Professor Ian Donald for his interest and encouragement, and to his staff for their co-operation, also the University Department of Pathology for permission to see the relevant histology.

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SURGICAL CAPSULE OF THE BENIGN ENLARGEMENT OF THE PROSTATE

ITS DEVELOPMENT AND ACTION

BY

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[WITH SPECIAL PLATE]

The term "surgical capsule" is applied to the fibromuscular covering of the hypertrophied lobes of the benign enlargement of the prostate; it separates the hypertrophied periurethral glands from the glands of the posterior lobe. It therefore occupies precisely the same position as the interlobar or periurethral septum, which is described as separating the periurethral glands from those of the posterior lobe. The existence and structure of this septum and its relation to the surgical capsule have given rise to this investigation.

Material

Post-mortem specimens were obtained of the whole gland, including the base of the bladder, for nearly every year of life from puberty to old age. A series of foetal and infantile glands were also sectioned. Whole sections of enucleated glands were examined. A total of 107 glands were included in this series. Each gland was sectioned at the upper extremity of the verumontanum in the horizontal plane and four sections were cut. Some specimens were also cut sagittally and coronally and a few diagonal to the sagittal plane. In cases of special interest step sections were cut at various levels. The four sections were stained respectively with haematoxylin and eosin, van Gieson, Weigert's elastic stain, and Masson's triple-dye stain. The sections were examined by means of an Aldis microprojector fitted to an Aldis projector. Two drawings were made of each specimen—one in black-and-white, the other in colour—separate colours being used for different tissues and structures.

Review of Literature

The majority of writers have accepted that the surgical capsule is the normal outer coat of a benign neoplasm and that enucleation takes place between this layer and the compressed glandular tissue of the posterior lobe. Marion (1940) states that the capsule completely surrounds the adenomatous tissue, the fibres of which are arranged in a circular manner around the tumour, varying in thickness from 2 to 5 mm. From the interior of the capsule he describes muscle fibres branching off to surround the enclosed nodules of the

adenomatous tissue. Marion considers that this smooth muscle is similar to the muscle of the vesical sphincter. Lowsley and Kirwin (1944) state that there is a definite line of cleavage between this capsule and the prostatic tissue, making enucleation of the adenomatous tissue from the remaining prostatic tissue an easy matter. Winsbury-White (1961) describes the circular arrangement of the capsular fibres on the surface of the enucleated adenoma, from the deep surface of which strands pass inwards to surround the lobes and contained adenomata; while the bed from which the adenomata have been removed consists of a thickened fibro-muscular layer in which are scattered formations of compressed and atrophic glandular tissue, the false capsule. Most authors refer only briefly to the surgical capsule; few describe it in detail, and even fewer discuss its development.

Interlobar or Periurethral Septum

Adrion (1922) states that the periurethral glands are separated from those of the posterior lobe by a muscle bed extending down from the bladder musculature. Loeschke (1920) also describes a muscle septum which can be seen to lie between these two groups of glands. But Jacoby (1923) was not convinced that this septum occurred in every specimen. *Gray's Anatomy* concludes that the outer and inner glandular zones are separated by an ill-defined capsule. Franks (1953) describes an indefinite capsule separating the long external glands from the inner secretory elements. It would appear that the general opinion is that there is a fibro-muscular septum separating the posterior-lobe glands from the periurethral glands, but this septum is not constant in all prostate glands.

Musculature of the Prostate Gland in Relation to the Surgical Capsule

Ellis (1905) stated that at birth the prostate gland was a muscular organ and that the glandular elements predominated only at puberty. Harrison (1893) maintained that the role of the prostate was essentially to act as a sphincter to the urethra, as it was made up of smooth muscle fibres which group themselves around the urethra in a thick band, but when the glandular elements develop they caused the musculo-elastic tissue to separate and become scattered. Aubaret (1914) agreed that at birth there existed an axial musculo-elastic cylinder encircling the urethra which spread out peripherally over the gland lobules. Weski (1902) describes, in the 6-months-old child, longitudinal elastic fibres continuous with the walls of the bladder, periurethral circular fibres, circular fibro-muscular tissue around the excretory canals of the prostate and around the alveoli of the glands, and finally a fascicular fibre-muscular capsule encircling the whole gland. He agreed that there was a central elastic-fibre core. Moore (1943) claimed that although the muscle fibres appear to be typical smooth muscle, yet their cytoplasm often differs from that of the smooth muscle elsewhere in certain specific staining qualities and that the nuclei may be stellate rather than spindle-shaped, and he suggests that they may arise from perivascular tissue. Also that this smooth-muscle tissue, grown as an intraocular transplant, is stimulated by oestrogen, while similar transplants of smooth stomach muscle are unaffected by oestrogen.

Development of Surgical Capsule in Relation to Interlobar Septum in Present Series of Specimens of Prostate Gland

This series of specimens confirm the well-recognized fact that the prostate gland constantly changes its histological structure radically throughout life, and specific changes of structure cannot always be associated with definite age-groups. Nevertheless an average sequence of changes of histological structure can be made out for successive age-groups.

In early foetal life the prostate gland is represented by a mass of undifferentiated mesenchyme which encircles the pelvic portion of the urogenital sinus, extending from the entrance of the ureters into the bladder to below the entrance of the mesonephric ducts into the pelvic portion of the urogenital sinus. Buds from the epithelium of the urethra migrate into this mesenchyme to form the rudiments of the prostatic glands. The mesenchyme soon differentiates mainly into fibrous tissue, but a few smooth-muscle cells appear in the anterior part of the gland; these rapidly increase, completing an outer zone of circularly arranged muscle fibres, a middle zone of longitudinally arranged smooth muscle fibres, and an inner zone of fibrous tissue. This is the structure of the prostate gland at birth; there are comparatively few glandular elements present.

With the cessation of the maternal hormones there is a rapid proliferation of posterior lobe, appearing first in the postero-lateral part of the gland from ducts arising from the posterior wall of the urethra on each side of the verumontanum. As a result of this proliferation of the long glands of the posterior lobe the urethra, surrounded by its cylinder of fibro-elastic and muscle tissue, is pushed from its central position to the anterior part of the prostate and becomes adherent to the true capsule of the gland. At puberty, therefore, the long glands of the posterior lobe occupy three-quarters of the whole gland and the urethral mass the anterior quarter. This histological structure is maintained throughout the third and fourth decades, with only slight variation in the proportion of fibrous and muscle tissue in relation to the gland tissue. There are few periurethral glands arising from the posterior wall of the urethra above the verumontanum and there is no suggestion of a fibro-muscular septum separating the glands of the posterior lobe from the periurethral mass (Special Plate, Fig. 1); but in the fifth and sixth decades the prostate begins to show one of three different histological structures.

At least one-third of the specimens in these two decades show a similar structure to those of the third and fourth decades, there being little development of the periurethral glands and no suggestion of a septum separating the periurethral tissue from the glands of the posterior lobe, while the trabeculae supporting the acini of these glands maintain the slightly radial arrangement of early adult life.

A second group, less than a quarter of the specimens examined, show a small prostate gland with marked increase in the fibrous tissue of the trabeculae in proportion to the smooth muscle and a reduction in the size and number of the acini of the glands of the posterior lobe. The periurethral glands are poorly developed and there is no interlobar septum. This type of prostate progresses to become the small fibrous prostate.

The third group, consisting of less than half the specimens of this age-group, show very characteristic features; there is marked hypertrophy of the periurethral glands in the periphery of the fibro-muscular mass surrounding the urethra. Anterior to the urethra, between the true capsule and the fibro-muscular tissue surrounding the urethra, a band of transversely arranged smooth muscle and fibrous tissue develops. A similar condensation of transversely arranged muscle and fibrous cells appears between the sheath of the ejaculatory ducts and the urethra posteriorly. The trabeculae at the periphery of the periurethral tissue now become arranged in a concentric manner around the fibro-muscular mass surrounding the urethra (Special Plate, Fig. 2). These concentrically arranged trabeculae become continuous with the fibro-muscular glands in front of and behind the urethra, thus forming a loose-meshed septum between the periurethral glands and the glands of the posterior lobe.

The loculi and acini contained within these concentrically arranged trabeculae take on a crescentic shape to give an almost fissured appearance to the septum. As the hypertrophy of the periurethral glands increases, these concentric trabeculae thicken considerably by an increase in the smooth muscle of which they are composed and to a less degree the fibrous tissue (Special Plate, Fig. 3). The loculi are further drawn out crescentically and contain epithelium flattened and compressed. As the hypertrophy of the periurethral glands increases so the fibro-muscular tissue surrounding them becomes more closely compressed, containing fewer elongated spaces lined with epithelium, until a dense capsule covering all the periurethral glands is formed—the surgical capsule. Enucleation of the hypertrophied periurethral gland mass normally takes place through the central plane of this capsule, leaving an inner layer to ensheath the enucleated portion of the gland and an outer layer—the false capsule—to line the prostatic cavity (Special Plate, Fig. 4).

Structural Anatomy of the Surgical Capsule

In the young adult the trabeculae extend from the periurethral fibro-muscular tissue, in a sponge-like network, to the true capsule. The trabeculae in general are formed of outer zones of fibrous tissue and a central core of smooth muscle, enclosing irregularly oval or rectangular loculi, containing the acini or ducts of the glands of the posterior lobe, so that on contraction of the smooth muscle the acini or ducts are emptied of secretion.

In middle age, when the trabeculae at the periphery of the periurethral mass may become rearranged concentrically around the urethra, the smooth-muscle core of each trabecula hypertrophies and adjacent trabeculae are pressed together, so narrowing or obliterating the enclosed loculi. The interlobar or periurethral septum so produced is adherent over the anterior half of its circumference with the true capsule, few glandular elements being found between these two capsules. Above, at the junction of the bladder with the true capsule, this interlobar septum is continuous with the inner layer of the longitudinal muscle coat of the bladder, anteriorly and laterally. Posteriorly, from a point on the inferior surface of the trigone, midway between the interureteric bar and the apex of the trigone, where it is continuous with the longitudinal muscle of the bladder, it passes downwards and forwards in front of the sheath of the ejaculatory ducts, separating the glands of the posterior lobe from the periurethral gland. At the proximal end of the verumontanum it is pierced by the urethra, so that at enucleation the verumontanum and ejaculatory ducts should remain uninjured. From there it passes forwards over the glands and striped muscle at the apex of the prostate to become adherent to the true capsule, with which it ascends to the junction of the bladder and prostate.

J. E. SEMPLE: KEY TO NUMBERS ON SPECIAL PLATE

FIG. 1

The urethra (1) has been incised anteriorly as the routine procedure in post-mortem examination. The urethra is anteriorly placed in the gland and is surrounded by a zone of fibro-muscular and elastic tissue (2), from which trabeculae (3) of smooth muscle and fibrous tissue spread out peripherally to join the true capsule surrounding the gland (4). There is no evidence of a septum separating the periurethral zone from the glands of the posterior lobe.

FIG. 2

The urethra (1), surrounded by a fibro-muscular and elastic-tissue zone (2), is now more centrally placed in the gland. Periurethral glands (3), arising from the posterior wall of the urethra above the verumontanum, develop in the periphery of the fibro-muscular and elastic mass surrounding the urethra. The trabeculae adjacent to the periurethral mass (4) adopt a concentric arrangement encircling this zone. The loculi formed by these trabeculae and containing the acini of the glands of the posterior lobe are also drawn out crescentically (5) around this periurethral zone. There is a marked increase of transversely arranged fibro-muscular tissue in front of the urethra (6), between it and the true capsule, and a similar arrangement of fibro-muscular tissue posteriorly (7), between the ejaculatory ducts (8) and the urethra. The concentrically arranged trabeculae unite with these transverse fasciculae to form a fibro-muscular ring between the periurethral glands and the glands of the posterior lobe.

FIG. 3

The urethra (1) lies in the centre of the gland. The periurethral glands (3) have developed at the expense of the fibro-muscular and elastic tissue surrounding the urethra (2). The trabeculae (4) adjacent to the periurethral glands show a concentric arrangement, while the more remote trabeculae maintain their normal architecture. These concentrically arranged trabeculae are not sufficiently condensed to suggest a septum separating the periurethral glands from the main mass of the glands of the posterior lobe. There is a well-marked collection of transversely arranged fibro-muscular tissue between the urethra and the true capsule anteriorly (5).

FIG. 4

The urethra (1) has come to lie in the posterior half of the gland. It is surrounded by lobules of hypertrophied periurethral glands (2), each being enclosed in its own capsule, and the whole periurethral mass is surrounded by a thick fibro-muscular layer, the surgical capsule (3). The surgical capsule is adherent to the true capsule over the anterior half of its circumference with no glandular elements interposed between these two capsules. Laterally, where these two capsules meet, there is a wedge of fibro-muscular tissue (4) containing few glandular elements. Numerous blood-vessels lie just on the outer side of the surgical capsule, but few could be followed through the thickness of the capsule. The surgical capsule is thickened anteriorly and posteriorly. Here it forms a definite septum between the periurethral glands and the glands of the posterior lobe.

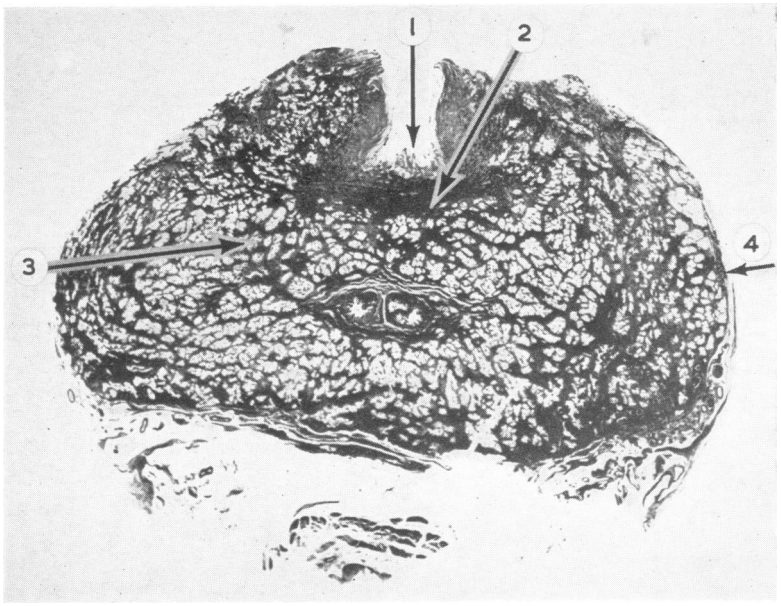

FIG. 1.—Horizontal section of the prostate gland of a man aged 30 at the level of the upper extremity of the verumontanum.

[A key to the numbers on the four figures is given in a panel on page 1642]

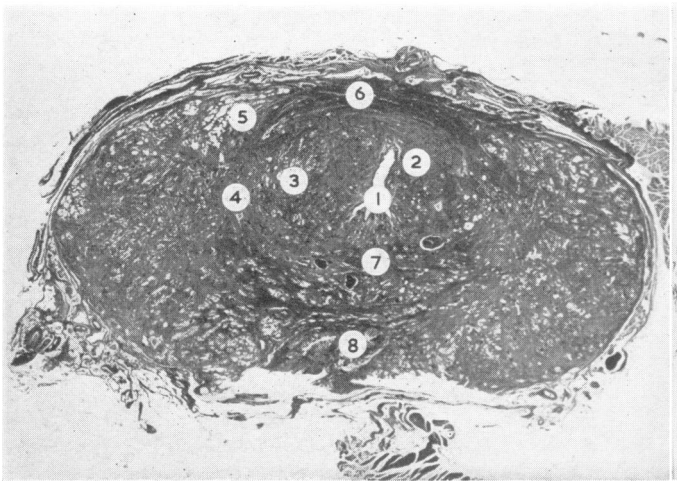

FIG. 2.—Horizontal cross-section of the prostate gland at the level of the upper extremity of the verumontanum in a man aged 43.

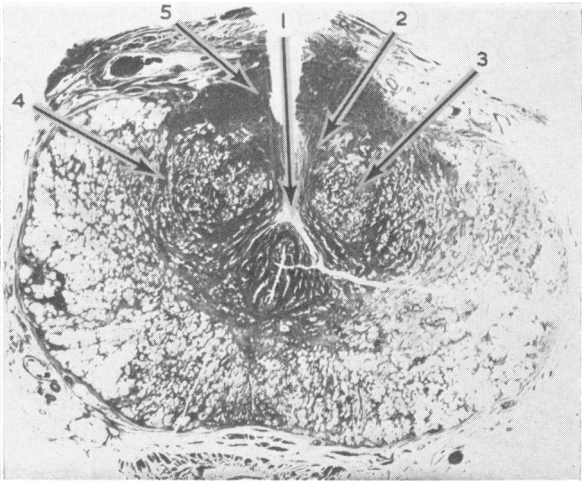

FIG. 3.—Horizontal section through the prostate gland at the level of the upper part of the verumontanum in a man aged 50.

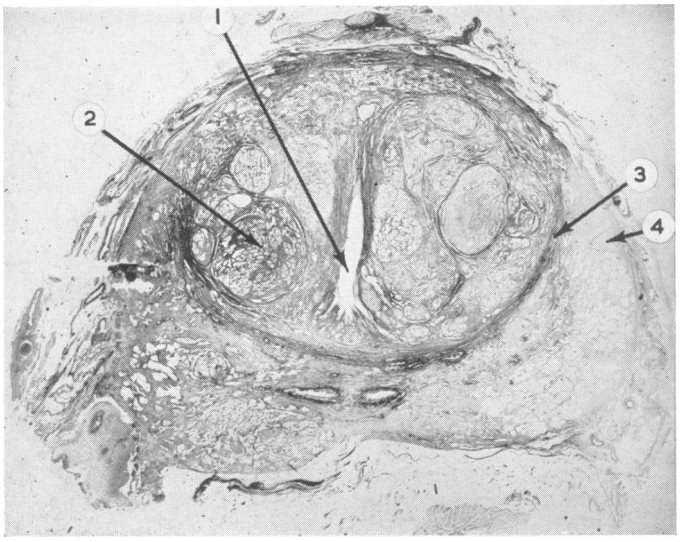

FIG. 4.—Horizontal cross-section of the prostate gland at the level of the upper extremity of the verumontanum in a man aged 67.

In the horizontal section it will be seen that the wedge-shaped space which is present where the surgical capsule meets the true capsule laterally is filled with fibro-muscular tissue in which there are very few if any glandular elements, so that when the periurethral mass increases in size very few glands are sandwiched between these two capsules. The glandular elements of the posterior lobe appear to retract rather than to be forced back by the enlarged periurethral mass. As the periurethral glands continue to hypertrophy, the smooth muscle of the septum continues to increase in proportion to the fibrous tissue, but it also becomes more compressed and denser, and the loculi lined with epithelium become obliterated, until the typical surgical capsule is produced.

Action of the Surgical Capsule

The action of the surgical capsule on the prostate gland is mainly in two directions. Firstly, the enclosure of a hypertrophying gland in a thick muscle-sheath, which is fixed above and below, causes the periurethral enlargement to project upwards either as a cone or as separate lobes into the bladder, which may result in obstruction of the bladder neck, and retention or contraction of the smooth muscle alone may cause retention. The elongation of the prostatic urethra and the migration of the verumontanum towards the apex of the prostate from the centre of the prostatic urethra and the backward curvature of the urethra are also largely due to the action of this capsule.

Secondly, the blood supply of the gland is markedly affected by the surgical capsule; the prostate gland is supplied by the prostatic branches of the inferior vesical artery on both sides, two branches passing to the urethra and two to the capsule on each side. In the young adult there is anastomosis through the gland of these two sets of arteries, but when the trabeculae become concentrically arranged around the periurethral mass this anastomosis is considerably decreased, so that periurethral enlargement has to rely on the urethral branches, which become as a result greatly enlarged, so that during enucleation arterial bleeding is very much more localized than it would otherwise have been. The venous drainage of the prostate is similarly affected by this capsule. The adherence of the surgical capsule to the true capsule anteriorly may result in the tearing of the vein which ascends in the true capsule in the midline. The large collection of veins which drain much of the hypertrophied portion of the gland run down with the urethra to empty into the plexus of veins at the apex of the gland. They are torn during enucleation at the point where the urethra pierces the capsule just above the verumontanum. The veins accompanying the urethral branches of the prostatic arteries are also hypertrophied with their associated arteries as a result of their anastomosis with the capsular vessels being reduced by the surgical capsule.

Summary

The surgical capsule is produced by the continued development of the interlobar septum. This septum is present only when the periurethral glands hypertrophy. It is mainly the result of the hypertrophy of the smooth muscle and to a less extent of the fibrous tissue of the trabeculae. The trabeculae become rearranged in a concentric manner around the hypertrophying periurethral glands, first producing a loose crescentic meshwork between the glands of the posterior lobe and the periurethral glands. This meshwork becomes condensed into a dense fibro-muscular sheet. The structure and attachments of this capsule are mainly responsible for the enlarged portion of the gland projecting upwards into the bladder and either indirectly or directly causing retention. The blood supply of the enlarged prostate is radically affected by the development of the capsule. The presence of this capsule is essential for the enucleation of the hypertrophied portion of the prostate, which should take place through the central plane of this capsule, leaving an inner layer to cover the enucleated gland and the outer layer to line the resulting prostatic cavity. This lining of the prostatic cavity plays an important part in the control of bleeding, the contraction of the prostatic cavity, and the epithelization of this cavity.

This investigation was made possible only by the fullest co-operation of the staff of Group 9 Laboratories, West Herts. I am especially indebted to Dr. C. C. S. Pike for his assistance and advice; also to Dr. R. M. Ransom, Dr. J. Taylor, and Dr. R. M. Read for their help in preparing the specimens. I would like to thank Dr. R. C. B. Pugh for his advice and constructive criticism. I am very grateful to G. R. Bryden for preparing the great majority of the sections and to R. E. Bartholomew for the photomicrography.

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The Minister of Health, Mr. Enoch Powell, addressing the annual conference of the Hospital Caterers' Association at Weston-super-Mare on April 25, said: ". . . For food is a desperately important thing. Anywhere this is true; and though perhaps in hospital there are certain other things which rank above it in importance, it is still desperately important there. Like many other aspects of a national hospital service, this one is tantalizingly and frustratingly difficult to get hold of and to influence. I am convinced that in the 2½ million meals a day which the hospitals serve and the £40m. a year which the hospitals spend on food there is immense waste, of which a substantial part, though naturally not a precisely definable part, need not occur. I am convinced that the choice, preparation, and service of food to hospital patients is one of the main points of human relations and that, in total over the service as a whole, immense damage to relations with patients and public and to the esteem of the service is done by faulty choice, preparation, and presentation of food, and that a great part of this damage is avoidable. . . . You will recognize what I mean when I say that our hospital service to-day offers many strange studies in contrast: the juxtaposition of the most adventurous and innovating methods, techniques, equipment, and ideas, with the survival of some almost antediluvian traditions and habits, traditions and habits which are so familiar that it calls for a conscious effort to see how incongruous they have become. Some of these traditions and habits survive and flourish in hospital catering. . . . At every state, in preparation, distribution, dishing-up and service, collection and clearance, the traditional methods still in use in the majority of hospitals are cumbrous, wasteful of time, labour, and material, and above all (what I care about most) hugely insensitive."