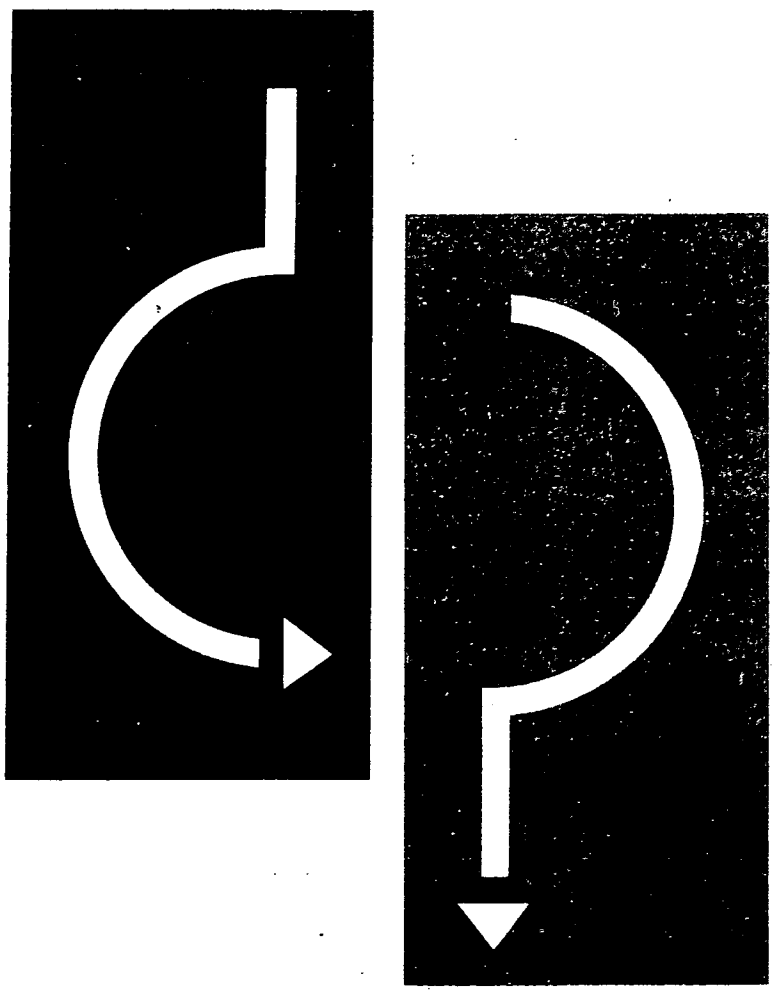
Central Sterile Supply

Principles and Practice



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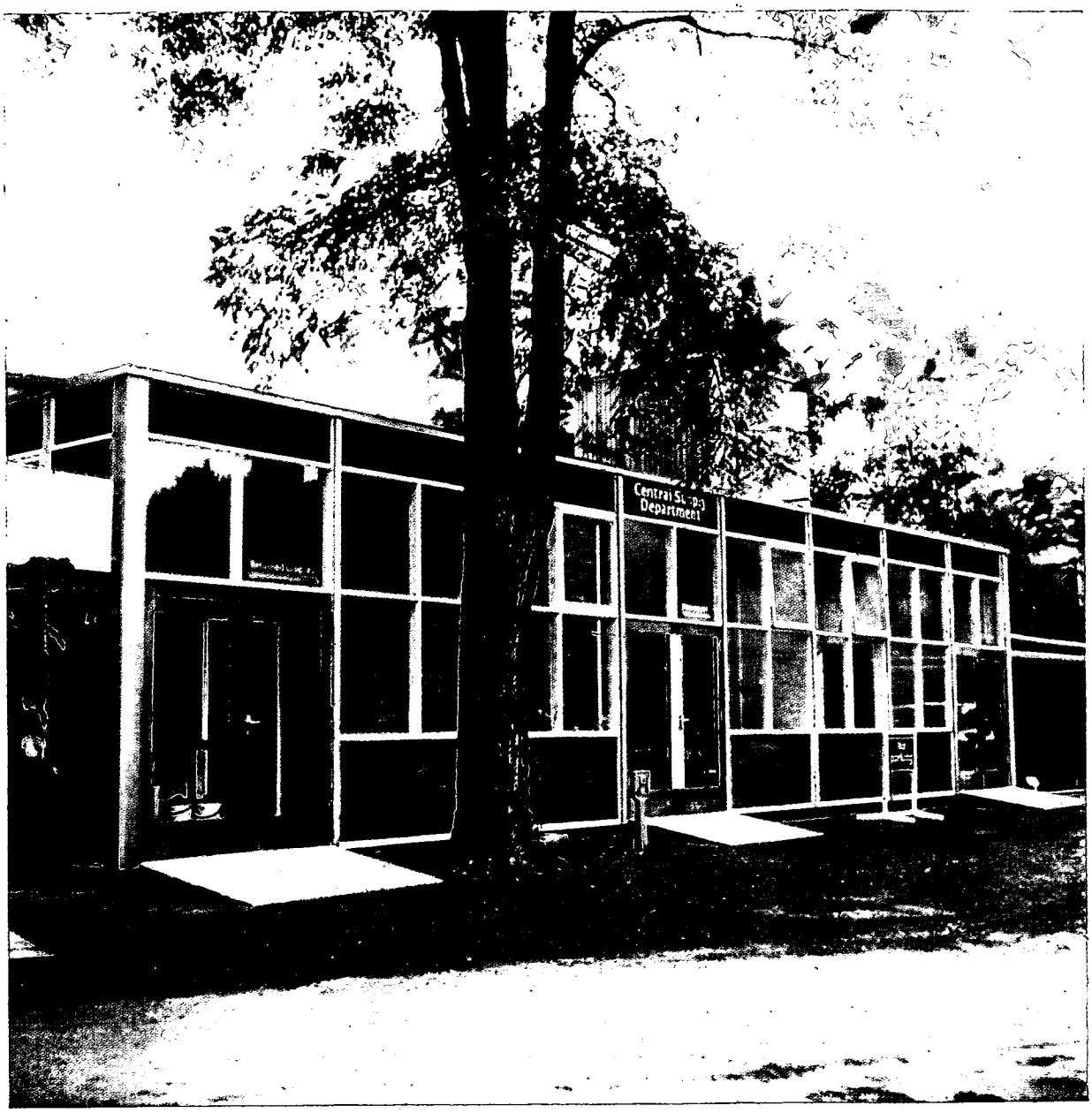

1 The Experimental Central Sterile Supply Department, Addenbrooke's Hospital, Cambridge

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Foreword

The trustees of the Nuffield Provincial Hospitals Trust have over the past five years sponsored investigations into hospital sterilizing practices. This report is the third and final report of the Trust's investigations.

Their first publication, in 1957, was *Planning and Organization of Central Syringe Services* and their second, published in 1958, was *Present Sterilizing Practice in Six Hospitals*. The three reports should be regarded as a single work.

This final report is based on the operational research team's investigations into American and European central sterile supply practices—although little was to be learned from Continental practice—together with experimental work undertaken in the Central Sterile Supply Department set up at Addenbrooke's Hospital, Cambridge, which the trustees have backed with generous financial aid.

Central sterile supply has only comparatively recently been introduced into this country. Although guide material in the report is based on the result of experiments at Cambridge, this does not necessarily mean that all the methods tried out there were formulated at Cambridge. Much information has been gained from Portsmouth and Bristol. There are a number of workers in the field and it is due to the growing enthusiasm of administrators, doctors and nurses, who can examine critically the operation of central sterile supply at the bedside, that new methods are periodically being introduced.

During this work the operational research team has experimented and tried various methods, and as necessarily happens in the development of any new project, much has had to be discarded while different methods were evaluated and one or more chosen as satisfactory. It will be seen, therefore, in the report that two or more methods are described so that a hospital authority setting up a central sterile supply service can adopt the method best suited to local conditions.

In the National Health Service it is inevitable that any development of central sterile supply must also be assessed from the point of view of economics. The introduction of American practices of central sterile supply in this country would be far too expensive and would mean that years must elapse before central sterile supply could be adopted nationally.

Until a number of central sterile supply depots have been working for at least two to three years it will be impossible to ascertain which type of service will be the more economical—a sub-Regional depot serving a number of hospital Groups, or a Group depot serving a smaller number of hospitals. It is hoped that the information given in this report will enable a Management Committee to consider introducing central sterile supply at a level believed at present to be economically feasible.

Since the publication of the Trust's report on *Present Sterilizing Practice in Six Hospitals* it has been gratifying to see the number of hospitals that have taken the lessons of that publication to heart by improving their dressing techniques and methods of sterilization.

Efficient sterilization and good dressing techniques are in the forefront of the continuing battle against hospital cross infection. Hospital authorities who suffer from a shortage of nurses and midwives might profitably turn to central sterile supply as it will be seen from this report that the procedures involved can be carried out by relatively unskilled labour, thus freeing the nurse for her proper duties at the bedside.

The introduction of disposable sterile materials will obviously affect central sterile supply as we know it at present. There seems to be, however, in some quarters an attitude of mind that all work in central sterile supply departments, as described in the report, will eventually be completely superseded by the introduction of a range of sterile disposable articles prepared by the manufacturer. The operational research team has pointed out that this cannot happen. Hospital authorities ought now to take advantage of the availability of these disposable articles in order to introduce central sterile supply as rapidly as possible, rather than to use the introduction of the disposable article as an excuse for doing nothing.

It is as well to remember that the results of even the most efficient central sterile supply department could come to nought if the basic principles of asepsis and antisepsis were

not properly understood by everybody working in the hospital. The necessity for hospital authorities to define responsibility in this sphere is as important now as it ever was.

Finally, the advisory panel would like to pay tribute to the Trust's operational research team who have been responsible over the past five years for producing the guide material in the three volumes sponsored by the Trust. Research into and assessment of central sterile supply techniques in this country, in America and on the Continent has entailed long, patient and painstaking work on their part.

February 1962 JOHN REVANS

Introduction

Over a period of years the trustees of the Nuffield Provincial Hospitals Trust have steadily supported investigations into hospital sterilizing practice. In 1957 they published a booklet on how central syringe services might be planned and run.[1] A year later a further publication followed. This reported how sterilization was then being conducted.[2] This present book, the final one of three, gives an account of their long-term investigations into the organization of central sterile supply and suggests methods whereby British hospitals might plan and run their sterilizing practice. The methods described in the following pages are not the only ones; provided the principles remain intact any one of several methods can be adopted, the choice being dependent upon local considerations. So far as can be determined no previous comprehensive book on this subject has been published in the British Isles. This is largely because little work on the organization of central sterile supply has been done. G. Sykes's book[3] covers a wide field and deals as much with the theory as with the practice of sterilization. But it hardly sets out to be of practical guidance to hospitals on how to do the job. R. E. O. Williams, R. Blowers, L. P. Garrod and R. A. Shooter's excellent book[4] outlines the epidemiology of hospital infection, and suggests a number of ways in which hospital infection can be controlled and reduced. It does not attempt to go into the details of central sterile supply. More recently the Association of Clinical Pathologists published a special edition of its journal[5] dealing with hospital cross-infection. But there was only space in this edition for one article dealing with the organization of central sterile supply, a subject which demands much fuller treatment. It is hoped that this book dealing as it does in some detail with the organization of central sterile supply will fill a gap in the current needs of British hospitals.

Of recent years two publications by Carl W. Walter[6] and John J. Perkins[7] dealing with central sterilizing have appeared in the U.S.A. The advice given in these text books is not, as will be shown later, altogether applicable to British hospitals. American hospitals are in competition with each other; whereas British hospitals, being organized in groups, are expected to co-operate. Differences between American and British practice are therefore to be expected. Further, since these two American books were written many developments have occurred. The use of high-vacuum autoclaves has transformed the techniques for the sterilization of dressings; moving-belt infra-red ovens have provided an improved method for the sterilization of syringes and ward instruments; the substitution of disposable paper for returnable linen and the use of cartons instead of hospital drums have changed packaging methods. All these affect the organization of central sterile supply and must be taken into account in any system advocated. It is clear, therefore, that we should not follow uncritically American practice or that of the Continent, which is in many respects based on the American pattern. The time is ripe to advocate a system of central sterile supply suitable for British hospitals. That is what this book sets out to do.

The experimental central sterile supply department at Cambridge which was sponsored jointly by the Board of Governors of the United Cambridge Hospitals and the Nuffield Provincial Hospitals Trust has provided the basis for the system advocated in these pages. Much of the experimental work described has been done there. But this department has only functioned since May 1960. This is altogether too short a time to enable detailed attention to be given to all aspects of the work that has had to be done. It is hoped, nevertheless, that by establishing the principles involved in the organization of central sterile supply and outlining a method of their application, a useful lead will have been given. When a few more departments have been built and more experimental work done then the pattern may change. But this is only likely to be in matters of detail. The principles enunciated will remain even if the methods of their application are modified in time.

This brief introduction cannot close without acknowledging the great help which the operational research team has received. So many people have generously

[1] Nuffield Provincial Hospitals Trust (1957), *Planning and Organization of Central Syringe Services, London.*
[2] Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London.
[3] Sykes G (1958), *Disinfection and Sterilization*, E & F N Spon. London.
[4] Williams R E O, Blowers R, Garrod L P, and Shooter R A (1960), *Hospital Infection*, Lloyd-Luke. London.
[5] *J. clin. Path.* (1961), **14**, 1.
[6] Walter Carl W (1958), *The Aseptic Treatment of Wounds*, The Macmillan Company. New York.
[7] Perkins John J (1956), *Principles and Methods of Sterilization*, Charles C Thomas, Illinois, 244.

contributed to the successful completion of the investigation that it is impossible to name them all. But mention must be made of the advisory panel, who have encouraged and guided the team in their deliberations over the past five years. Their help and criticism have been invaluable. Tribute must also be paid to E. M. Darmady who, in matters of central sterile supply, is usually translating into action steps which others are still debating. The greatest help has also been given by the medical, nursing and administrative staff of Addenbrooke's Hospital. Throughout many months the staff there have tried out new ideas, some hopeful, some hopeless. In every instance the staff have conducted the trials with interest and patience, and the team are indebted to them. The team have also been encouraged by the knowledge that once sterilization arrangements have been centralized the nursing staff never want to return to the old methods. This has also been the experience of others experimenting in this field. It is hoped that, in future, not only will nurses have less work to do, but that the equipment they use will really be sterile and some contribution will be made towards a reduction in hospital infection.

Part 1 The Central Sterile Supply Department *CSSD*

Chapter 1 General Considerations

The aims of CSSD—the scope of CSSD—the role of the manufacturer—suggestions for interim measures.

The Aims of the Central Sterile Supply Department (CSSD)

1 It has been characteristic of sterilizing practice in the past that all sterilization should be decentralized and done in the wards and other hospital departments. It is already generally accepted that decentralized methods of sterilization cannot be effective. Boilers which feature so prominently in clean utility rooms have been shown to be ineffective in achieving sterility, even if they are used properly.[8] All too often they are not.[9] Nor is it likely that the contents of metal drums treated in the main hospital autoclave are always sterile.[10] It would be no remedy to this inefficient practice to rely on exhorting the nursing staff and others to do the job better. Future sterilizing policy to be effective must provide a centralization of facilities, where modern equipment can be employed, where routine tasks can be done by staff who are not so highly trained as nurses, and where supervision and control are assured. Such a trend is indeed becoming increasingly noticeable throughout the hospital service. As the *Lancet*[11] says: '. . . There is nothing new about the idea of a hospital central sterile supply department. Twelve years ago Walter regarded such departments as essential, and a recent visitor to the United States noted that they have been introduced everywhere. . . .' Again, as the Ministry[12] says: '. . . one answer to the problem may be to consider the practicability of setting up central sterile departments so as to overcome the need for having expensive items of equipment dispersed throughout the hospitals. . . .' A possible objection to CSSDs is sometimes put forward by matrons and tutors who contend that nurses cannot learn how to sterilize if it is all to be done for them. This may not of itself be sufficient reason to continue a sterilizing practice which has been shown to be suspect. In any case the General Nursing Council asks that nurses shall be taught the techniques of sterilization in the classrooms of hospitals served by CSSDs. A nurse will not therefore be without instruction if she later moves to a hospital where there is no CSSD. Moreover, some instruction in CSSD methods should be given to nurses whilst they are in training.

2 CSSDs are now an accepted feature of hospital planning. But it is essential that their purpose should be clearly thought out and uncompromisingly stated. Considerable discussion has taken place on this issue and it is generally agreed that the aims of CSSDs are:

(*a*) TO PROVIDE STERILIZED MATERIALS FROM A CENTRAL DEPARTMENT WHERE STERILIZING PRACTICE IS CONDUCTED UNDER CONDITIONS WHICH CAN BE PROPERLY CONTROLLED, THEREBY CONTRIBUTING TO A REDUCTION IN THE INCIDENCE OF HOSPITAL INFECTION

(*b*) TO TAKE SOME OF THE WORK OFF THE NURSING STAFF SO THAT THEY CAN DEVOTE MORE TIME TO THEIR PATIENTS

The Scope of CSSD

3 To achieve the aims set out, it is necessary first to decide what is to be dealt with in the CSSD. Clearly the wider its scope the better since controlled sterilization is one of the aims. But are there any items which it is impracticable to sterilize centrally, desirable though it might be to do so? Let us consider:

(*a*) Surgical instruments for use in the operating theatres.
(*b*) Bedpans and urinals.
(*c*) Pharmaceuticals.
(*d*) Bedding.
(*e*) Clean equipment, for example portable suction apparatus.

8 *Lancet* (1959), *i*, 622–624
9 Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 20 para. 18
10 *Ibid.* 24, para. 25, 38, Table III
11 *Lancet* (1960), *ii*, 353
12 H M (59) 33, See *Lancet* (1959), *i*, 791

(*a*) *Surgical Instruments* The following points should be borne in mind when considering the processing of theatre instruments.

(*i*) Theatres are usually provided with the proper facilities for sterilizing and preparing instruments for an operation. No protective packaging is called for since sterile instruments pass directly into the theatre for use.

(*ii*) Theatre staff are trained to observe a high standard of aseptic technique and they suffer none of the distractions of their colleagues in the wards. They are familiar with the requirements of operative procedures and with those of the surgeons with whom they work.

(*iii*) The number and variety of instruments needed for an operation is considerable. But a general set need only be duplicated, or at most trebled, to allow an operating list to run smoothly.

(*iv*) Sterilizing facilities are readily available for the dropped or forgotten instrument.

To place the responsibility for processing theatre instruments on the CSSD would involve a considerable capital outlay, because it would prove impracticable to use a set of instruments for more than one operation a day. The cost of 'filling the pipe line' to meet a day's operating list would be prohibitive. There would also be the additional cost of labour and materials in packaging the instruments for storage and transport. Special training and supervision of lay staff would be required to enable them correctly to handle and package complicated instrument sets; and the bulk and weight of such sets would add considerably to the daily transport of sterile supplies. These are important disadvantages, when considered against the ease with which instruments can be mechanically washed and sterilized in the theatres. It is obvious that there is little to recommend the processing of theatre instruments in a CSSD.

(*b*) *Bedpans* Early ambulation of patients has brought about a general decrease in the number of bedpans required. Nevertheless, in a busy female surgical ward of 27 beds, between 75 and 126 bedpans can be called for in one day. In a male medical ward of similar size, 2·6 bedpans and 77 urinals can be required in one day. Bearing in mind these figures and the unpleasantness and the bulkiness of transporting such articles about a hospital, it would be unrealistic to undertake the processing of bedpans and urinals centrally. Even if disposable bedpans should prove suitable, they would still remain the responsibility of the ward rather than the CSSD.

(*c*) *Pharmaceuticals* Hospital pharmacies produce and sterilize a number of special products mostly in liquid form. But few would argue that these should be produced in CSSDs. It may safely be concluded that the production of pharmaceuticals and pyrogen-free sterile water must remain the province of the pharmacist.

(*d*) *Bedding* It may be argued that CSSDs should undertake the disinfection of bedding. This includes mattresses, blankets, pillows, and other similar articles. These may require boiling, gaseous or steam sterilization, and the machinery and processes are rather different from those normally used in CSSDs. In America, bedding is dealt with in the hospital laundry. It is thought that either here or in a bed-disinfection unit is the proper place and that beds and bedding should be dealt with there and not in the CSSD.

(*e*) *Clean Equipment* There are items of special equipment such as suction apparatus, oxygen equipment, etc., which wards and departments require from time to time. Each ward usually holds its own equipment and the staff are responsible for maintaining it in a clean and workable condition. This practice can be criticised as being both uneconomic and administratively unsatisfactory. Costly pieces of equipment are likely to lie idle awaiting emergency use, and routine servicing is liable to be overlooked. Some improvement might be found in the central storage of such equipment from where it could be issued on request and returned after use. An arrangement along these lines would achieve economy and efficiency by ensuring an intensive use of equipment, a high standard of cleanliness and a periodic servicing by technicians. There is thus some force in the argument that CSSDs should ultimately undertake the maintenance and storage of clean equipment. Pride of place should, nevertheless, be given to wards' needs for sterile equipment leaving such things as the maintenance of clean equipment for later consideration when CSSDs are fully established.

4 In establishing a CSSD we can now, therefore, state that it should produce for the hospitals it serves all sterile requirements other than theatre surgical instruments, bedpans and urinals, pharmaceuticals and bedding. Only when such requirements have been fully

met might it be considered advisable to include clean equipment.

The Role of the Manufacturer

5 The question is often asked, why establish a CSSD at all? Would it not be cheaper to buy everything pre-packed and pre-sterilized from the manufacturers? As Knox[13] observes: '. . . there is an increased feeling that many types of sterilization should not be carried out on a hospital basis at all, but that commercial production and distribution would give more efficient and in the long run more economical results . . .' and later '. . . We seem to be moving into an era in which sterilization will be much less a hospital responsibility but will be in fact an industrial process carried out by industrial methods . . . on an industrial scale'. Let us examine this concept. There are three principal factors to be considered:

(*a*) Will the manufacturers produce as good a quality of product as the hospital can for itself?
(*b*) Can the manufacturers cover the whole range required?
(*c*) Will the price be economic?

(*a*) *Quality* Some fifty years ago it was common practice for surgeons to sterilize their own catgut. No surgeon would now think of doing so, nor is he allowed to. The product he buys from manufacturers is more surely sterile and better packed than anything he can produce for himself. As a result, surgical tetanus contracted from catgut is now unknown. More recently, manufacturers have increased their range of sterile disposable products, and there is no evidence to show that their record does not equal that of the suture manufacturers. Added to this there is the argument that a manufacturer's livelihood rests upon the unquestionable quality of his product. It is therefore reasonable to assume—indeed reputable manufacturers have already demonstrated—that the quality of products packaged and sterilized by them will equal, and in many instances better, those which hospitals produce for themselves.

(*b*) *Range* There are two categories of sterile articles produced by manufacturers:

(*i*) Those which are sold sterile, used once and then thrown away. These are commonly known as disposable articles.
(*ii*) Those which are hired and returned to manufacturers to be processed, and re-issued, probably to a different user. These are as yet limited to syringes and hypodermic needles.

Can these two categories of equipment provided by manufacturers cover the whole range of a hospital's requirements? That is the question posed by Knox. Appendices E, F, and J list the sterile equipments which it has been found necessary to issue to the wards and departments at Cambridge. The lists are very long and include all kinds of articles which manufacturers have not yet attempted to produce under (*i*) or (*ii*) above. They would either be unsatisfactory if made sufficiently cheap to be disposable (for example dressing instruments) or it would be uneconomical to send articles (for example spinal needles, pint measures, etc., which are used in small quantities) backwards and forwards. These items hospitals can easily process for themselves. Manufacturers will always tend to limit the range of articles they produce to those which are likely to be used in large quantities, and which it will be easy for them to sell at competitive prices. This range can meet but a small proportion of a hospital's demands, and for a long time to come hospital staff will have to be prepared to produce the remainder.

(*c*) *Price* It is not wished at this stage to enter into details of price since Chapter VII is devoted to financial considerations. It is sufficient to say that such information as is available indicates that if hospitals buy disposable or re-usable articles from manufacturers, they will have to pay a little more than they would do if they were themselves to undertake the task (see paragraphs 134 to 137). This is because manufacturers have to meet a number of charges which hospitals do not incur. A profit for their shareholders and heavy transport costs are cases in point. Such charges tend to increase a manufacturer's costs, and they can only offset these by greater efficiency in production. Hospitals should, therefore, avoid buying those things which they can themselves easily produce. Nevertheless, occasions may arise when the scale of operation is very small or suitable labour is unobtainable. In such circumstances there may be no alternative to buying disposable and re-usable articles direct from the manufacturers.

6 There are, however, some articles which are difficult to process even with the facilities of a CSSD. Surgical gloves, catheters and hypodermic needles are good examples. Not only is the processing of each of these items laborious, but there is no means of knowing whether the work has been properly done. Is no pair of gloves ever

[13] Knox R (1961), *J. clin. Path.* **14**, 11

returned into service with a hole? Are catheters always clean? Are the hubs and lumens of hypodermic needles always clear? Few people would answer these questions in an unqualified affirmative. Yet, if these items are not properly cleaned and sterilized, it may be dangerous to the patients, the staff, or to both. These are therefore the articles to which hospitals should give priority in their purchases from manufacturers. Such articles should be bought, used once only, and then thrown away; even if by doing so an increase in costs results. Some assessment of the cost of such a policy is given in paragraph 145.

7 In conclusion it is suggested that, hospitals should buy from manufacturers only those sterile disposable articles which they cannot process satisfactorily for themselves. Such a policy will provide the most efficient solution.

Suggestions for Interim Measures

8 The general points so far made define the aims and scope of central sterile supply and suggest that hospitals should run such departments for themselves. But in some hospitals it may not be immediately possible to do so. There may be no room for a CSSD or there may be other and more urgent claims upon a limited budget. Before proceeding, therefore, to discuss the principles and the details of organization of CSSDs, it may help such hospitals to outline what steps might be taken now, 'on-a-shoe-string' as it were, to improve sterilizing practice until such time as a CSSD can be built.

Such a problem recently presented itself at the Bristol Royal Infirmary.[14] The paragraphs that follow outline some suggestions most of which are based on the experience gained there. Broadly it is suggested that the following steps be taken:

(*a*) The autoclave should be upgraded.
(*b*) The hospital should start a central syringe service.
(*c*) Pre-packed dressing packs should be used on the wards.
(*d*) Sterile disposable catheters and needles, and disposable rubber gloves should be bought from the manufacturers, if money is available.
(*e*) Ward instruments, lumbar-puncture and intravenous cutdown sets and certain urological equipment should be processed centrally.

[14] Personal communication from Dr V G Alder, PhD (Senior Hospital Bacteriologist, United Bristol Hospitals)

(*a*) *Upgrading the Autoclaves* It is not always necessary to purchase new autoclaves. Existing autoclaves with a chamber suitable to withstand an increased pressure can be upgraded, for a modest sum, to automatic high pre-vacuum status by fitting conversion units. Converted autoclaves can be mechanically reliable as well as bacteriologically efficient. At the Bristol Royal Infirmary two converted autoclaves have been in routine use for over two years. They have performed all the sterilizing required for two general hospitals, a children's hospital, a maternity hospital, an eye hospital and a dental hospital (a total of 1,000 beds). In addition they have performed emergency sterilizing for one other hospital. The autoclaves are not used for more than eight hours a day. A routine servicing scheme is provided by the manufacturers once a quarter or on demand in the case of an emergency. The staff working the autoclaves now total $1\frac{1}{2}$ persons as against the $3\frac{1}{2}$ persons employed formerly.

(*b*) *Central Syringe Service* There are three possible ways of providing the hospital with syringes. Disposable syringes can be bought; sterile, re-usable syringes can be hired from a manufacturer who undertakes to process them; or the hospital can run its own syringe service. The present range of disposable syringes does not cover all the uses for which syringes are required; they will also prove more expensive than syringes processed in the hospital (see paragraph 147). It is felt that hospitals should leave disposable syringes for the use of others who have no alternative source of supply. Hospitals should also be able to process their own syringes more cheaply than can a manufacturer for them. It is accordingly suggested that those hospitals which have the facilities and the staff should run a syringe service. This should be on a scale big enough to provide syringes for local health authority clinics, general practitioners, and midwives. Hospitals that already undertake this service have not found that it makes any appreciable increase in demand on staff or equipment. Such users must, of course, undertake their own delivery and collection.

A room of some 200 square feet should be sufficient. Washing on such a limited scale of operation would probably be better done by hand in a sink. A drying oven and a moving-belt infra-red sterilizer or two hot-air ovens would be needed. The general methods of processing and packing are described later in paragraph 77. Most of the needs for needles could be met by using disposable needles bought already sterilized from a reputable manufacturer. Methods for processing needles

which cannot yet be bought from the manufacturers are described in paragraph 71.

(*c*) *Pre-packed Dressings* One of the aims of central sterile supply is to take work off the nursing staff in the wards. A way in which this can be done is by providing the nurses with pre-packed dressings. Hospitals can either:

(*i*) buy pre-packed clean or sterilized dressings from a manufacturer; or
(*ii*) prepare the dressing packs centrally for themselves.

As has been mentioned earlier in this chapter, and will be described at greater length in paragraphs 132–137 the latter policy will probably prove slightly the cheaper of the two. The following information may help hospitals where it is decided to undertake packing locally. A room of about 120 square feet will be big enough. In this area it has been found that two persons can prepare the dressings packs for a hospital of about 400 beds. Contents of dressing packs are given at Appendix E and packaging methods are described in paragraph 50 *et seq.*

(*d*) *Disposable Catheters and Gloves* Mention has already been made of the difficulty of processing catheters and gloves. Because of this difficulty it is suggested that hospitals should take advantage, as soon as possible, of the superior quality of the disposable substitutes, and buy them. The cost of this policy is given in detail in paragraph 145 (*b*) and (*c*).

(*e*) *Ward Instruments* The method of processing and sterilizing ward instruments is similar to that for the processing of syringes. It should, therefore, be simple also to undertake the sterilization of ward instruments and sets for procedures such as lumbar puncture, in the room described in 8 (*b*) above. The purchase of additional ward instruments to 'fill the pipe line' will, of course, involve the hospital in some additional expenditure.

9 The measures that have been outlined above will go part of the way only in taking the work off the wards and centralizing sterile supply. A glance at Appendix F will at once make it clear how many are the items which these arrangements do not cover and which will still have to be boiled in the wards. The steps described cannot be regarded as more than interim measures which might be done on a restricted budget in a limited space. To reap the full benefits of a centralized service a complete CSSD is necessary. This will be discussed in the chapters that follow.

Chapter 2 Broad Working Principles

Responsibility—contaminated and sterile to be separate —work flow—delivery and collection—machines—summary of principles—staff.

Responsibility

10 When the Trust published their booklet[15] it was stated:

> '. . . *Responsibility for carrying out routine sterilizing tasks and responsibility for their supervision, must be clearly defined, clearly understood, and undivided . . .*'

All too often hospital authorities still fail to realize the importance of clear definition, particularly with regard to responsibility for routine sterilizing tasks. All too often refuge is taken in some cloudy compromise. The soundness of the views originally expressed has since been abundantly confirmed.

11 To whom should the superintendent of the CSSD be responsible? The pharmacists claim[16] that they should be responsible for hospital CSSDs. In support of this claim they argue that they are already responsible for the supply of injectable fluids, that they have had systematic instruction in the principles of sterilization, and that they are familiar with the requirements of safe systems of working pressure equipment. Williams *et al.*[17] argue that the administrative control of hospital infection lies in the appointment of an efficient Control of Infection Officer who should be a member of the hospital staff committees and sufficiently senior to command the attention of his colleagues. Might not the CSSD superintendent be responsible to this Control of Infection Officer rather than to the pharmacist?

12 In considering the matter it should be remembered that:

(*a*) the introduction of central sterile supply entails changes in surgical and nursing procedures. This may give rise to opposition from some quarters. The pharmacist is not in as strong a position to overcome such opposition as is one of the medical staff;

(*b*) to-date it has always been a member of the medical staff who has introduced central sterile supply to those hospitals which have started it.

13 But the point that matters is that whoever accepts responsibility for the CSSD should be interested. He will be in competition with his colleagues for a share of funds, for which the demand is always greater than the allocations; he will have to meet the criticism and even opposition of staff whose views may be different from his own; he will have to ensure that funds are spent wisely for the benefit of patients and staff alike. It is unlikely that the pharmacist has the necessary standing to handle these situations successfully; and it is equally unlikely that they will be handled successfully if the member of the medical staff made responsible for the CSSD is not interested. The person who is most likely to be interested is the Control of Infection Officer. It is, therefore, concluded that he is the right person in whom responsibility should be vested.

A first basic principle of organization can therefore now be enunciated:

> 1 *Responsibility for the supervision of sterilizing tasks should be clearly defined, clearly understood, undivided and vested in the control of infection officer or the person who undertakes his functions.*

Contaminated and Sterile to be Separate

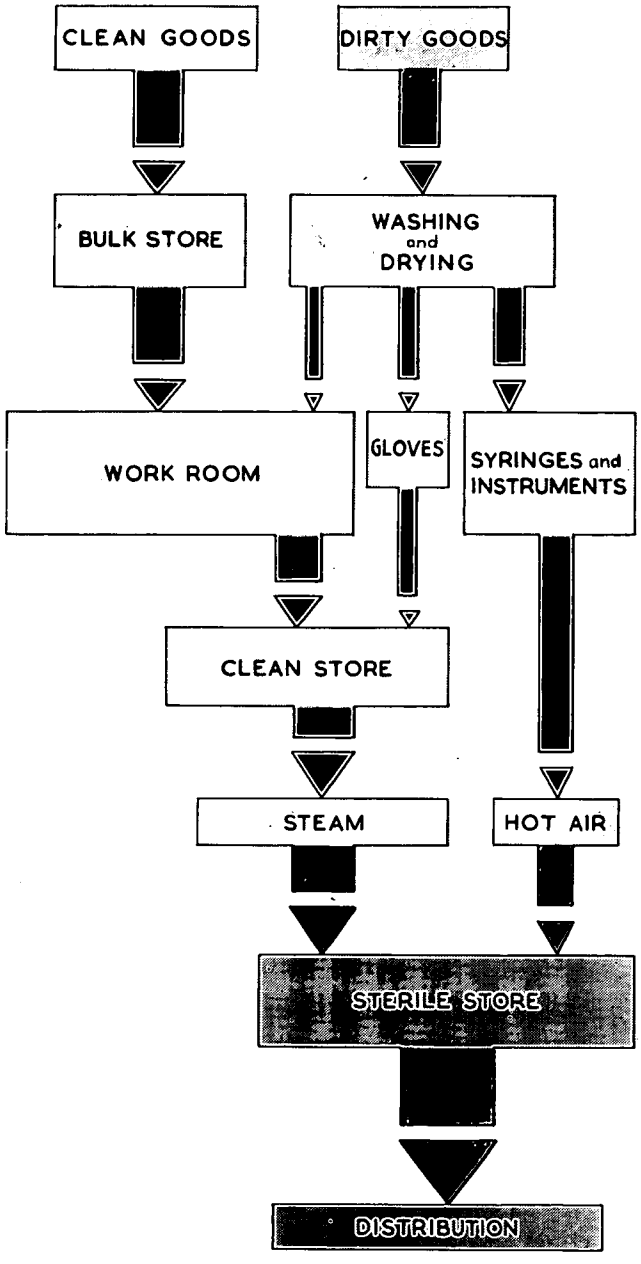
14 There are three categories of equipment, contaminated, clean and sterile, to be dealt with in CSSDs. It may be of help to define each category before it is discussed.

(*a*) As soon as it is used a syringe or a surgical instrument may be contaminated by bacteria. As it is impracticable to differentiate between potentially contaminated and contaminated articles, CSSDs must treat all used articles as *Contaminated Articles*. The word contaminated is used in that sense throughout this book.

(*b*) But there are other articles which, although they may be contaminated, have never been used, in

[15] Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 51
[16] *The Hospital* (1960), **56**, 960
[17] Williams R E O, Blowers R, Garrod L P, and Shooter R A (1960), *Hospital Infection*, Lloyd-Luke, London, 155

2 Diagram 1
Organisation of work flow



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the sense that they have not been introduced to the vicinity of the patients. Examples of these are new equipment from manufacturers and date-expired packs which have never left the ward clean utility rooms. Such articles are regarded as *Clean Items*. It will thus be understood that contaminated articles require to be washed before being sterilized whilst clean items do not.

(*c*) *Sterile supplies* cover all articles which have been sterilized.

15 In accordance with the definition just given, the bulk of equipment returned from the wards will be contaminated. It is a wise and necessary precaution therefore to keep it completely separate from sterilized packs. Never should sterile supplies and contaminated articles be carried on the same trolley at the same time. As *Present Sterilizing Practice in Six Hospitals*[18] showed, there is a real risk that the two may get mixed up. The same is also true of sterile and contaminated equipment being carried on the same van at the same time. No persons undertaking delivery can be supervised. There will always be pressure to allow staff delivering sterile packs to collect contaminated articles at the same time. It reduces the journeys to be made if they do so. Nevertheless such pressure should be resisted and delivery always kept quite separate from collection. If different vans cannot be made available for delivery and collection, separate rounds one for delivery and another for collection should be insisted upon.

16 In the central department the contaminated work must be kept quite separate from the sterile work. Contaminated articles should all be washed and dried in one room before being dispersed to other rooms for further processing. Finally, it is urged that this organization is sufficiently important to be given the status of a further principle which can now be stated:

> 2 *Contaminated articles should always be kept separate from clean goods and sterile supplies.*

Work Flow

17 To the washed and dried re-usable items will be added the laundered linen, the clean goods, many of them disposable, and the dressings from the manufacturers. These have to be made into suitable packs for sterilization and issue. It is important to ensure by a careful and logical work flow that clean packs awaiting sterilization can at no time become confused with sterile supplies. If this arrangement is not made, mistakes can occur and clean and sterile can get mixed up. Further, a proper work arrangement which ensures that everything required is in the right place, in the right quantity, and at the right time, will of itself achieve an economy of labour which will reduce day-to-day running costs. The work flow envisaged can best be described in the form of a diagram, which is shown opposite.

This conception of work arrangement can be expressed as a third principle:

> 3 *The greatest attention should be paid to the proper direction of work flow and economy of labour.*

Delivery and Collection

18 It has been stated earlier that one of the aims of a CSSD is to take some of the work off the nurses. If sterile supplies are not delivered, the staff in the wards and departments will have to come to the CSSD to get them. This will increase the total of the work involved in delivery and collection which will be unco-ordinated and spasmodic. It follows, therefore, that the CSSD should be responsible for delivery and collection. The same need for the central direction of this service occurs when a group of hospitals are supplied from a large and distant CSSD. It has been shown by E M Darmady, K E A Hughes, Winifred Tuke and Patricia Verdon[19] how much time can be taken up by delivering sterile supplies. Different systems have been tried and are described later in this book. Here it is only wished to make the point that a delivery and collection system is essential, and should be adopted by all central departments as a fourth principle:

> 4 *Central sterile supply departments should deliver all sterile supplies to users, and should also undertake the collection of contaminated articles.*

Machinery

19 Either in the planning stage, or later when the department is working, the question is going to arise of

[18] Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 26

[19] *The Hospital* (1960), **56**, 824

the value of mechanical equipment versus manual methods. To answer this question it is necessary to pose some more searching ones.

(*a*) Can the task be efficiently done by hand?
(*b*) Is there staff available to do it?
(*c*) Is the task an unpleasant one?
(*d*) Is a detailed inspection of the end product desirable?
(*e*) Is the size of the task great enough to justify the cost of mechanical equipment?

A machine will guarantee a constant standard of efficiency and will have a greater productive capacity than a given number of staff. In general, labour is difficult to get and costly to employ. Unpleasant tasks are those least conscientiously carried out, and the end products will need more careful inspection than would otherwise be the case. But the final and most important question is whether the demand likely to be made on the machine is large enough to use it to capacity, so justifying the high capital cost? Industry answered these questions a long time ago, and any industrialist would now advise the use of mechanical equipment, if by doing so a greater output could be achieved without an increase in staff. In general, therefore, it is recommended that for those tasks for which they are suitable, machines rather than manual labour should be employed, provided that the scale of operation is big enough. This may be stated as a fifth principle:

> 5 *For many operations a machine will provide a more satisfactory and economical solution than will manual work.*

Summary of Principles

20 The principles which should govern the organization of central sterile supply departments may now be summarized:

> 1 *Responsibility for the supervision of sterilizing tasks should be clearly defined, clearly understood, undivided and vested in the control of infection officer, or the person who undertakes his functions.*
>
> 2 *Contaminated articles should always be kept separate from clean goods and sterile supplies.*
>
> 3 *The greatest attention should be paid to the proper direction of work flow and economy of labour.*
>
> 4 *Central sterile supply departments should deliver all sterile supplies to users, and should also undertake the collection of contaminated articles.*
>
> 5 *For many operations a machine will provide a more satisfactory and economical solution than will manual work.*

Staff

21 This chapter cannot close without considering the composition of the staff for CSSDs. As has been mentioned earlier the superintendent—for that is what it is suggested the person in charge be called—should be responsible to the Control of Infection Officer. This responsibility should be direct and undivided; any attempt to split it should be avoided. The organization and control of work within the CSSD will certainly necessitate the appointment of a deputy since the superintendent will often have to be away from the department, meeting the users and seeing that they are satisfied. Someone must also be in charge when the superintendent is on holiday. Experience has shown that it is an advantage if either the superintendent or his/her deputy is a trained nurse. What then are the qualities required of the superintendent and the deputy? Advertisements for superintendents have been published by different hospital authorities from time to time. These have stressed ability to control staff and to organize more than knowledge of sterilizing techniques. The qualities that seem to be required are those of character and intellect which are always in demand. Superintendents are required to be managers. This is the quality that is probably more important than any other. Superintendents have been appointed from different fields. Some are laboratory technicians; some are trained nurses; some are men; some are women. It is right that hospital authorities in their search for the right kind of superintendent and deputy should cast their net wide and should stress ability to control and organize, more than technical qualifications.

22 It has been a practice in the past to employ men for working the autoclaves. Small, modern autoclaves are not heavy to open, to load or to shut. There is, therefore, no longer the same need to employ men. Young women graded as orderlies have been found suitable to staff the CSSD. One hospital has staffed their department with pre-nursing cadets, and they report very highly on their standard of work. This may be a ready source of labour, but pre-nursing cadets require also to gain

3 The staff of a CSSD

experience in other hospital departments. In such circumstances a CSSD superintendent would have to accept not only a more rapid change of staff than is desirable, but also the additional work involved in supervising the cadets. Further consideration is given to the grading of staff in paragraph 139.

23 When employing lay personnel it is necessary to impose a measure of discipline with regard to their clothing. A smart overall and shoes have a salutary effect and encourage staff to take a pride in their appearance. This point is illustrated in the photograph above.

Chapter 3 Planning a *CSSD*

The size of CSSDs—the space required—the siting of CSSDs—the use of space—the autoclave—work flow—fitments, furniture and finishing—miscellaneous items—services—equipment—recent developments.

The Size of CSSDs

24 The optimum size for CSSDs is one of the early planning problems facing hospital authorities. In Britain hospitals are organized in groups, each group of hospitals being administered by a management committee which is responsible for the day-to-day running of the hospitals in its group. This management committee enjoys a high level of autonomy subject only to the general planning policy of a regional board, which is in turn responsible to the Ministry of Health. One of the advantages of grouping hospitals under one management committee is to secure co-operation between the hospitals of a group. It is therefore important to consider whether CSSDs should be established on a small scale in each hospital; on a large scale to serve a hospital group; or on an even larger scale at regional board level to serve more than one group of hospitals.

25 In America, hospitals are independent and more often than not are in competition one with the other. It is usual, therefore, for each hospital to run its own CSSD. Such an arrangement has the advantage that the wards can expect to receive a more personal service which, if the need arises, can be varied on demand. But such a service is certain to be an extravagant one.

(*a*) Expensive mechanical equipment is unlikely to be justified on the small scale of a hospital CSSD. (It is already clear that expensive equipment, such as autoclaves and washing machines are often only used for about one third of their capacity, because the scale of operation is too small.)
(*b*) Levels of staffing will be high because of the need to cover supervisory and 'on call' demands.

26 During a visit to America in 1959, it was found that the number of persons employed in CSSDs varied between four (a hospital for indigents) and 14 (a new university teaching hospital) per 100 beds served. There are lessons to be learned from these figures. The hospital for indigents had 3,000 beds, whilst the teaching hospital had 400. Although the service given by the CSSD in the teaching hospital was the better of the two, nevertheless the lower number of staff per 100 beds in the indigent hospital was largely attributable to its scale of operation. It was thus able to achieve the economies of large scale production. The position under the National Health Service is rather different. Hospitals are expected to co-operate with each other. Indeed their organization into groups is designed to such an end. It would be folly if each British hospital were slavishly to copy American practice and run its own CSSD without considering the pros and cons of the matter. What are the arguments involved?

(*a*) *Each Hospital Running its Own CSSD* With a small organization it is easy to meet the personal requirements of the medical and nursing staff. A van would not be required for delivery outside the hospital. But a duplication of expensive equipment would result. Each hospital would need one and perhaps two autoclaves, whilst washing machines would inevitably be used below capacity. A superintendent would also be needed for each hospital as would also additional staff to cover holiday periods. If each hospital were to run its own CSSD it could only result in extravagance, both in staff and resources.

(*b*) *One Hospital Running a CSSD for all the Hospitals in its Group* This already happens in the field of pathology. Each hospital group also has its own administrative services. For CSSDs to serve groups would thus follow an organizational pattern, which is already well established. Further, such an organization should be able to achieve reasonable economies in the use of capital equipment and staff. Thus, only one set of autoclaves and one superintendent would be wanted for a group department. Given good will and well-found routine, the personal service offered by the small department should not be jeopardized by size or distance. It is, therefore, considered that a group central sterile supply is the organization most suited to National Health Service conditions. It is appreciated that hospital groups vary in the types of hospital comprising the group and in the distances separating the hospitals in them, etc. Each case should be considered on its merits. Whatever organization is decided upon, it would be wasteful to have two CSSDs covering one geographical area. The needs of

mental hospitals, local health authority clinics, district nurses and midwives, and general practitioners should all be catered for from the CSSD in their vicinity. Steps to that end have already been taken in some districts. The administrative difficulties involved are not insuperable.

(*c*) *One CSSD Covering a Number of Groups* The hospital services in large industrial towns are often administered by more than one hospital group.There will clearly be occasions when one CSSD covering perhaps a whole town might prove a satisfactory solution. But to control a service of this size requires two things: first, a member of the medical staff interested in running a large service; and secondly, the wholehearted co-operation of the groups concerned. Where these requirements exist a central service in a large town should provide the most economical solution. Paragraph 140 discusses at some length the higher cost of distribution over long distances. It is, in general, advisable to keep down the distances over which distribution has to take place.

(*d*) *Teaching Hospitals* These hospitals require separate consideration. A teaching hospital and its peripheral hospitals may comprise a compact group, in which case it will probably be best to plan the CSSD as for any other hospital group. But if the peripheral hospitals are scattered, as is the case with some of the London teaching hospitals, a different organization may be called for. As stated earlier, if each hospital runs its own CSSD extravagance will result. But a teaching hospital probably runs transport to its peripheral hospitals anyway. It is possible that this service could be utilised for central sterile supplies. If this is impracticable the best solution would probably be to supply the peripheral hospitals with sterile supplies from a local non-teaching group.

27 In general, it is suggested that, one central sterile supply department should be organized to serve the hospitals of a group. Provided the distances to be travelled between them are not great, a number of groups might economically be served from a sub-regional centre. There are likely to be a few occasions on which each hospital running its own CSSD will provide an economical solution.

The Space Required

28 Hospital authorities will want to know how large a building is required for the number of beds to be served from it. It will be appreciated that such a question can only be answered satisfactorily in the light of experience. This is unlikely to be forthcoming for at least a further five years. All that can be said with certainty at this stage is that, unless it is intended for a pilot study, no CSSD should be established to serve less than 500 beds. For this some 2,000 square feet should be ample. For, say, a 1,000 beds, an area of 3,500 square feet should suffice. The greater the number of beds to be served the smaller should be the space per bed required in the CSSD. Several departments are now being planned to serve more than 1,000 beds, and in these the space required per bed may be expected to fall a little lower than that mentioned above. On becoming fully operative it may appear that there is a shortage of space in the CSSD. In such circumstances it is necessary to establish whether the shortage is apparent or real. The first remedy is to study the work organization. It may well be found to be wasteful of space. If the department only operates a five day week, to introduce Saturday and Sunday working will effect appreciable economies in the amount of space required on Mondays. Peak loads will be levelled and a smoother tempo of work will result. If one or both of these remedies do not solve the problem, consideration should be given to a two-shift system of working. This measure should double the output, and the processing equipment would be used more intensively. Both of these are important economic advantages. In the USA it is usual for CSSDs to work three shifts, although superintendents admit that the night shift is not very productive.

29 In general, the recommended area allowances for British CSSDs are somewhat less than those suggested in the USA, where between four and seven square feet per bed has been found to be adequate.[20] But American CSSDs are organized to serve only the hospital in which they are sited. British CSSDs serving at least a group of hospitals should not require so much space.

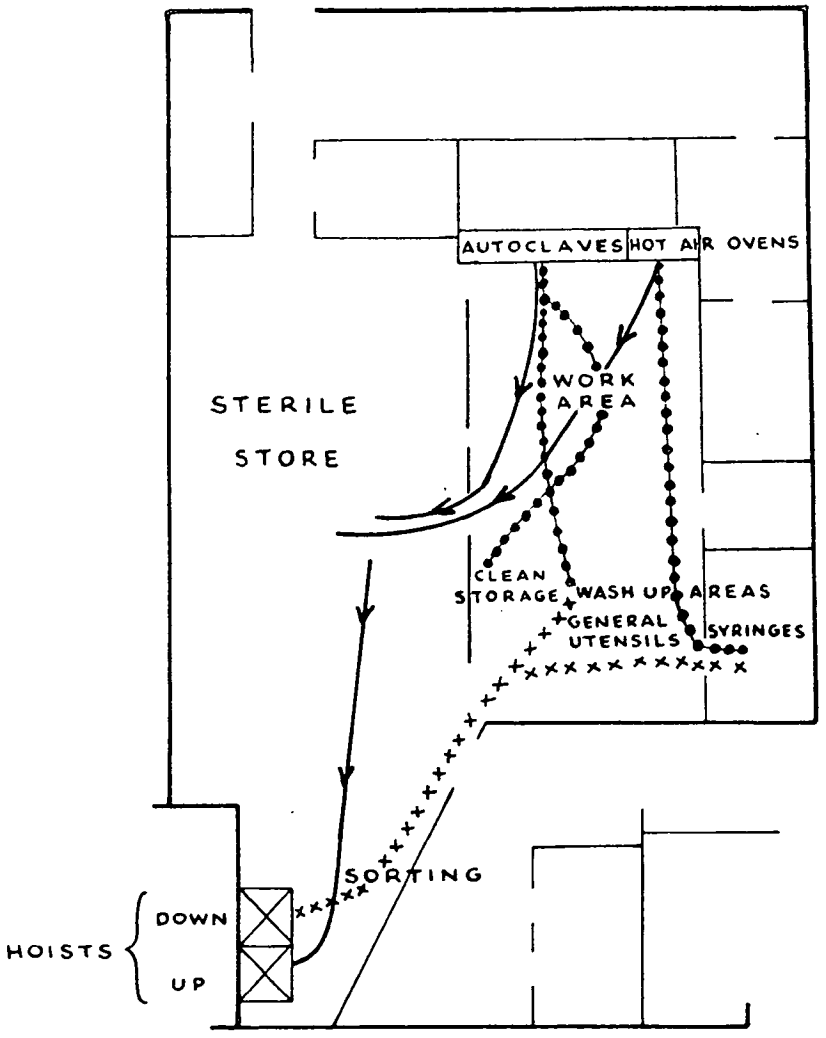
The Siting of CSSDs

30 It is important to consider at an early stage where CSSDs should be sited. Should they be sited as they often are in America, in the basement of the ward blocks? Should they be sited under the theatres? Or should they be sited away from the centres of hospitals where they can develop on their own? Many American hospitals, and certainly those in towns, tend to plan their wards in a

[20] Perkins John J (1956), *Principles and Methods of Sterilization*, Illinois: Charles C Thomas, 244

Plan I

Central Sterile Supply department
Herbert C Moffit Hospital
University of California U.S.A.



4 The circulation within the CSSD at the Herbert C Moffit Hospital

vertical block and to put their CSSDs in the basement under the ward blocks they serve. This may be convenient from the point of view of the wards, but it creates difficulties in planning the department. The hoists connecting the CSSD and the wards are invariably positioned to suit the convenience of the wards. It is right that this should be so, if only because there are many wards and but one CSSD. This position can be inconvenient. The point as illustrated by the Herbert C Moffitt Hospital, constructed in 1956 on a congested site on Parnassus Avenue, San Francisco, is worthy of consideration. A visit was made to this department in 1959. Here the layout of the CSSD in the basement has had to conform to the layout above. The area of the department is, except for a small syringe processing room and the sterile store room, undivided. It will be noticed, on Plan 1, shown on p. 12, how the work flow crosses at several points, and how the siting of the two hoists causes the flows of sterile and contaminated goods to cross each other at the one point where it is important to ensure separation. There is a notable contrast between the work flow on this plan and that shown in Diagram 1, opposite p. 7.

31 This is an example of a confused circulation which is liable to occur where the layout of one department has to conform to that of another with quite different requirements. Similar confusion may occur if the CSSDs are sited beneath operating theatres. The design of theatre suites, and the circulation within them, will be tightly controlled by the medical and nursing staff. Such circulation may be quite inappropriate on the floor below. If CSSDs are to be organized effectively, whether for a hospital or a group of hospitals, they should be sited away from hospital departments which might dictate their shape and organization. They should be sited where they can be designed functionally. This postulates a site where the architect is free to develop his plan as he requires. Road access is essential so that vehicles can be driven up to unload contaminated and clean goods, and to collect sterile packs for delivery.

Use of Space in the Department

32 How should the central department be divided up to perform its task? How large should each room be? The work to be done will consist of contaminated work, clean work, and sterile storage. The rooms in the department should be designed to keep these three categories separate. Table I gives the proportion of total space which experience has shown can conveniently be devoted to each room and lists the rooms in which it is convenient to do the different types of work.

Table I Rooms in the central department

Serial	Room	*Nature of work*	*Proportion of space %*
1	**Wash Room** in which everything is washed up	Dirty	10
2	**Work Room** in which all packaging is undertaken . . .	Clean	26
3	**Syringe and Instrument** processing room	Clean	9
4	**Unsterile Pack Store** . .	Clean	4
5	**Bulk Store**	Clean	11
6	**Sterile Store**	Sterile	16
7	**Miscellaneous Rooms**, including glove room, office, rest room, lavatories, etc.	Clean	19
8	**Autoclaves**	Clean	5
			100

In small departments it may be convenient to combine certain rooms. Thus the storage for unsterile packs (Serial 4) may, for local reasons, be provided round the walls of the work room (Serial 2); or a bench for syringes and instruments (Serial 3) may be provided in the work room instead of being installed in a room of its own. In effect, therefore, rooms marked 'Clean' may be combined in a single room, but work concerned with contaminated articles and sterile supplies should always be kept separate from work of other kinds. It has proved a better policy at Cambridge to sterilize dressings, and equipment not used routinely, and all of which is autoclaved, after receipt rather than in anticipation of the daily requisitions. In this event the proportion of space allotted to the sterile store (Serial 6) should be reduced, and that for the unsterile pack store (Serial 4) increased by a similar amount.

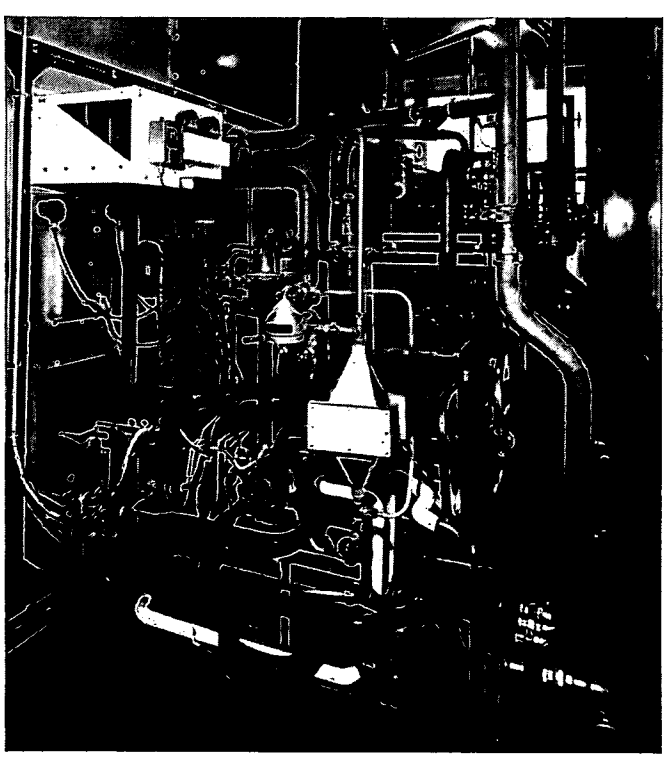
The Autoclaves

33 An early planning decision will be required with regard to the autoclaves. Should they be double- or single-ended? How large should they be? The object of installing double-ended autoclaves is to keep the sterilized packs separate from those awaiting sterilization. That this does not always succeed is shown in a previous report.[21] The distinction intended to exist between the two ends of the autoclaves was sometimes muddled by

[21] Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 37

the way in which the attendants used them. This will always be a danger except in those departments which are so large as to justify a separate staff to work at each end of the autoclaves. There will be few departments big enough to justify this and it is suggested that, in general, autoclaves should be single-ended. There is one further argument which favours a single door. The modern autoclave is a complicated machine which requires careful maintenance. A second door would considerably add to this task.

34 It has been customary to use large autoclaves in hospitals—perhaps of some 60 cubic feet capacity. But the speed of the modern high-vacuum machines has so reduced the time of the sterilizing cycle that smaller autoclaves can do more work in a shorter time. It is generally advisable to instal two small autoclaves rather than one large one since one is then available should the other be temporarily out of action for maintenance. At Cambridge, two autoclaves of 24 cubic feet capacity have been installed for the 1,000 beds ultimately to be provided with sterile supplies. These are thought to be larger than is necessary for such a task. Two of 12 cubic feet each would have been sufficient and it is suggested that this is a suitable size of autoclave for most CSSDs.



5 The servicing area at the back of the CSSD autoclaves. Adequate space is required to allow room for the engineers

35 It is important that autoclaves should be fitted with valves to carry thermocouple leads for testing purposes; also that sufficient space should be left at the back and sides of the autoclaves to allow the engineer to move round them. It is sometimes suggested that autoclaves should be placed on an outside wall to avoid the necessity of engineers entering the CSSD work area. This unfortunately would be no solution since maintenance usually involves manipulation of the control panel. The photograph below points the need for adequate space behind the autoclaves, for which an allowance has been made in Table 1.

Work Flow

36 To economize in labour and to increase efficiency the department should be organized so as to provide a logical work flow (see Diagram 1) through contaminated, via clean to sterile. This is essentially an architectural problem, which can only be solved taking into account particular site conditions. Some ways in which a work flow can be arranged will be seen from the plans of the different departments shown later in Appendix C.

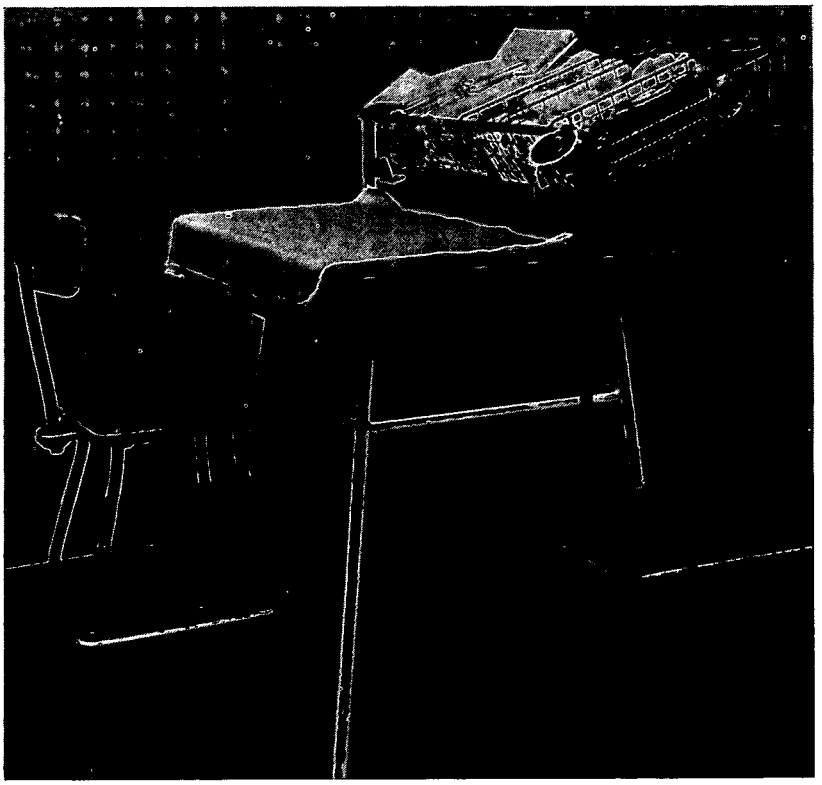
Fitments, Furniture and Finishing

37 It may be of help to have a description of and some remarks on the suitability of furniture and fittings. At Cambridge all furniture units are movable and of standard dimensions. This is necessary if units are to be interchangeable and moved about to find the most advantageous positions for them. Easy cleaning, labour-saving use, and good appearance were other factors which influenced their design.

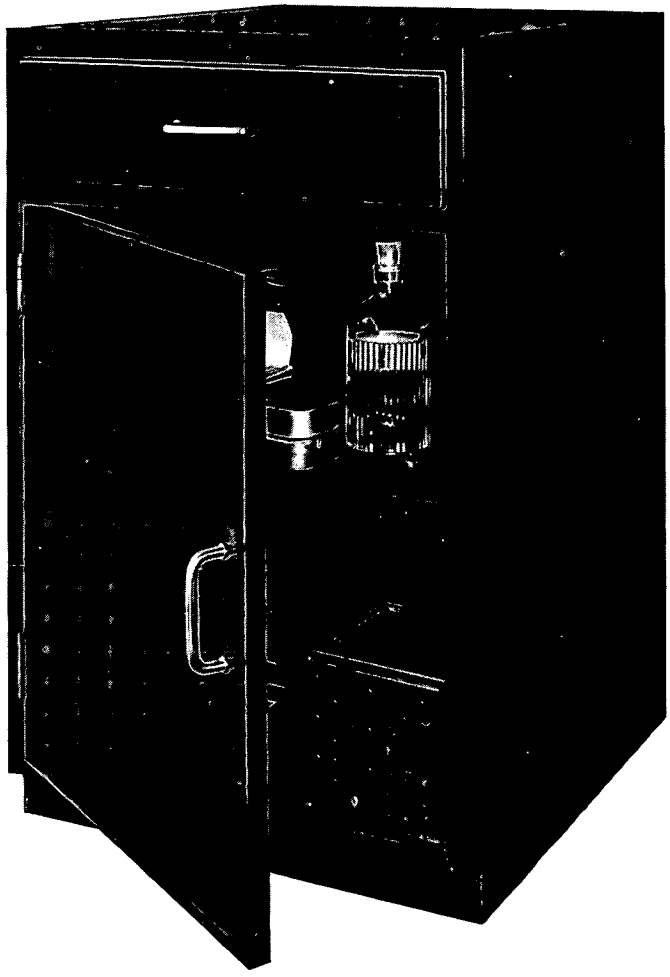
38 Work benches are required in the wash, syringe and instrument, and work rooms. To ensure flexibility it was decided that the bench height throughout should be 35 inches and the width 24 inches. Chair seats are 25 inches from the floor. Such heights have proved comfortable to work at and it is possible for the staff to work standing or sitting. The supports and edgings of the benches have been constructed of varnished hardwood and the working surface is covered with a polyvinyl material. This material was selected in preference to laminated plastic and stainless steel as being softer yet

sufficiently resilient. It is easily kept clean. It has however been found that it is unsuitable for wet work. For this a stainless steel surface covered with loose sheets of thin polyfoam material is preferable. This material deadens the noise, reduces breakages and absorbs the wetness. In the work room a surface for the preparation of packs is required. An experimental bench was made 12 feet long and 4 feet wide, with underbench storage for component parts of the packs, and a raised conveyor belt down the centre to remove the completed packs. The conveyor belt however proved more of a hindrance than a help. Orderlies found it tiring to work from the underbench units and preferred to have the components of the packs on the bench. The variety of items to be packed was too wide for them all to be stored under the bench. As the bench proved too small to be used as originally intended it was divided into separate tables—a decision which was influenced by the dwindling circulation space. Each orderly now has a table two-and-a-half feet square (the area of the largest size of wrapping paper) at which to work. A type of bed table on which are placed the component parts of the pack is wheeled into a convenient position over the table. The simplicity of this type of work bench and the resulting flexibility compares favourably with the complicated and costly design of work stations, which are in use in some CSSDs.

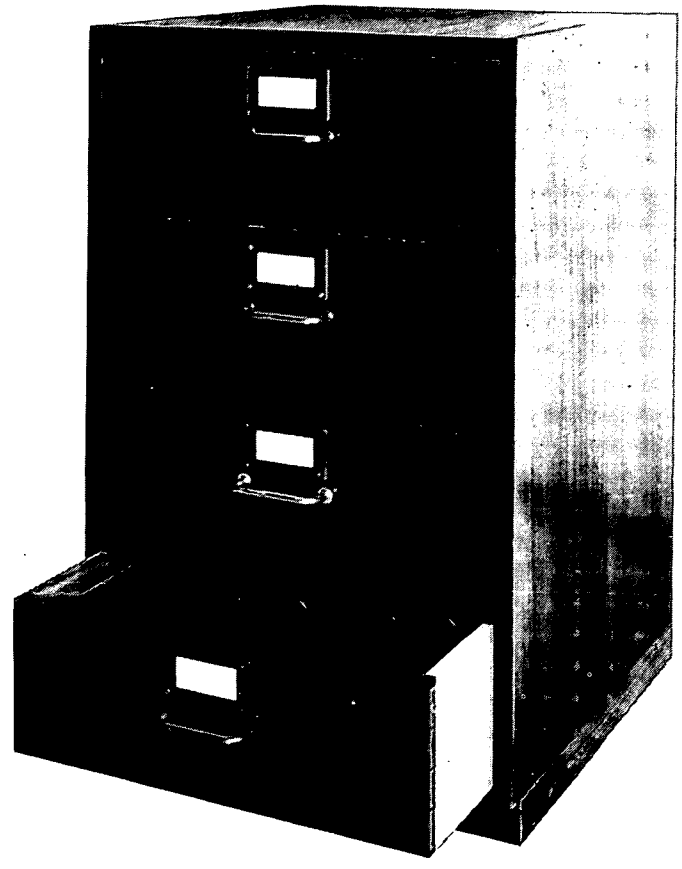
39 Notwithstanding the improved type of packing bench just described there will be some need for underbench storage units on a limited scale. In order to avoid the conventional cupboard and drawer, which are difficult to use and keep clean, a sugar bin design with a lining was tried. The principle of the design has proved a good one, but it is essential that light-weight materials should be used in construction, and the bins balanced for finger-tip control. The linings should be easily removed and replaced. The same design of bin has been found suitable for waste. A similar sized and constructed unit, but fitted with four drawers, was found to be necessary for the storage of semi-expendable items, such as syringe containers and replacements for broken syringes and instruments. In the wash room this is fitted with one drawer and a cupboard for keeping bottles of antiseptic and cleaning materials. In the early stages of planning the required capacity of these units should be established.



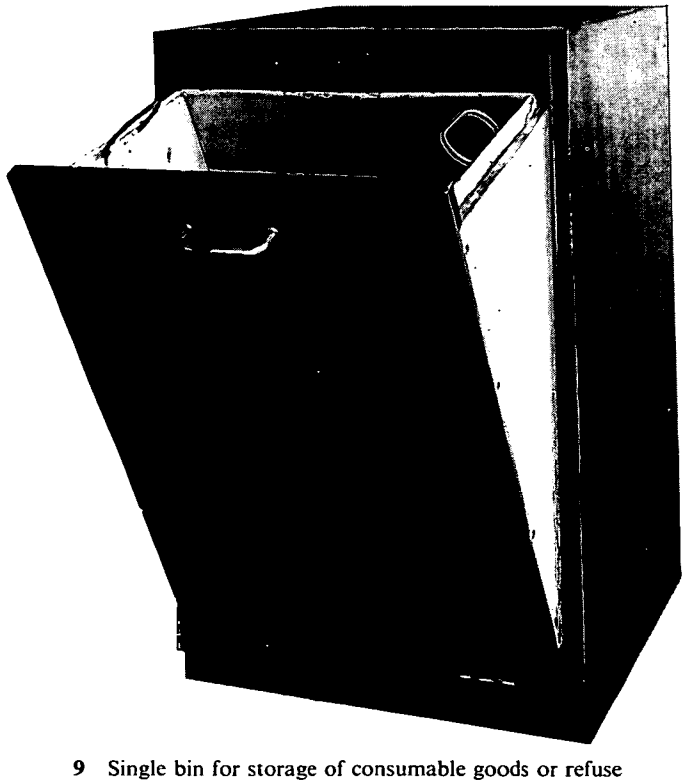
6 A work table and chair



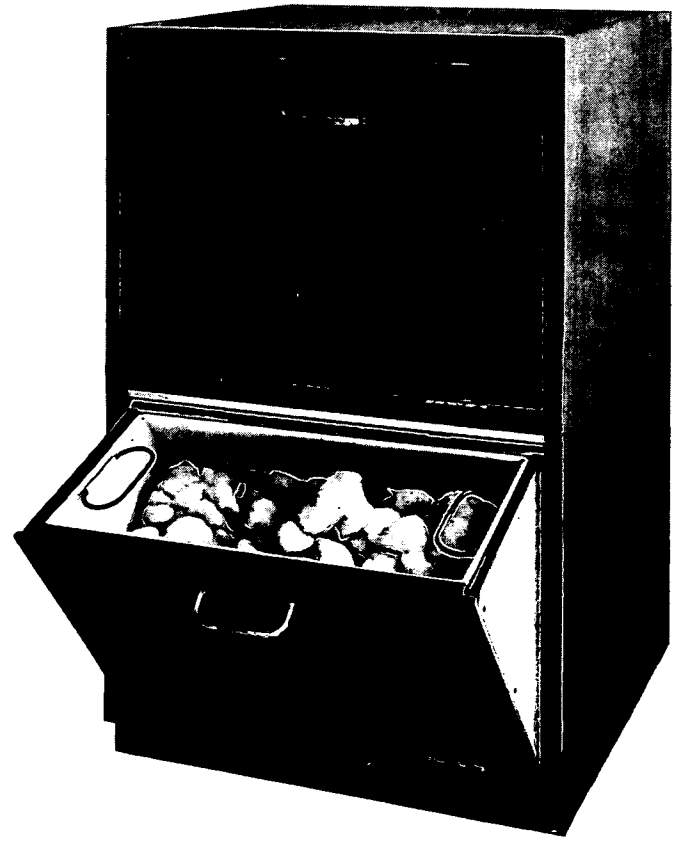
7 Cupboard and drawer unit



8 A 4-drawer unit



9 Single bin for storage of consumable goods or refuse

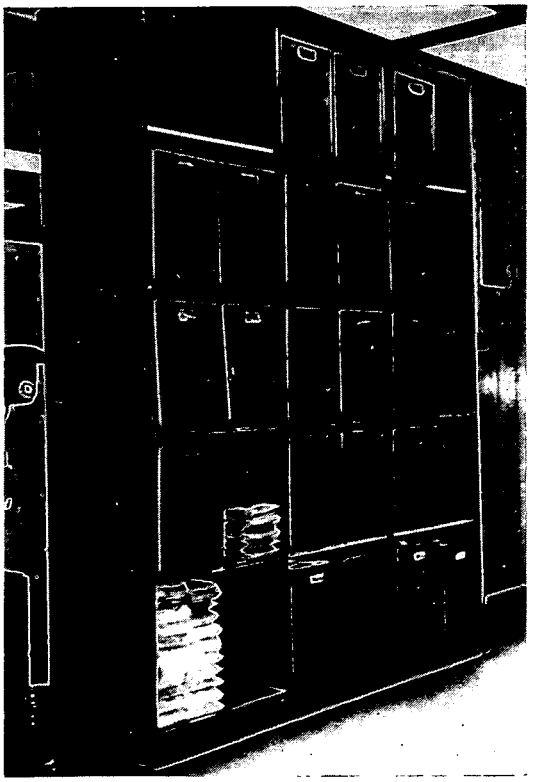


10 Double bin for storage of consumable goods

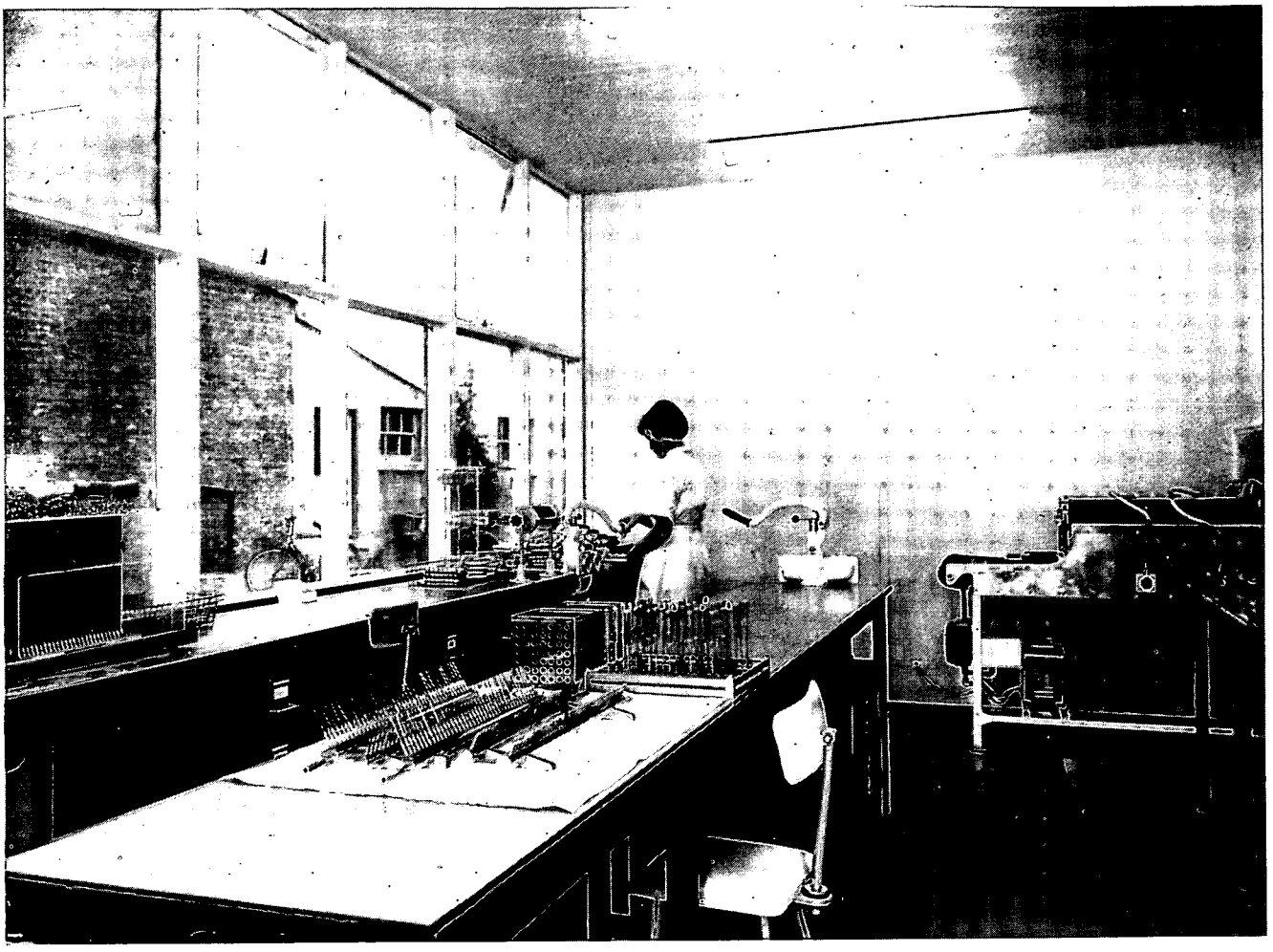
The capacity of those illustrated in photographs 7, 8, 9 and 10 is about 8 cubic feet.

40 Storage cupboards are required in the sterile store. They should have adjustable slatted shelves. Doors may help in excluding dust but they are liable to slow down the rate of work and to restrict the capacity of cupboards. Their use is therefore a matter of individual preference. Free standing cupboards were chosen at Cambridge. Storage is also required for packs in an unsterile rather than a sterile state. This may be provided in a cupboard or a small room, but the capacity of either should hold about one week's output of packs. It has been found convenient to store unsterile packs in bulk bins on the cupboard shelves. The bins are light and are placed alongside the packing bench during pack preparation. A similar practice is followed when the cardboard boxes are filled (see paragraph 63). A photograph of a cupboard with bins in position is shown below.

41 It is difficult to argue the need for expensive flooring material. Good quality linoleum, which should be sealed and preferably mottled so as to disguise marks and abrasions has been found suitable for most of the department, and it is comfortable to the feet of the staff. Such material can be washed with a modern mechanical cleaner, which is also suitable for polishing the surface. In the wash room a more robust flooring is advisable since water is inevitably spilled on the floor. A gulley is also recommended. A smooth wall surface is required which is easy to keep clean. The photograph on p. 18 illustrates the recommended quality finish.



11 Unsterile pack cupboard



12 The syringe and instrument room

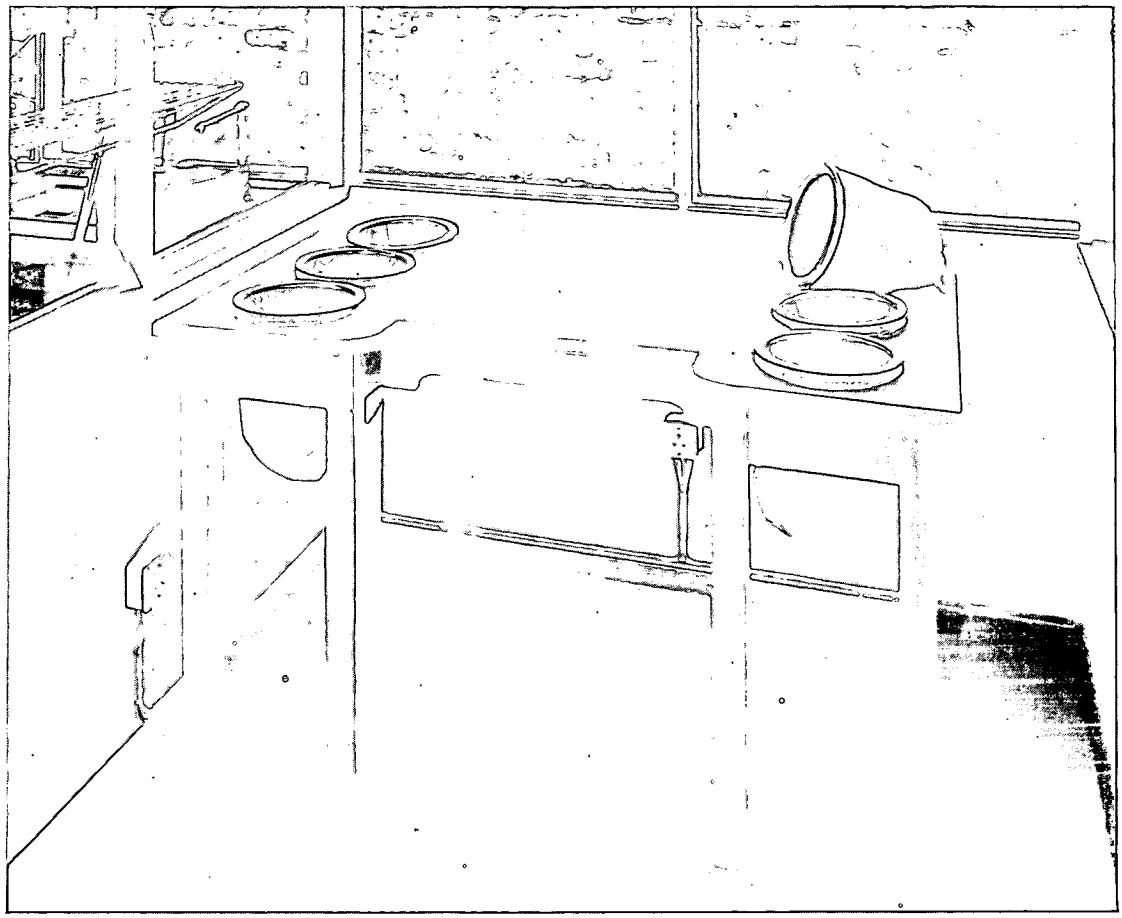
42 The colours chosen for the department should contribute to its quiet efficiency and introduce a cheerful note. They can also be used objectively. Thus, at Cambridge, a neutral background is provided by the use of broken white for ceilings and walls, white for woodwork and grey for bench surfaces and floorings. Strong colours have been limited to the doors and used to signify the different zones to which they give access. Red denotes a contaminated, yellow a clean, and green a sterile zone. These colours brighten the department and act as a continual reminder to the staff, when they enter a room, of the type of work on which they will be engaged.

Miscellaneous Items

43 There are a number of miscellaneous items which will be needed:

(*a*) *Work Chairs* A simple design of chair which is easily maintained and kept clean, with a back rest and footrail, and a seat 25 inches from the ground has proved satisfactory. This chair can be seen in photograph 6 on p. 15.

(*b*) *Glove Processing Bench* If gloves are to be processed in the CSSD, a special design of bench is required for this work. It needs a central pile-up and



13 The glove processing bench. The nylon bag shown on the right of the photograph is detachable and washable

packaging area and accommodation for sorted gloves. The photograph above illustrates the design of bench chosen.

(*c*) *Linen Folding Table* Linen requires to be inspected for holes before being folded and made up into packs. A glass-topped table measuring 60 inches by 36 inches and lit internally so as to reveal holes, has been found useful. Two 'de luxe warm-white' 80-watt strip lights will be found to give adequate lighting. If it is thought that the glare from the table surface is likely to cause eye fatigue, an acid-etched glass with the etched surface facing inwards, will reduce the glare. A photograph of this table is shown on p. 20.

(*d*) *Notice Board* A notice board for telephone messages is useful, and for this purpose laminated plastic and a lead pencil have proved a lot cleaner than a blackboard and chalk. The notice board is illustrated on p. 21.

(*e*) *Clocks* Two clocks are the minimum necessary. One is required in the rest room and the other in the work room.

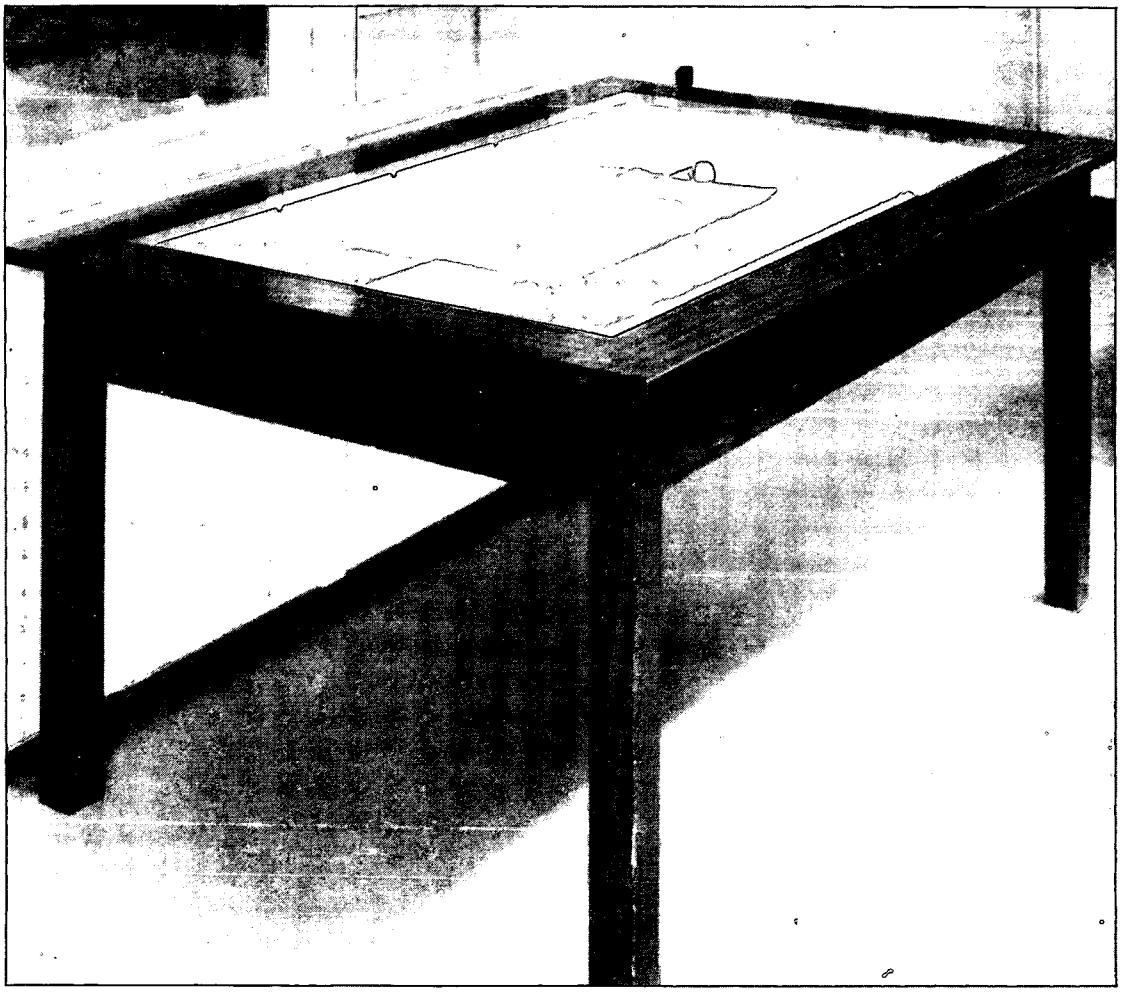
(*f*) *Rest Room* The rest room should be furnished with comfortable chairs, and facilities for making tea.

At Appendix A are listed the furniture and supplies which are used at Cambridge.

Services

It is not proposed to discuss at length the services required in a CSSD, but the following general remarks may be found helpful.

44 (*a*) Steam will be required for the autoclaves; to heat the water for the washing machine if a high-



14 The linen inspection and folding table

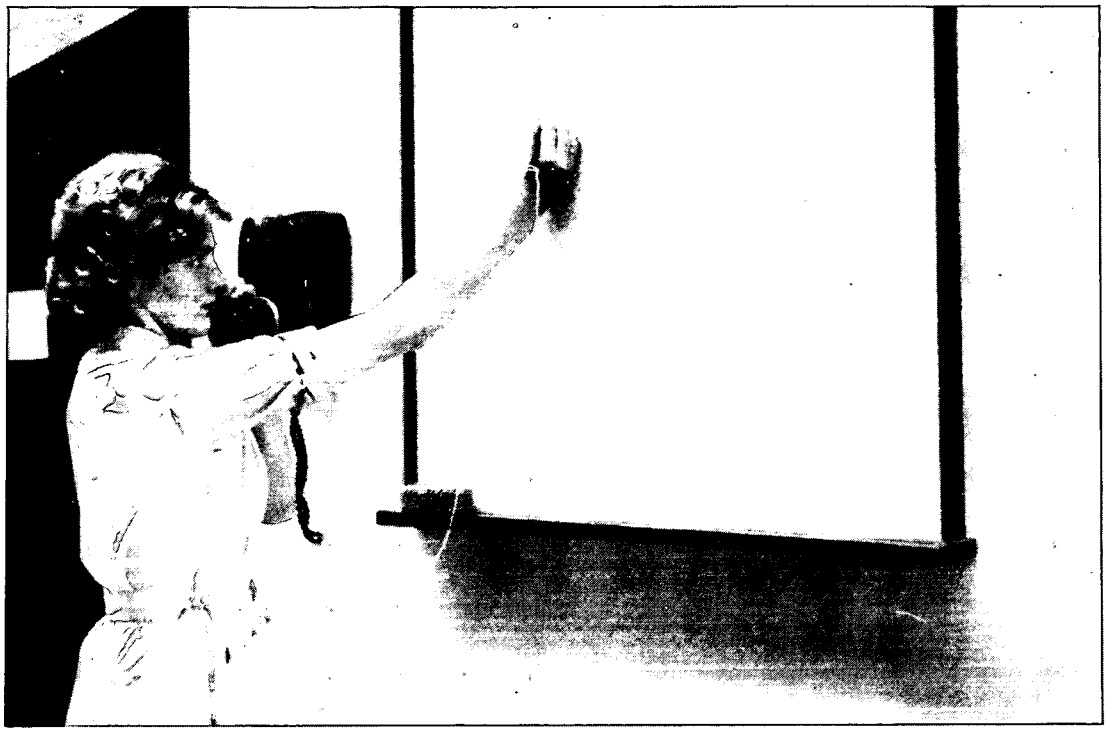
pressure water jet type of machine is employed; for the water still; and possibly for central heating. It cannot be too strongly emphasized that the steam supply to the autoclaves should be dry. For efficient working autoclaves require a supply of dry steam at a pressure of not less than 60 lb per square inch.

(*b*) A plentiful supply of electric power points is advisable. It will cost more initially, but the resulting advantage of being able to re-site equipment justifies the additional cost. The needs of the majority of electrical equipment, including the autoclave, hot-air oven, drying cabinet and washing machine can be served by 13 amp plugs. An infra-red oven requires 40 amps.

(*c*) A water supply will be required for all the sinks, for the water still, for the autoclaves, and also in the loading and unloading bays for the cleaning of trolleys. A hot and cold water supply is required for the washing machine and the glove-washer. Where a large capacity soaking sink is fitted an appropriately sized tap and drainage pipe is needed for quick filling and emptying. For the high-pressure water-jet type of washer, the pressure of the cold water supply should not be less than 26 lb per square inch.

(*d*) The general level of illumination throughout the department must be good and the best use made of natural light. Standards for natural lighting are given by A F Dufton in a DSIR pamphlet.[22]

[22] Dufton A F (1946), *Protractors for the Computation of Daylight Factors*, DSIR, *Building Research Technical Paper* No. 28, HMSO



15 The notice board conveniently sited by the telephone

Shadowless lighting is essential over the work benches and this is particularly important in bench areas where syringes, needles and surgical instruments are to be processed. The lighting in the experimental CSSD at Cambridge has been found, by experience, to be satisfactory. The general level of illumination there is some 20–25 lumens on the working plane. On p. 18 there is a photograph which demonstrates an impression of the use made of natural daylight supplemented by artificial light.

Equipment

45 An appreciable variety of equipment is required in the central department. Details of the equipment and the sources from which it can be obtained are given at Appendix B.

Recent Developments

46 The experimental department at Cambridge demonstrates some of the points in planning a CSSD. This chapter outlines the stage of development reached as this book goes to press. It will be appreciated, however, that the experimental work being done there has not yet been concluded. At this present stage of the development of CSSDs they are not static but dynamic, and it is recommended therefore that visits be made to the department to see work not described, but which has recently been completed.

Chapter 4 Cleaning, Drying and Packaging

Rinsing, sorting and soaking—washing and drying—packaging general—dressing packs—supplementary packs—opening paper bags—catheters and rubber tubing—gloves—outer covering—handling of cardboard boxes—theatre packaging—items for hot-air sterilization—needle processing and packaging—syringe processing and packaging—instrument packaging—shelf life of sterile packs—sterile water—equipment for sterile water—shelf life of sterile water flasks—supplementary sources of sterile water—cleanliness of the CSSD.

Rinsing, Sorting and Soaking

47 Much of the equipment with which wards and hospital departments are supplied is disposed of after use into dressing bins or refuse chutes. But items such as syringes, instruments, Lane's bottles, stainless steelware, and rubber goods, have to be returned to the central department for processing and re-issue. Should these contaminated articles be rinsed before they are returned? How should the staff of the CSSD, who will have to handle the contaminated articles, be protected?

(*a*) *Rinsing* It will generally be accepted that if an instrument is rinsed immediately after it has been used much of the contamination will be washed away. The rinsing will be done by the nurses, who may contaminate their fingers whilst doing so. Such contamination can easily be transmitted from patient to patient in the wards via the nurses' fingers. This is, of course, just the danger which it is most wished to avoid. If the used syringe or instrument is not rinsed immediately after use, then it should be returned to the CSSD in a suitable container and it must be accepted that the contamination will be all the more difficult to remove. Evidence to help in considering the matter is unlikely to be forthcoming for a long time. A decision has to be made, and it is a difficult one. After considering the alternatives it has been decided at Cambridge that all used equipment will be returned *unrinsed* to the CSSD.

(*b*) *Sorting* Even if rinsing were to be done on the wards it cannot be assumed that returned instruments and syringes would be clean. Indeed they will almost certainly still be contaminated, whatever is done to them in the wards. The staff of the CSSD should therefore be afforded some protection. Again there are alternatives. Either all contaminated articles should be autoclaved immediately on return, or the staff should wear protective clothing when handling them. There are disadvantages in both methods:

(*i*) It would be of little use if the contaminated equipment had to be handled before being put into the autoclave. This means returning the equipment in a container which can go straight into the autoclave. Suitable containers for such a purpose would have to be of some heat resistant material which might be awkward and heavy to transport.

(*ii*) The autoclaving process bakes the protein on to the syringes and instruments thus making them more difficult to clean.

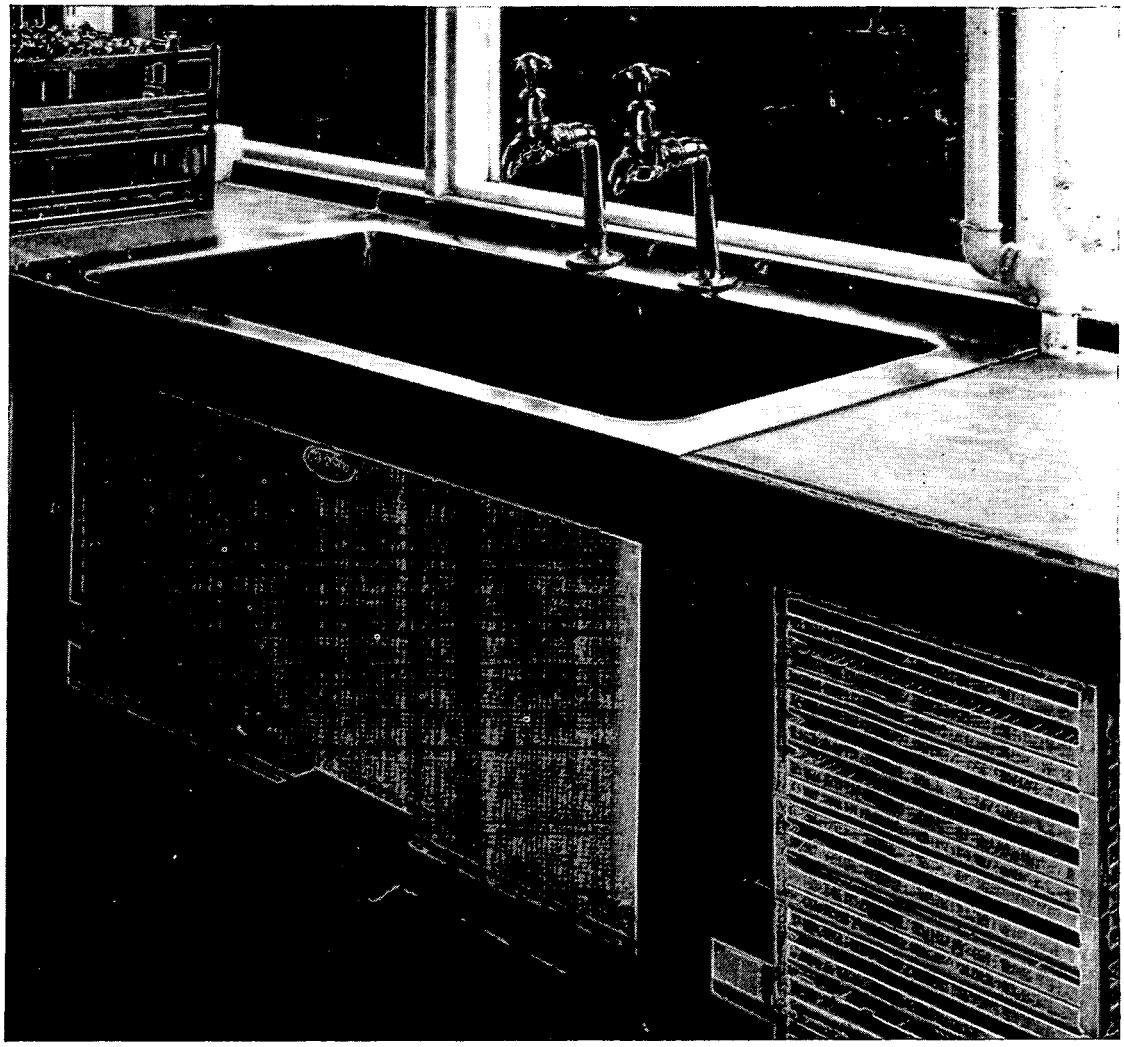
(*iii*) It is doubtful whether protective clothing can always provide that complete protection which should be the aim.

After considering the various factors involved, it was decided at Cambridge not to autoclave the contaminated articles on return to the CSSD, but to protect the staff. This decision was influenced by the knowledge that the next process of washing the returned equipment would make use of high-pressure water jets, which might be rendered ineffectual, if protein had been previously baked onto the returned articles. Washroom staff handling contaminated articles are required to wear rubber aprons with adequate coverage, rubber gloves with deep cuffs to protect the forearms, masks and rubber boots.

(*c*) *Soaking* In order to get the best results from the washing machine, it was decided to soak all returned equipment for at least four hours before loading it into the machine. This arrangement has worked well and sinks 43 inches long, 24 inches deep and 16 inches wide, internally, have been found suitable for such a purpose. Two sinks of this size are usually required. The photograph on p. 23 illustrates the sink described.

Washing and Drying

48 Sterilization is no substitute for cleanliness. This is often forgotten. How then should the articles returned to CSSDs be washed? It has been argued earlier in paragraph 19 that work should not be undertaken manually if there is an efficient machine available to do it.



16 One of the soaking sinks

This is particularly true of washing-up since the task is so unattractive. There are two types of machine on the market, those using ultrasonic waves and those using high-pressure water jets. The latter type of machine has proved successful at Cambridge for everything other than rubber goods and needles. It is mechanically reliable; has been shown to wash-up efficiently; it does not need an orderly continually to serve it; and it has the advantage that it can wash bottles and other large items which cannot be accommodated economically in ultrasonic washing tanks. Details of its performance are given at Appendix D. The methods of washing catheters, gloves and needles are described later in the paragraphs dealing with these equipments.

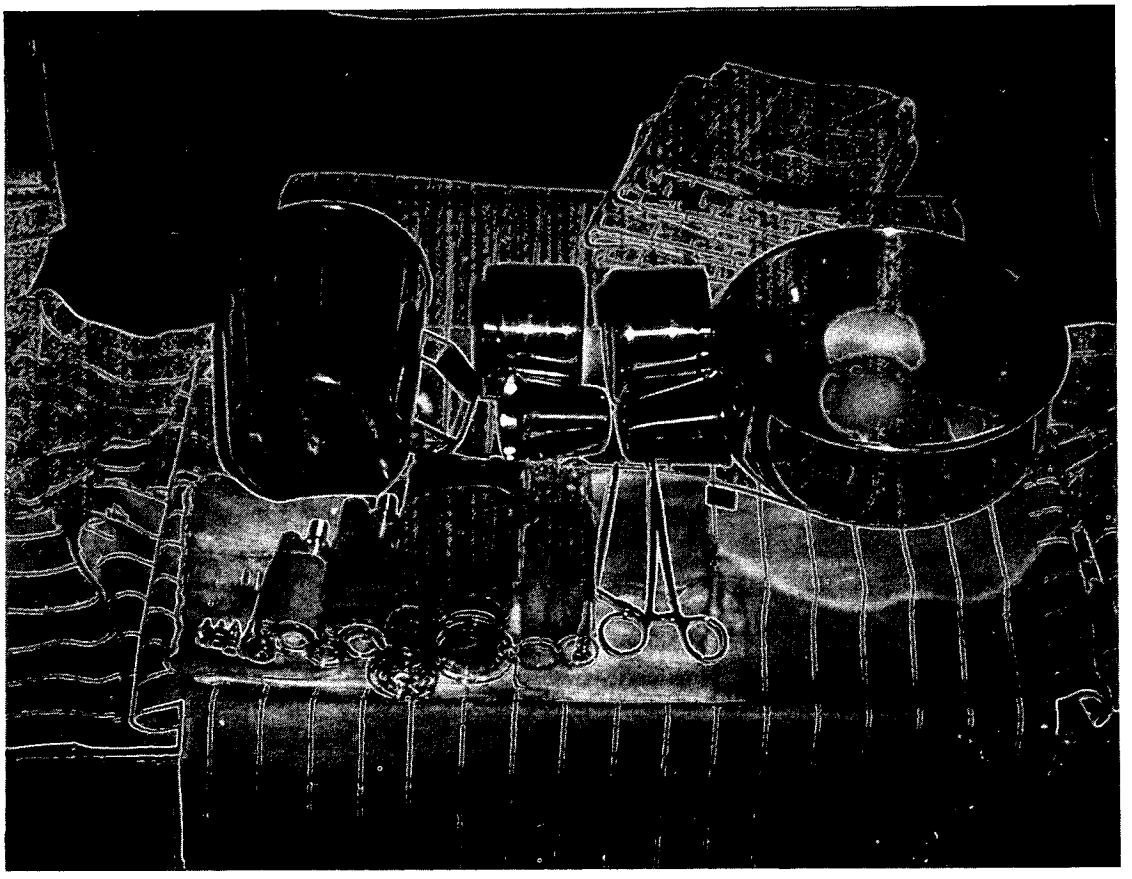
49 After goods have been washed they need to be dried. The load includes a variety of materials, such as glass, metal and rubber, each of which takes a different period of time to dry. The required flexibility is not forthcoming from an infra-red moving belt drier on which everything has to receive the same heat treatment for the same length of time. It is accordingly thought that the conventional drying oven is the more convenient. There are, however, several points about the design of drying ovens which need attention. First, the capacity of the oven should be determined by the output of the washing machine. Secondly, for convenient working it should be double-sided so that wet goods from the washer can be put in on one side and taken out dry on the

other. Thirdly, the most convenient site for an oven is let into the wall between the wash room and the work room, or the wash room and the syringe and instrument room.

Packaging General

50 In the USA it is the usual practice to pack all goods in two layers of linen and to sterilize them in an autoclave. A photograph of a typical American pack is shown below.

must be allowed for. In normal circumstances many of the items will not be required and they will then travel back and forth unused between CSSD and ward. Fifthly, as research has shown (see Appendix G) two layers of linen provide comparatively poor protection against bacterial penetration. These criticisms are important and demand a reconsideration of packaging policy. In doing so it would be shortsighted not to take advantage of modern developments which enable us to improve on present methods in the following ways:



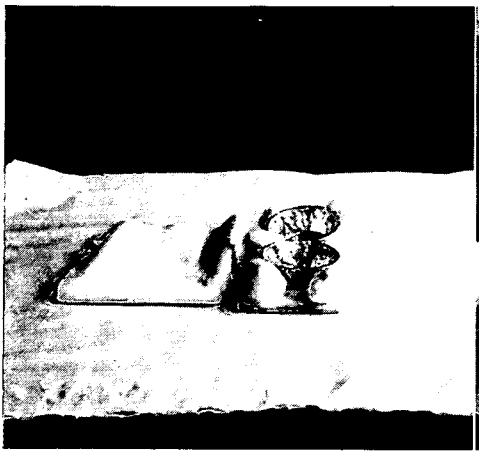
17 An American composite pack

This type of pack has serious disadvantages. First, the syringes have to be packed dismantled for autoclaving. This means that they must subsequently be assembled for use under unsterile conditions. Secondly, the towels and drapes have to be laundered before they can be re-used. This is expensive. Thirdly, the pack is complicated to assemble, awkward to pack and heavy to handle. Fourthly, it contains every item that a nurse or doctor may require. This is necessary because all contingencies

(*a*) The chances would be reduced of a sterilized syringe becoming contaminated before use, if it were to be removed from the composite pack described above and sterilized by dry heat, already assembled, in its own container.

(*b*) Instruments would be used more economically if they also were packaged separately from dressings and sterilized by dry heat.

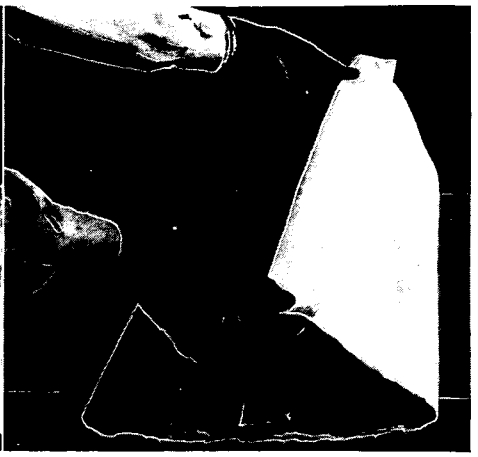
(*c*) The heavy initial outlay on linen and the cost



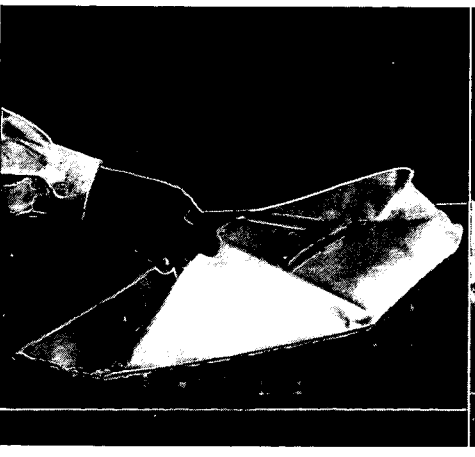
(*a*)
Medium pack, basic dressings required for lumbar puncture, aspiration, etc.

(*b*)

and

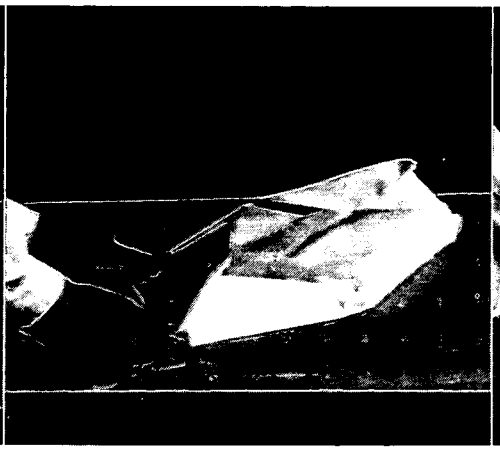


(*c*)
Long sides of paper everted by 2 inches, folded to centre and overlapped

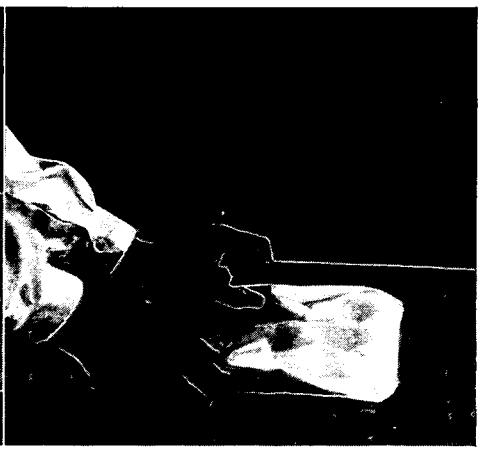


(*d*)

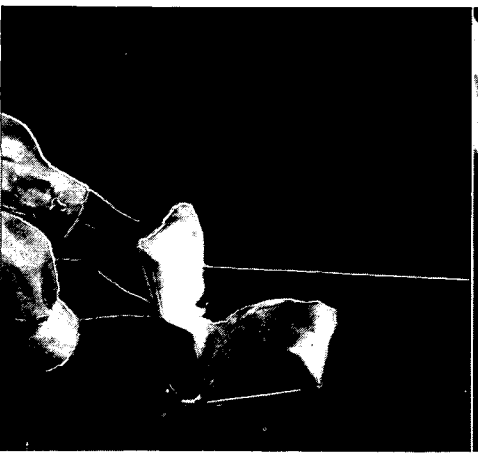
and



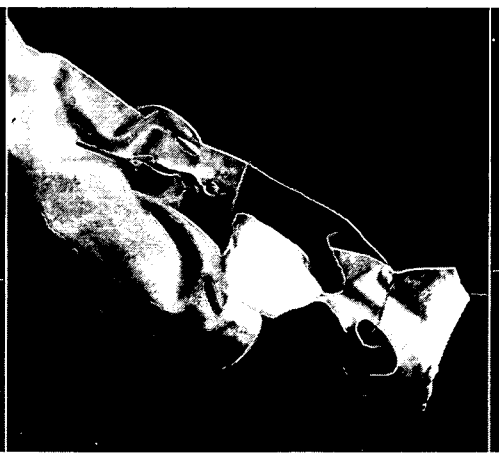
(*e*)
Open ends mitred



(*f*)
Mitred corners folded to centre



(*g*)
Pack folded in half along its width



(*h*)
Elastic band applied

(*j*)
Complete pack ready to place in a cardboard box

of laundering could be reduced by using disposable paper in place of it. Paper also provides a better barrier against bacterial penetration.

(*d*) The bulky and expensive stainless steel bowls and gallipots could nearly all be replaced by disposable substitutes made of aluminium foil.

51 These developments necessitate a break-down of the composite type of American pack illustrated on p. 24, and the re-assembly of its contents into their constituent parts. This procedure has worked well and has been shown to have several advantages. First, packing is quicker since each article is put inside a container designed to hold it. Secondly, it is more economical of equipment because the nursing staff, instead of using a composite pack holding everything they are likely to want, select only what they need for a particular treatment. Thirdly, it provides a simple system for lay personnel to master. Fourthly, the system is flexible and will allow, without disruption of the basic packaging plan, the gradual introduction of pre-sterilized disposable equipment as this becomes available from the manufacturers. And fifthly, large stocks of dressing packs can be made up in advance of need. This practice would prove uneconomic if the dressing pack also contained re-usable equipment (see paragraph 103 (*b*)).

52 It is now for consideration how the constituent parts of a hospital's sterile supplies should be assembled and packed. A basic division which has worked satisfactorily at Cambridge is to separate those items which can be sterilized by steam from those which can be sterilized by hot air. Thus, dressings, supplementary packs, rubber goods and theatre packs are suitably packaged for steam sterilization, and syringes, needles and small ward instruments for hot air. They will be considered in that order.

Dressing Packs

53 Before deciding how to wrap the dressing packs, consideration should be given to their contents. Some measure of standardization is essential. A hospital group setting up a CSSD should be advised by a small committee. Members of the committee should include nursing staff and the CSSD superintendent; its purpose being to agree the contents of the dressing packs to be supplied to all hospitals in the group. To achieve economy in the use of dressings it is advisable to cater for the average need and to fill the dressing packs accordingly. To meet requirements above the average, supplementary packs containing dressings materials individually wrapped will be found suitable. The range and content of dressing packs used at Cambridge can be found at Appendix E and of supplementary packs at Appendix F.

54 It has been argued earlier that paper, rather than linen, should be used for the wrap which is to enclose the dressings and which, when opened, will form the sterile field from which the nurse works. In considering the best type of paper to use a number of factors have to be considered. An appreciation of these is given at Appendix G. The paper must provide an efficient barrier against bacterial penetration. It should be conformable and simple to open out. It should be reasonably priced and of good appearance. Paper with such qualities can be bought sheeted in sizes approximately 30 inches by 30 inches for large and medium packs, and 20 inches by 20 inches for small packs.

There are various methods of folding but the method shown on p. 25 has been adopted at Cambridge. It is simple to perform in the CSSD and nurses find it convenient to open.

55 In organizing the work bench so as to enable the orderlies to achieve a high rate of pack production, the following points should be borne in mind:

(*a*) Each orderly should have grouped within easy reach all the items required for the pack.

(*b*) The work should be done sitting and in reasonable comfort.

(*c*) There should be a pile-up area for the finished product away from, but within easy reach of, the preparation area.

So long as these points are given proper attention, there is no need for a complex work bench. The simpler its design the more flexible it will be and the more easily can it be adapted to suit the task in hand. A photograph of a simple layout which has been found to work well is shown on p. 15.

Supplementary Packs

56 There are numerous packs including a small proportion of dressings materials, which are required to supplement the basic dressing packs. The contents of them range from safety pins to proctoscopes and two-

19 The corners are turned in before the open edge of the bag is folded over three times

pint measures. (A list of the packs is given at Appendix F.) It will be found more convenient to pack these supplementary items in paper bags than in paper sheets. Sets for procedures such as aspiration, lumbar puncture, etc., are made up from individually packed items in the supplementary range. (The Adson pattern of manometer and adaptor can be easily contained in a paper bag.) Appendix H gives some technical details of the types of paper bags which have proved suitable. It is important that the bags used should be properly sealed to prevent contamination. There are three possible methods of closure:

(*a*) Folding and stapling.
(*b*) Folding and taping.
(*c*) Heat-sealing.

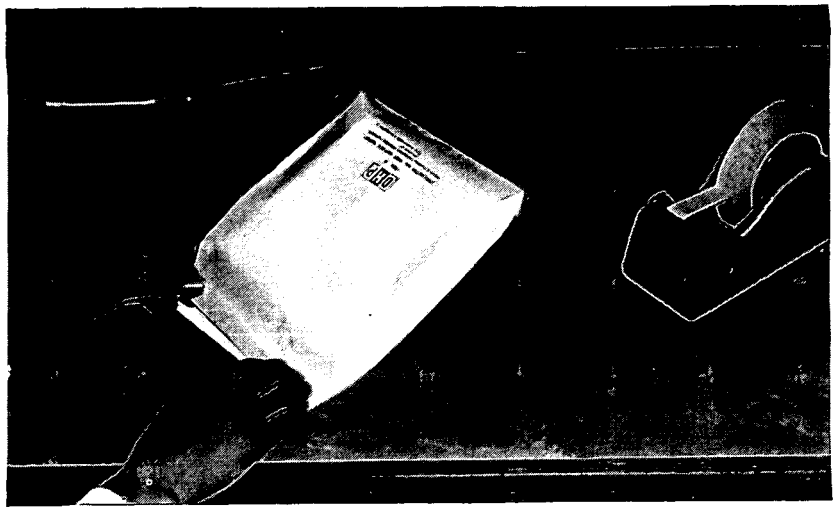
(*a*) *Folding and Stapling* This is a quick and convenient method of closing paper bags. The corners of the bag are mitred and the edges folded over three times and secured with staples. A foot-operated stapling machine is on the market which allows three staples simultaneously to be inserted along the fold of the bag. But it is not possible by these means to obtain an adequate seal, because the staples make holes. For this reason it is considered unsafe and is not recommended, other than for items which are used in a clean rather than a sterile state, for example, stomach and rectal tubes, and nailbrushes.

(*b*) *Folding and Taping* The method of closing the opening of the bag is the same as described for stapling, but a piece of pressure-sensitive tape is used to secure the final fold. This affords an efficient seal. Pressure sensitive tape becomes striped during the autoclaving process which gives an indication that the pack has been autoclaved. The technique of folding and taping is illustrated above and on p. 28.

(*c*) *Heat-Sealing* Manufacturers are now producing paper bags with the opening treated with a wide band of thermoplastic solution. This solution, when subjected to heat and pressure, forms an excellent seal and a machine is now available for this purpose. This method of sealing is quicker and less laborious than folding and taping. But practical experience has, for the following reasons, revealed the necessity for checking the seal after the bag has been treated:

(*i*) There is no way of ensuring that the correct amount of heat and pressure has been applied, nor that it has been applied in the correct place.

(*ii*) With gussetted bags it is difficult to obtain an even pressure between the sealing jaws. As a result the centre of the bag, where there are but two layers of paper, may remain unsealed; whilst the corners, where there are four layers, are firmly



20 The third fold is secured with a strip of pressure-sensitive tape, two-thirds the width of the bag

stuck together. This can partly be overcome with the use of 'pyramid' patterned jaws.

The manufacturers are aware of the shortcomings of sealing machines and it is believed that they will overcome them and make a machine which is proof against human error. But manufacturers have not yet achieved this with adequate certainty.

57 It is concluded that either heat-sealing or folding and taping the opening of paper bags are satisfactory methods of closure. Of the two, heat-sealing is cheaper and quicker and, provided that it can be done properly, the more efficient, but it is not yet sure enough. It is therefore recommended that, until the criticisms of the present sealing machine have been met, gussetted paper bags should be closed by folding and taping. If desired non-gussetted bags may be heat-sealed using 'pyramid' patterned jaws, provided that the seal is inspected afterwards.

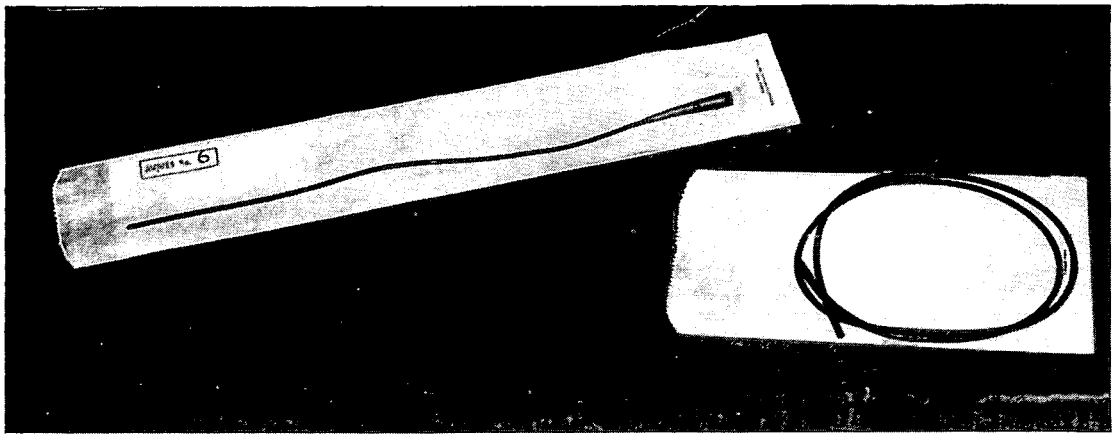
Opening Paper Bags

58 To extract its sterile contents a paper bag can either be torn across or cut open. Gussetted bags present a greater resistance to tearing than do plain bags and for this reason it is recommended that they should be cut. Tearing also creates a dust aerosol and in areas such as the theatres where it is important to avoid this, it is advisable to cut bags open. An advantage of folding and taping is that the tape can be cut across and the bag opened in such a way as to avoid fingering the edge over which the contents of the bag are to be tipped.

Catheters and Rubber Tubing

59 It has already been mentioned that catheters are one of the items which are difficult to process, under hospital conditions (paragraph 6). Supplies from the CSSD should carry with them a guarantee of sterility. The catheter cannot carry such guarantee, because of the known difficulty of cleaning and sterilizing narrow bore flexible tubes. The hazards of using imperfectly clean and unsterile catheters are generally appreciated, and it is because of these that disposable catheters are recommended. A complete range of disposable catheters is not however yet available; and those that are, are prohibitively expensive (see paragraph 145 (*c*)). Some types of catheters will perforce have to continue to be processed in the CSSD. A description of a method of processing catheters and tubing should therefore have a place in this book.

60 A higher standard of cleanliness can be achieved if catheters and tubing are given a soaking period of four hours before washing. Trials at Cambridge have shown that improved results can be obtained by the addition of 'Adkahest' to the warm soaking water (stock solution: Di Sodium Ethylene Diamine Tetra-acetic acid 48 gm.; Teepol 200 ml.; water 800 ml.; dilution: 25 ml. to 1 litre). After soaking, each catheter and tube should be flushed



21 A packaging method for a Jacques' catheter and a Ryle's tube

with a jet of water under pressure. For this purpose a small hand-operated flusher is on the market. Following this operation they can be washed and rinsed in the same machine that is used for gloves and dried in the drying oven. But even with the most thorough processing it is impossible always to reach the proper standard of cleanliness desired.

61 The paper bags used for packaging the catheters should be sufficiently long to make bending of the catheters unnecessary. Longer tubes which it is impracticable to pack straight should be loosely curled, care being taken to avoid kinking. Every effort should be made to avoid the use of lengths of tubing over 36 inches, for then it is difficult for steam to displace the air trapped inside. Paper bags should be sealed in a manner described earlier. The photograph above illustrates a suggested packaging method.

Gloves

62 Surgical gloves are another item which cannot be processed satisfactorily in the CSSD. It is impossible to test them and to guarantee the surgeon a sterile intact glove. Disposable surgical gloves are now available, have been tried at Cambridge and found satisfactory. Their use is recommended.

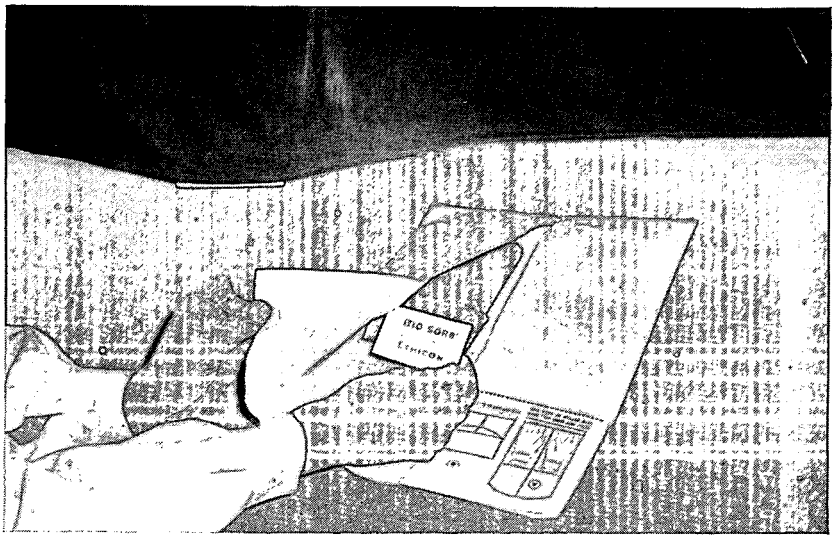
If for local reasons the introduction of disposable surgical gloves has to be delayed, the following description of a method used at Cambridge for processing gloves may be helpful. Perhaps more than other commodities processed in the CSSD, gloves require the detailed attention of skilled and reliable labour. A number of processes are involved:

(*a*) Washing and rinsing
(*b*) Testing
(*c*) Drying
(*d*) Mending
(*e*) Powdering
(*f*) Sorting into sizes
(*g*) Turning, pairing and packing
(*h*) Sterilizing

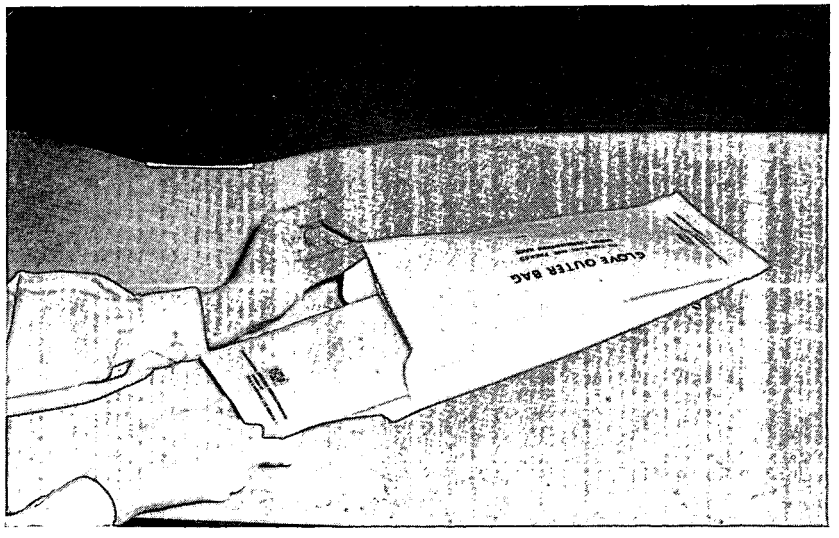
(*a*) *Washing and Rinsing* Gloves can be washed mechanically in the type of machine described at Appendix B. A higher proportion of clean gloves results if the wearer rinses his gloves in the theatre before removing them; and if the gloves are kept in a moist condition during the interval between usage and washing.

(*b*) *Testing* The most efficient method of testing for holes was found to be the water test. By this method a glove is filled with water, the cuff twisted to prevent water escaping, and pressure applied. The gloves are then carefully examined for beads of water escaping through the fabric, and any puncture marked for mending. It was found convenient to test the gloves immediately after washing and before drying. The gloves have in any case to be handled separately at this stage in order to squeeze out excess moisture before putting them in the drying machine. Gloves which have been mended are returned twenty-four hours later to the washing process and retested with that day's load.

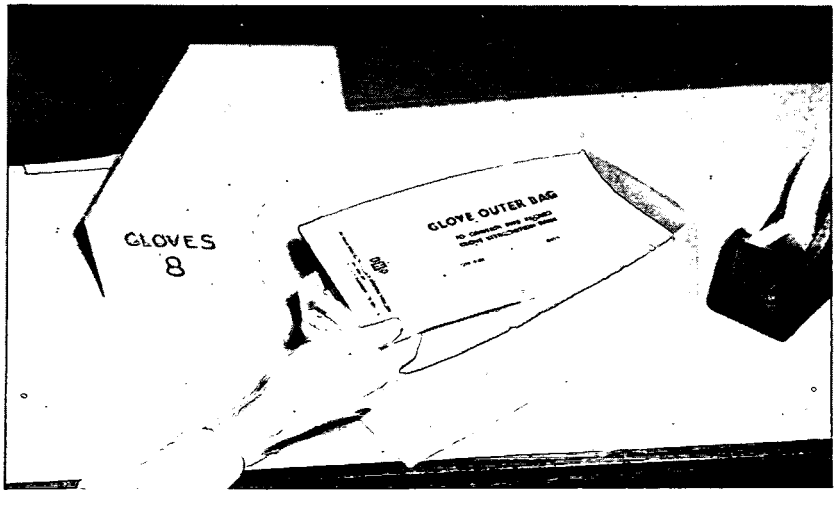
(*c*) *Drying* Gloves can be satisfactorily dried in a machine (see Appendix B). The best results are ob-



22 Adding the powder sachet to gloves fitted into a wallet



23 Inserting closed wallet into a paper bag



24 The sealed bag being placed in a cardboard box ready for sterilization

tained if excess moisture is expelled from the glove before inserting it in the drier. This should be done by hand. A small mangle has been tried, but it is tedious to feed and often splits the glove fabric.

(*d*) *Mending* An efficient rubber solution for repairing gloves is now available and can be obtained from the manufacturers of the glove machine. No rubber patch is required with the solution, which forms its own smooth and almost imperceptible patch.

(*e*) *Powdering* This is done efficiently in a machine (see Appendix B). The coating of powder on the gloves is even and the machine is air-tight.

(*f*) *Sorting* A simple type of bench designed to contain six holes, each of which is fitted with a washable nylon bag, and a central pile-up area, has been found adequate for sorting gloves into sizes. The central area accommodates about 144 gloves which is the output of each of the three machines. The total mechanical processing time is about $1\frac{1}{2}$ hours. An illustration of the glove bench described is shown on p. 19.

(*g*) *Turning and Pairing the Gloves, and Packing* During the processing stages (*a*) to (*f*) the gloves remain as they arrived from the theatres, inside out. It has been found most convenient to turn and pair them at the packing stage. Disposable paper wallets have been found acceptable and gloves are packed into these together with a commercially prepared powder sachet. As an added safeguard for theatre handling the filled wallet is sealed inside a paper bag. The sealed bags are packed by size into cardboard boxes ready for sterilization. The method of packaging is illustrated on p. 30.

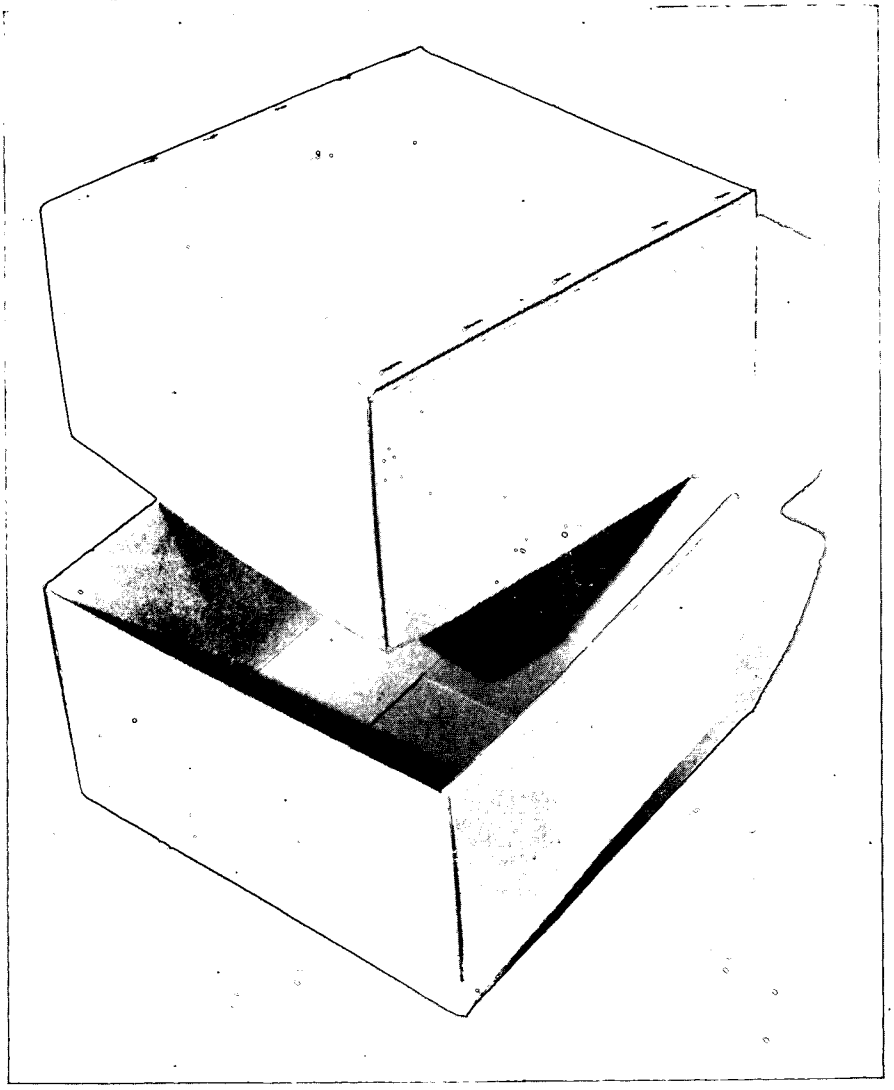
(*h*) *Sterilizing* Surgical gloves packaged in the manner described can be adequately sterilized in a modern high-pressure steam sterilizer. At Cambridge a pressure of 32 lbs. p.s.i. has been used routinely for gloves without adverse effect on the rubber fabric. The average life of a glove was found under these conditions to be between three and five usages.

Outer Covering

63 When the dressing packs, the supplementary packs and the catheters have been packed in the manner suggested there will be one barrier only, that of the paper, between the sterile contents and contamination by airborne and other bacteria. But as the work of V G and F I Alder[23] shows, there is a need for more than one barrier. For adequate protection a minimum of two layers is necessary. If the inner barrier is paper, then the outer barrier should be sufficiently robust to protect the

[23] Alder V G and F I (1961), *J.clin.Path.* **14,** 76

25 The cardboard box collapsed for storing



26 The cardboard box made up and ready for use

contents of the pack against puncturing in transit and moisture. A linen outer wrap might provide a firmer wrap than paper; but it is a poor bacterial barrier, and is certainly not proof against moisture. It also has to be laundered. The sterilizable cardboard box does not seem to have such disadvantages. It has proved successful at Cambridge over a period of many months and is now becoming widely used throughout the hospital service. Its use is recommended. To each filled cardboard box is added an indicator paper which during the sterilizing process changes from black to white revealing the word 'Autoclaved'. This provides the user of the packs with a definite indication that the box has been through the autoclave.

Handling of Cardboard Boxes

64 If, as has been suggested in the previous paragraph, the majority of sterile supplies go out from a CSSD in returnable cardboard boxes, some plan for their handling on return must be made, since the bulk of the returned boxes is considerable. Collection of the boxes from the hospitals and their delivery at the CSSD raises no problems. It is in the department itself that careful organization is required to cope with them on their return. At Cambridge the boxes pass through four distinct areas:

(*a*) A reception or loading bay
(*b*) A packing area

(*c*) An autoclaving area
(*d*) The sterile store

(*a*) *Reception Bay* Cardboard boxes arrive back in bulk containers. From these they are unloaded, sorted by type and stacked on mobile shelves. The boxes then remain in this reception bay on their mobile shelves until the orderlies are ready to fill them.

(*b*) *Packing Area* This area should be adjacent to the unsterile pack store and there should be sufficient space in it to contain two sets of mobile shelves and a packing bench. One set of shelves, holding empty cardboard boxes is wheeled in from the unloading bay, the other is loaded with the filled boxes, later to be wheeled to the autoclaving area.

(*c*) *Autoclaving Area* An area in front of the autoclaves should be reserved for parking banks of mobile shelves, piled with filled cardboard boxes. Here they should be stored until required for autoclaving.

(*d*) *The Sterile Store* Before the boxes are autoclaved they are loaded into perforated aluminium trays, in which they are later delivered to the wards. Each tray is filled according to the quantity requisitioned by the ward (as many as six trays may be required for one ward). Each tray is labelled with the ward's name. After sterilization trays are wheeled into the sterile store where the hot-air sterilized packs are added to them and delivery made without delay.

The arrangement and the siting of the four areas for dealing with cardboard boxes at Cambridge is shown on the trace attached to the plan of the department at Appendix C.

Theatre Packaging

65 Soiled theatre linen will be sent to the laundry from where it will be returned to the CSSD. In the CSSD it will be inspected for holes and folded. An internally lit table is a help when checking linen for holes. A photograph of such a table is shown on p. 20. It is recommended that holed linen should be returned to the central linen room for repair and not done by CSSD orderlies, whose primary tasks are packing and sterilizing.

66 Various papers have been produced which are replacing cotton dressing towels in the wards. But a suitable paper is not yet available to replace theatre linen. (The word 'linen' is used in its broadest sense.) Paper manufacturers are aware of this need and are making good progress in their endeavour to produce a conformable water-repellent paper. In the meantime theatres will have to continue to be provided with their packs at least partly wrapped in and containing linen. It is suggested that theatre packs should be prepared on the same principle as recommended for the ward dressing pack, in that the wrapping when opened should form a sterile field. For theatre packs, however, two layers of wrapping in addition to a cardboard box should be employed. There are two reasons which make the additional layer advisable:

(*a*) Theatre aseptic technique requires that the clean outer layer of wrapping should be opened by an unscrubbed nurse, leaving the sterile inner layer to be handled by the scrubbed nurse.
(*b*) Theatre packs are more bulky than ward packs. Two layers of wrapping are therefore indicated, the folds being secured by string.

Until an efficient paper is available to replace linen it is suggested that one of the two wrappers should be of paper. The inner linen wrap will thus provide a surface for the theatre nurse to work on, and the outer layer of paper an efficient protective barrier. This method of wrapping, by saving a layer of linen, can effect a reduction in laundry costs.

67 Because of the limited range of sizes cardboard boxes may be found unsuitable for the larger theatre packs. A 37 lb. Kraft paper sack has proved a satisfactory substitute. Two or three packs can usually be fitted into one sack, which is closed and tied with string. Steam penetrates these heavy-weight sacks satisfactorily.

68 There is not yet a material which can replace mackintosh. Further consideration is given to this aspect of theatre needs in paragraph 188. It will suffice here to say that when a paper substitute for theatre drapes is available, and provided that sisters and surgeons are prepared to work in drier conditions, the need for waterproof materials should not arise.

69 The following paragraphs outline a suggested method of preparing theatre packs.

(*a*) *Gowns* Most of the gowns can be assembled in threes, the remainder being individually packed, so as to allow flexibility in use. A paper hand towel should be packed with each gown. There are two methods of packing gowns. They may either be packed in a paper-lined cardboard box from which the surgeons

can help themselves, or be prepared on the same principle as the ward dressing packs. The latter method is used at Cambridge, and has been found convenient. It has already been stated that packs require two layers of wrapping, and that the inner one should be of linen. With gowns, however, the linen layer can satisfactorily be replaced by paper. The folds of the pack should be secured with string before placing it in a paper sack, which is then closed with tape and tied. A pack-tying machine has been found useful for this purpose. Details of the machine are given at Appendix B and a photograph is shown below.

27 The pack-tying machine in use

(*b*) *Basic Drape and Dressing Packs* The range and contents of basic packs is a matter which depends on the personal preferences of surgeons and sisters, and one which will be agreed with the CSSD superintendent in the early stages of planning. Some reference to this point is made in paragraph 186. It is suggested that basic requirements for drapes and dressings should be assembled on the lines recommended in paragraph 53. A method of packaging is described in paragraph 66 *et seq.*

(*c*) *Supplementary Packs* A range of items individually wrapped will be required to supplement the basic drape and dressing packs already mentioned. These supplementary items can be double-packed in paper bags and a number of bags placed in a cardboard box. At Cambridge it is preferred to close the mouth of the bag by folding and taping (see paragraph 58).

(*d*) *Gloves* A description of a suitable method of packing gloves has been given in paragraph 62.

(*e*) *Bowl Sets* The use of bowl packs is discussed in greater detail in paragraph 187 (*c*). If it is decided that bowls should be provided from the CSSD they should be packed separately from other goods. At least one hand basin will be required for an operation and this can be the container for the smaller utensils. Packaging as described in paragraphs 66–67 has been found convenient. Because of their size, a cardboard box as outer protection is unsuitable for bowl sets, and they should therefore be placed in paper sacks. The sterilization of utensils is often difficult in that steam condenses on the cold surface of the bowls and the routine drying time in the high-speed autoclave is inadequate. This difficulty can be reduced but not altogether overcome by preheating the packs. Bowls made of polypropylene do not present such a problem. They are light, only about an eighth of the price of stainless steel, and they appear to withstand sterilizing temperatures. Tests have shown that so long as these bowls are placed on their sides in the autoclave they will emerge dry. They have not yet been in use long enough to find out whether they stand up reasonably well to wear and tear.

(*f*) *Special Sets* Sets for procedures such as spinal anaesthesia which are probably used infrequently should be packaged in the same manner as a dressing pack. The cardboard box should be given additional protection in the form of a 28 lb. Kraft bag in which it

is sealed before sterilization. Thus packaged it can be given an expiry date of six months.

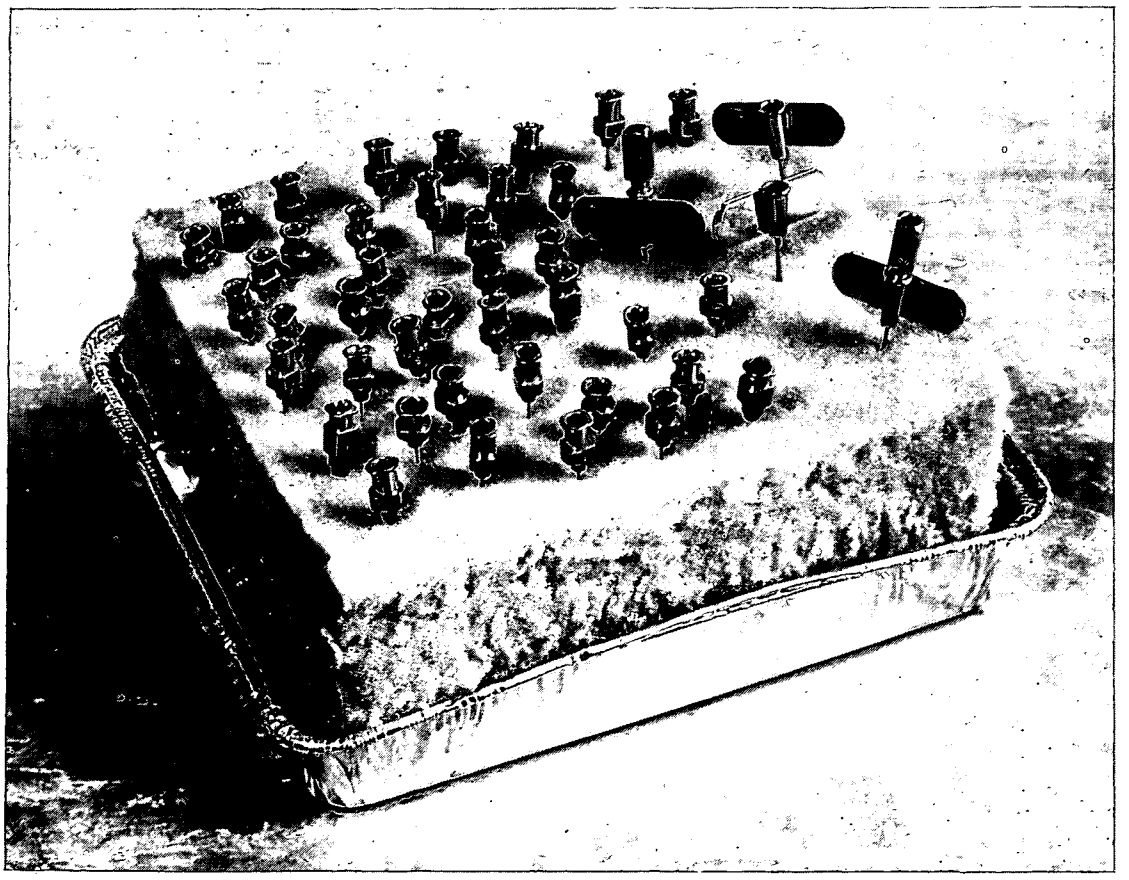
(*g*) *Sets for Emergency Use* Sets required for emergency use must be composite, containing every item that may be required for an emergency as, for example, cardiac massage, embolectomy, tracheostomy, etc. The method of packing should be the same as for Special Sets.

Items for Hot-air Sterilization

70 The advantages to be derived from packing needles, syringes, and instruments separately from dressings have already been discussed. Just as the nursing staff require a variety of dressings packs from which to choose, they also require a selection of syringes, needles and instrument packs. At Appendix J is a list of those packs which have proved convenient at Cambridge. The washing and drying of these articles will have already been completed in the wash room. It is necessary to consider the assembly and packaging processes of needles, syringes and instruments separately. Whichever method is adopted for packaging, it is desirable that this should be done in a separate room, or at least in a separate part of the work room. The following methods are now in general use.

Needle Processing and Packaging

71 Needle processing is a time-consuming task, because the hub and lumen of the needle are so laborious to clean. It is also frustrating for, however much time and trouble are taken in cleaning the needles, it is difficult to know whether it has been effective. As in the case of catheters, it is of the utmost importance to ensure a high standard of cleanliness. It is for this reason that the use is recommended of disposable needles bought pre-packed



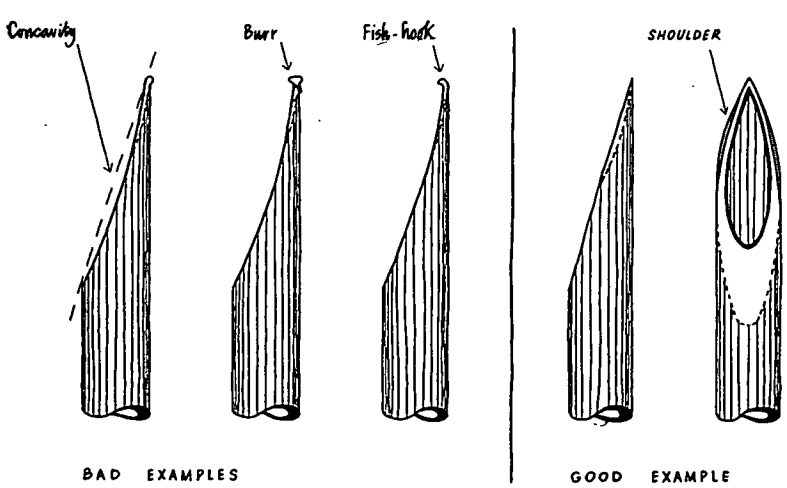
28 The suggested method of protecting needle points

and sterile from the manufacturers. Sterile disposable hypodermic needles are now readily obtainable and there is no reason why medical and nursing staff should not be wholly satisfied with them. Special needles, such as those used for lumbar puncture, aspiration, etc., and intravenous cannulae are unfortunately not yet obtainable and processing arrangements will have to be made.

72 Until special needles are included in the disposable range, every effort should be made to clean them as efficiently as possible with the facilities available to a CSSD. A small ultra-sonic tank is probably the best means of cleaning the hub and lumen, but this method has only the limited effect of loosening the dirt trapped in them. The loosened particles of dirt can usually be removed by flushing the needles with hot water under pressure. But before the needles are flushed it is convenient, first, to test them for sharpness, since it is important to flush a sharpened needle, to remove the dross. Needles should be flushed for at least two minutes and observed for partial or complete blockage. The insertion of a stilette wire may be helpful in dislodging a dirt particle in the lumen of a needle. If a needle remains even partially blocked it should be discarded.

73 The first step to be taken in preserving the sharpness of needles is to prevent blunting them. This may sound self-evident, but it is neglected in some services, where the needles are thrown together in dishes or tipped in bulk from one receptacle to another. At all times when the needles are not being handled or are awaiting packing, they should be stuck into needle cushions. Cellulose foam sponge is an excellent material for these cushions and may be used during all stages of processing. It is easily washed. Needle cushions can be cut from large sheets, and they should be thick enough to prevent the needle points protruding. It is better to have a number of small cushions than a few large ones. A photograph of needles in a cellulose cushion is shown on p. 35.

Claims may be made that needles can be tested for sharpness by being passed between thumb and finger nail or by being stuck through thin rubber stretched over a jar. Both methods are crude and it is recommended that a binocular microscope with magnification of 15 diameters should be used to determine the sharpness and the correctly shaped bevel of a needle point. This method of inspection will also show whether the aperture is clean and free from dross. Some drawings of needle points are given below.



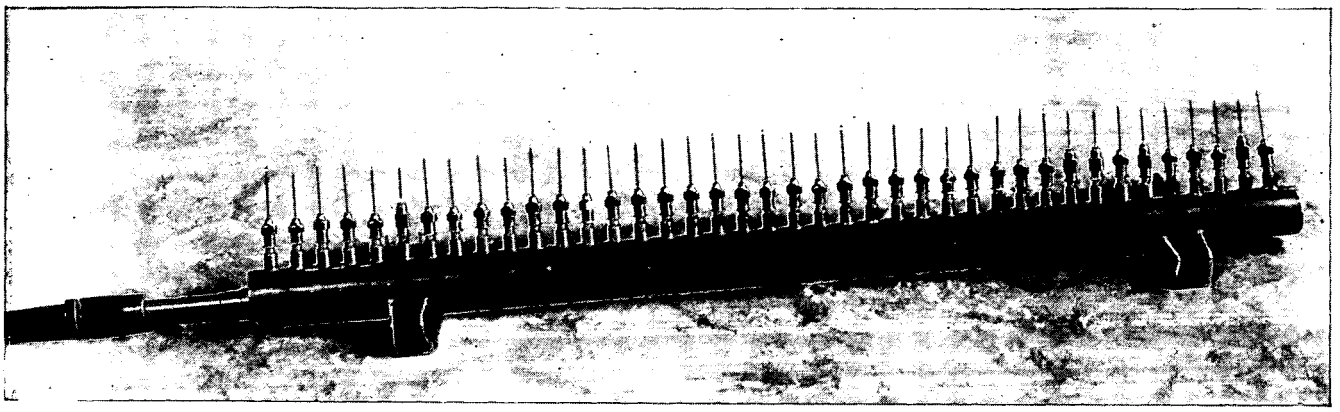
NEEDLE POINTS

29 *Drawing*

74 Needle sharpening is sometimes avoided on the grounds that the work is too specialized to be undertaken by orderlies, and that it is too costly in labour. Experience has shown that most people can learn to sharpen needles well, although it may take them a week or two to become proficient. Needles may be sharpened on a fine Arkansas stone lubricated with a light mineral oil, or on a rotary wheel. The former method will take longer when it comes to re-pointing a badly hooked needle, but it will wear the needles down less quickly. If a rotary grinding wheel is used, it should be three inches in diameter to give the needles a short strong point. It should be a fine-grain stone to suit the steel of which the needles are made. A machine which revolves at a relatively low speed is to be preferred, to avoid unnecessary heating and wear. The needles should be sharpened wet, and any which require more than slight re-touching should be dipped in water from time to time. Attention to these details will prolong the life of needles. Hard steel will take a sharper edge, will be less easily blunted and less quickly worn down than milder steel. Good quality needles of Austenitic 18/8 steel should therefore be used.

75 After inspection for sharpness, needles should be placed directly onto multiple holders preparatory to being flushed through with water. A photograph illustrating needles assembled on one of these holders is shown on p. 37.

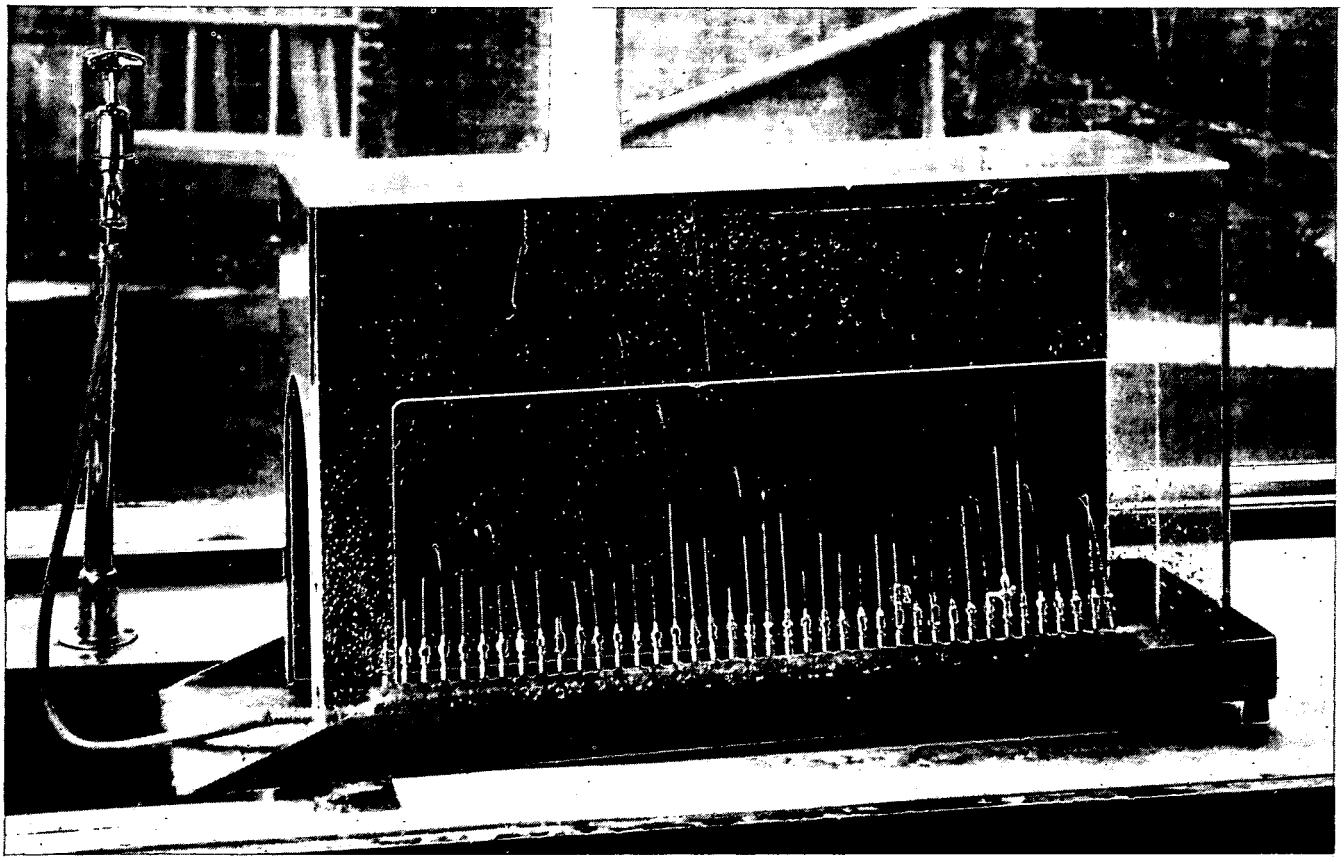
Holders similar to that illustrated can usually be made in the hospital instrument workshop. Once filled the holders are placed under a protective perspex hood and



30 Needles mounted on a holder preparatory to flushing

connected to the hot water supply. Should a needle be blocked it can immediately be detected against the black background of the hood. The hot water rinse is followed by compressed air, which rids the lumen of excess moisture and makes further drying unnecessary. A photograph of the box showing some needles being flushed is shown below.

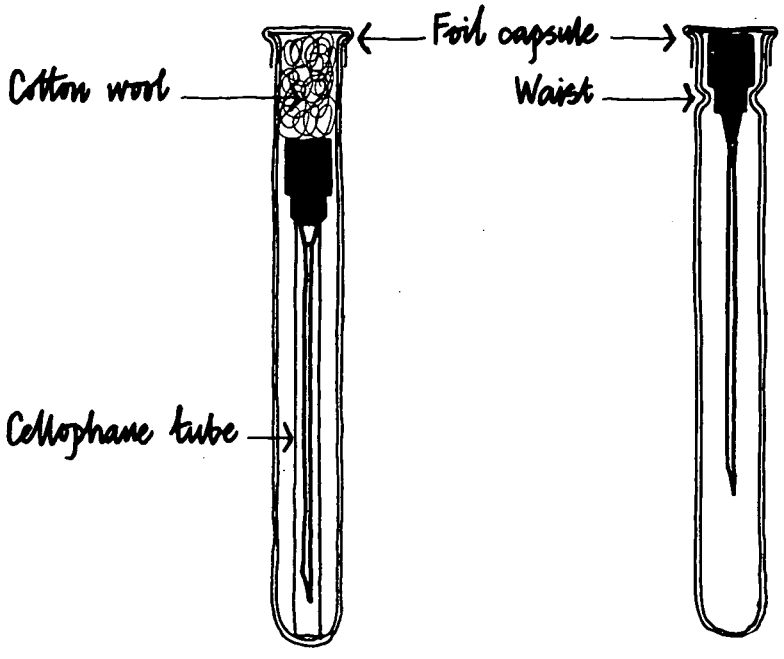
76 It will be found convenient to package all types of needle and cannula in glass tubes. The neck of the tube



31 Needles being flushed under a Perspex hood

should be waisted to support the needle, or a length of cellophane drinking straw should be slipped over the shaft, so that the point is held clear of the glass tube. The tubes can be sealed with aluminium foil capsules. Drawings of needles packed in glass tubes are shown below.

that its aperture is in line with the graduations on the syringe barrel. The needle should be put on firmly enough to ensure that it will not fall off, but not so tightly that the nozzle of the syringe may be damaged when it is taken off.



NEEDLE PACKS — Alternative types.

32 *Drawing*

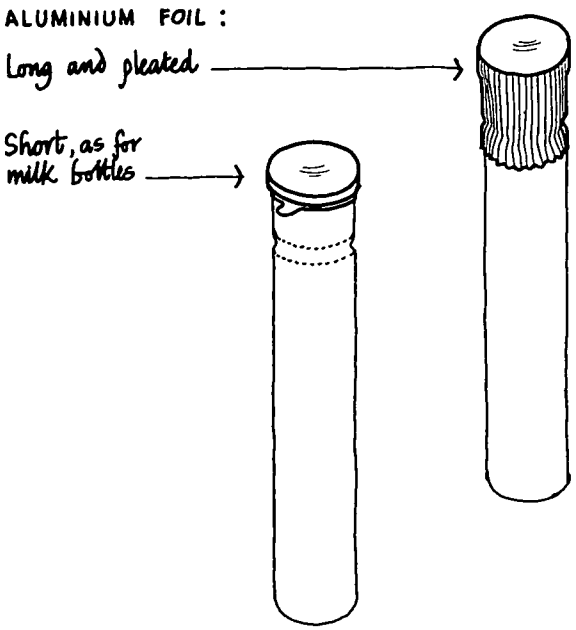
Syringe Processing and Packaging

77 Syringes should be inspected for cleanliness as barrel and plunger are picked up for assembly. Particular attention should be given to the inside of the nozzle, and any barrels not scrupulously clean should be returned for re-washing. Each plunger should then be lightly rolled over a small pad of cellulose foam impregnated with silicone lubricating fluid (a mixture of 510/550 silicones) inserted in a barrel and worked up and down and round to spread the silicone. The pad, which will require changing from time to time, should be kept in a shallow tin with a lid, with which it can be covered when not in use.

78 When a syringe is mounted with a needle prior to sterilization, the needle should be attached in such a way

79. When the syringe, with or without the needle, has been slipped into its extruded aluminium container an expendable foil cap should be used to close it. There are two types of foil cap, those with pleated sides which are widely used for bottles and those which more closely resemble the milk-bottle top. Both caps are available in a wide range of colours, and can be embossed. The pleated cap has been chosen at Cambridge because it accommodates slight variations in the length of plungers, and because it can also be used to close glass tubes. The tops of aluminium containers require to be moistened before this type of cap is applied. An improved capsuling machine operated by compressed air is now available for the application of pleated caps. It gives consistent pressure and forms an efficient seal. After capping, the containers should be placed in the tray or basket in which they are to be sterilized. Drawings of syringes in

alumium containers sealed with the two types of cap are shown below.



33 *Drawing*

Instrument Packaging

80 Instruments should arrive in the syringe and instrument room clean and dry. They should be carefully inspected for cleanliness and any impairment of performance. Scissors should be tested for sharpness. Tissue paper is useful for this purpose. The design of a suitable container for them presented a problem. The use of the extruded aluminium syringe tube had obvious advantages, and although dissecting forceps could be fitted into a 10 ml. or 20 ml. size, it was impossible to do so with ring-handled instruments. A container to hold these required a relatively wide diameter to its length, and one of such a shape would have proved wasteful of space in transit and in storage. An oval container seemed promising but it created manufacturing difficulties since oval tubes are difficult to extrude. It was therefore decided to re-design the instruments to fit into a 10 ml. or 20 ml. container. A firm did this successfully and a photograph is shown below of a 20 ml. container and pairs of scissors and artery forceps designed to fit into it. It will be noted from the photograph that the ring-handled instruments are capable of being opened out into a straight line. The design has an additional advantage in that sharp points are protected by the handle shafts. The cost is no greater than, and their performance compares favourably with, instruments of traditional design. They have now been in use at Cambridge for many months and have been found suitable both by medical and nursing staff and the staff of the CSSD. Instruments of this pattern are placed inside the container and the mouth plugged with a piece of cotton wool. The container is then sealed with an aluminium capsule in the ordinary way.

34 Packing instruments specially designed to fit into a 20 ml. container (for the purpose of demonstration the scissors have not been fully opened)

35 Packing dissecting forceps

Shelf Life of Sterile Packs

81 There is still much work to be done to determine the extent of the shelf life of packs. Some ground has however already been covered.[24] From the advice given it seems reasonable to assume that provided there are two layers of protection between the sterile articles and atmosphere and the storage conditions are of the standard which one would expect to find in clean utility rooms, a shelf life of 28 days can safely be set. Thus each pack other than those sterilized in hot-air which will be considered separately, are stamped with an expiry date 28 days from that of sterilization.[25] In practice, considerations of shelf life are largely academic since supplies are generally used within three days of sterilization. It may however be of help to discuss in detail the various points at which careful organization and a system of checking are required to ensure that date-expired packs are returned to the CSSD for reprocessing.

(*a*) *Wards* Occasionally an infrequently used item is ordered in anticipation of use. It is not used and lies forgotten on the shelf. It is for such reasons that the ward staff or a responsible member of the CSSD should make a weekly check of wards' stocks.

(*b*) *Reserve Supplies* A system for running the reserve supply cupboard, checking, and replenishing its stocks is discussed in paragraph 112. A representative from the CSSD has to visit the cupboard daily and a routine checking for date expiry is easily done at that time.

(*c*) *CSSD Sterile Store* It is recommended in paragraph 103 (*b*) that packs should be held in a clean state and sterilized in quantities to meet a known demand. It is thus unnecessary to hold more than, say, a 24-hours' supply in the sterile store. It should be easy to keep control over such a small quantity.

(*d*) *Hot-air Sterilized Packs* The packs which are sterilized by hot-air are turned over so rapidly that the problem of date expiry does not arise. The use of dispensers (see paragraph 167) preludes their use out of order.

Sterile Water—General

82 In addition to pyrogen-free sterile water, which as already stated in paragraph 3 (*c*) should remain the responsibility of the hospital pharmacy, there is a need for sterile water for topical use in the theatres, wards and departments. Let us consider the methods of supply and how they may be improved upon. The wards and departments other than theatres, use only a small amount of water. Their needs will therefore be considered first.

(*a*) *Wards and Departments* Present sources of the supply of sterile water may either be from a bottle

[24] Alder V G and F I (1961), *J.clin.Path.* **14**, 76

[25] A good system is to change the date on the stamp on a set day each week. This simplifies the routine and the pack checking

sterilized in the pharmacy, or water which is boiled on the wards and poured into a bottle. The latter method can be criticized as unsafe since there is no means of sterilizing the bottle which contains the boiled water. It is recommended therefore that, for those treatments which require sterile water, the supply should be obtained from a bottle which has been sealed and sterilized, either in the pharmacy or in the CSSD.

(*b*) *The Theatres* In many theatres sterile water for topical use is collected in sterilized containers from water boilers installed in the theatre suite. The safety and efficiency of this supply of 'sterile' water is jeopardized by the apparatus itself, because its functional efficiency is so often open to doubt.

(*i*) There is no means of sterilizing the faucet. Thus it is possible for the water flowing through it to become contaminated.

(*ii*) There are several ways in which the sterile water held in the boiler can become contaminated. Air may be sucked into the boiler as water is drawn off. Water in the 'sight tube' may be unsterile. There is no means of knowing whether the coil of cooling pipe through which flows unsterilized water, inside the boiler is intact, other than by stripping down the apparatus.

83 Hospitals are aware of the shortcomings of these 'sterile' water boilers and some manufacturers have endeavoured to improve them. For example, in an attempt to meet the criticism at (*i*) above, the faucets of some types of water boilers have been fitted with a manually-operated steam supply, which is purported to sterilize the faucet immediately prior to its being turned on. The time required to effect sterilization may be as long as five minutes. In busy theatres it would be difficult to ensure that this requirement was conscientiously observed. There is also available a steam pressure, water sterilizer, intended for use within the theatre suite. (Details can be found at the end of Appendix B.) This equipment meets the criticisms at (*ii*) above. But it is a large equipment, requiring the space and services of a small autoclave, and frequent inspection and maintenance. It is not automatic, and to prepare sufficient sterile water for one day's operating in one theatre takes one hour of a nurse's time.

84 It is clear therefore that there is a need for a sure and safe source of supply of sterile water. The most reliable source is, of course, the sealed flask, which is filled and sterilized in the CSSD. This method is widely used in America and on the Continent. But in this country it can create a problem because, owing to the British surgeons' practice of working 'wet' the amount of water used is prodigious. Two theatres undertaking general and urological surgery may use as much as 5 hundredweight of water a day. The physical effort of daily transporting this weight makes a scheme for a bottled supply of sterile water appear ridiculous, But in some hospitals the theatre staff have been able to reduce the consumption of sterile water to a more realistic level. It is, therefore, recommended that, if surgeons and theatre staff wish their patients to benefit from the advantages of water which has been sterilized in sealed flasks, they should endeavour to reduce the quantity they use by working in drier conditions.

Equipment Needed for Sterile Water

85 If water is to be supplied in flasks it is for consideration what equipment is needed in the CSSD for its production and delivery. The following will be required:

(*a*) A water still.
(*b*) A supply of flasks, and baskets to hold them.
(*c*) An autoclave.

(*a*) *The Water Still* Tap water contains minerals, many of which will be precipitated during sterilization, and form a film of scale on the flask wall. This film is difficult to remove by routine washing methods. For this reason distilled water is to be preferred. The output of a still should be based on the demand. Because of the advantage of its compact design and its high output in relation to its size, an American equipment has been installed at Cambridge. The still requires little maintenance and meets the needs of the Heinicke washing machine as well as a limited need for bottled water. Details of the still are given at Appendix B.

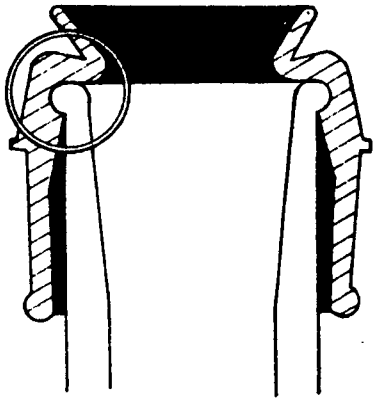
(*b*) *Flasks and Baskets* Again because of the improved design of their caps, the American types of flask are preferred to the British. During the cooling process a vacuum occurs inside the flask, the cap of which is designed so that it can be sucked automatically into position by the vacuum, thus forming a hermetic seal.

The diagram overleaf illustrates the details of this method of sealing.

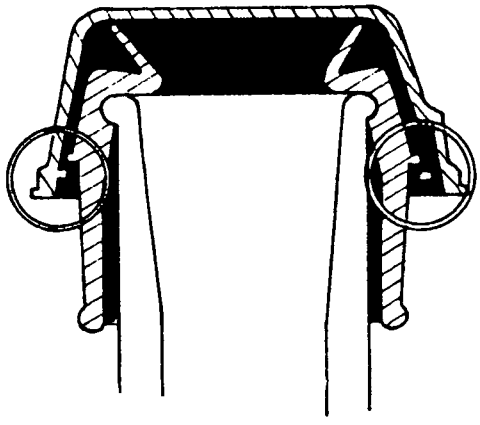
The flasks are available in a wide range of sizes and in a square or round shape. At Cambridge two-litre and

36 Diagram 2

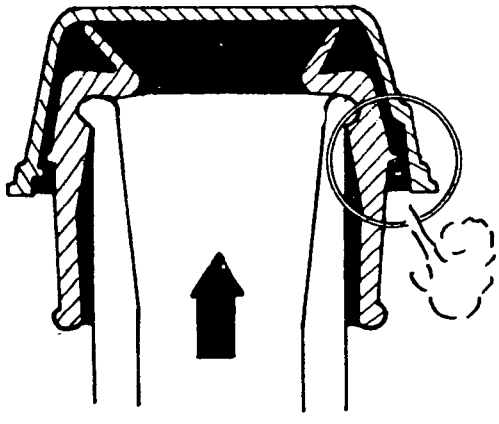
A INTERIOR COLLAR GROOVE EFFECTS AIR TIGHT SEAL AGAINST BEADED LIP OF FLASKS.



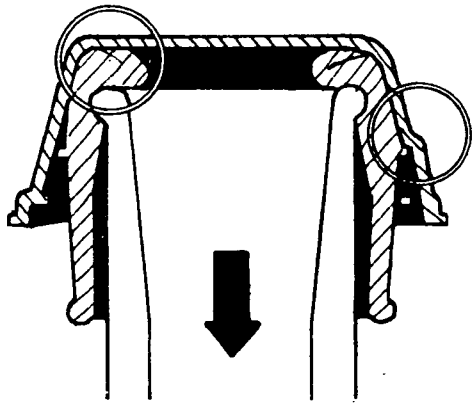
B HOLDER LUGS GRASP COLLAR BEAD TO PREVENT POP-OFF OF HOOD



C AIR VENT IN HOOD VENTS FLASK DURING COOL-DOWN PHASE OF STERILIZATION CYCLE



D CONDENSING STEAM WITHIN COOLING FLASK CREATED VACUUM SEAL



half-litre flasks have been found to meet the requirements of theatres and wards. Both the square and the round flask have been tried. The square flask is more economical of storage space, otherwise there is little to choose between them. Baskets for washing and for handling the flasks, four at a time, have been specially designed and are stackable, so facilitating delivery and storage. Photographs of the flasks and the baskets are shown on p. 43. Further details are given at Appendix B.

(*c*) *The Autoclave* Filled flasks with their specially designed caps resting in position are loaded into the sterilizer, in baskets of four. A simple downward displacement sterilizer can be used for sterilizing fluids but the cycle is slow and the flasks take several hours to cool. In these circumstances it is suggested that water should be the final sterilizing load of the day so that cooling can take place during the night. There are now available on the market steam sterilizers specially designed for the

37 Round water flasks, two-litre and half-litre sizes

rapid sterilization of liquids. Further details of these machines are given at the end of Appendix B. It is important however to point out that these sterilizers are only suitable for fluid sterilization and cannot be used for any of the other commodities processed in a CSSD. The demand for sterile water should therefore be large enough to justify the high cost of the special autoclave.

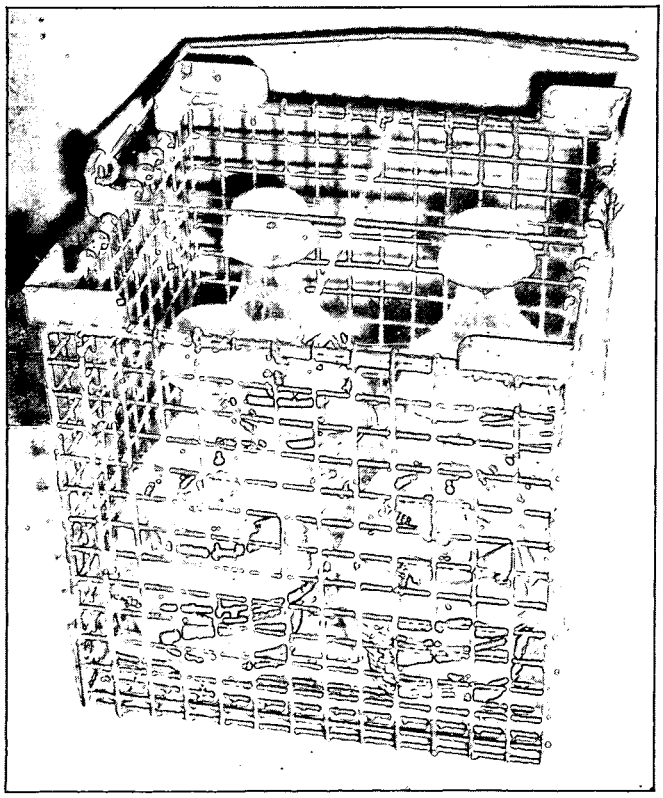
The Shelf Life of Sterile Water Flasks

86 It has already been stated that the caps of the flasks are designed to form a hermetic seal at the conclusion of the sterilizing cycle. It can safely be assumed that, provided the seal has formed correctly, the contents of the flask will remain sterile until the seal is broken. Once opened the contents of the flask should be used immediately, or discarded. As is the case with dressing and supplementary packs, the user requires some definite indication that the flask has been autoclaved. A colour-change indicator paper with the word 'autoclaved' printed on it serves the purpose. There is no means of affixing the paper to each bottle, but it is reasonably satisfactory to clip it to each basket of four bottles.

Supplementary Sources of Sterile Water

87 The method outlined in paragraph 85 will provide theatres with high-grade sterile water. But the production and transport of it can be laborious, particularly where large quantities of water are used, as in urological work. It may therefore help to have a supplementary source of supply. There are two sources of supplementary supply, although one of them is still only in the development stage:

(*a*) *A Filter Press* A small filter press is now available for use in the theatre. The method of filtration employed has been in use for many years, but it is only recently that it has been modified and adapted to hospital requirements. The equipment consists of a small stainless steel press which can be fitted into an area, about 18 inches by 12 inches, of the theatre's sterile preparation room. The press is electrically wired for sterilization, is



38 Flasks in the handling basket

simple to use and maintain. The faucet is detachable and can be steam sterilized as often as is deemed desirable. Filtered water from the domestic supplies is drawn off at the rate of one litre a minute, a speed which necessitates the collection of water in advance of need. Once running, the filter press should not be turned off until there is no further need for sterile water. At the end of a day's use the filter pads are renewed and the press switched on for sterilizing. This source of sterile water may also be of value in small hospitals where the theatres are not used as intensively as in the larger hospitals and where, because of their distance from the CSSD, it is wished to reduce the weight of bottled water to be transported. Further observations on the use of bottled and filtered water are made in paragraph 190. Details of the filter are given at Appendix B.

(*b*) *Physico-chemical Sterilized Water* For some six years now many theatres in France and elsewhere in Europe have been using tap water treated by a super-chlorination/dechlorination process.[26] This method of treatment is now being explored in this country and tests made to ascertain whether water treated in this way meets the full requirements of British medical standards. If the tests are successful a ready supply of sterile water at room or controlled temperature can be available 'on-tap'. The possibility of recontamination in the special pipe network or at the faucet is eliminated. Further details are given at the end of Appendix B.

26 Gosset A J (1955), *Mém. Acad. Chir.* **81**, 682

Cleanliness in the CSSD

88 This chapter so far has dealt with the cleaning and packaging of supplies. It would not be complete without some reference to the domestic cleanliness of the department in which these tasks are done. It cannot be said that hospitals are always in the habit of keeping the autoclaves and their environs up to the standard of a ship's boiler room. But this is the standard of cleanliness and appearance which should obtain. The same is true of other mechanical equipment. All require routine cleaning in order to keep them looking as good as when they were new. Bench tops, cupboards, sinks, floors, walls, etc., all require daily, weekly or periodic cleaning, in order to achieve the high standard of cleanliness necessary. Special arrangements should be made in the hospital for this cleaning service. The CSSD orderlies should not be required to do the job themselves, because it could only be at the expense of production. Yet when work ends all rooms in the department must be left tidy so that the cleaners can easily perform their task. This is a measure of simple discipline which should never be overlooked. It has been found most convenient if the cleaning is done either at the end of the working day, or before work begins. It is as necessary to supervise the work of domestic cleaners in CSSDs as it is, say, in the operating theatre suite.

Chapter 5 Sterilization

General — steam — hot-air — gas — chemicals — irradiation—filtration—pasteurization.

General

89 Chapter IV in general, and Appendices E, F, and J in particular, give an idea of the wide variety of articles which require sterilization in hospitals. This variety of articles, many of them in small quantities, is one of the features of hospital sterilizing problems; which, in this respect, are different from the problems facing manufacturers who usually have to sterilize a limited range in large quantities. The wide range of articles to be sterilized in a hospital CSSD at once poses the question as how best to sterilize each type of article. The following agents are available: steam; hot-air; gas; chemicals; irradiation; filtration and pasteurization.[27] It will probably be easiest to consider each sterilizing agent in turn, discussing for which type of article it is suitable and what practicable difficulties are likely to be encountered under hospital conditions.

Steam

90 Steam is the 'classic' agent for sterilization in hospitals. Its properties are well known. The application of steam to hospital sterilizing problems has recently been made the subject of a special study by a Medical Research Council Working Party and its reports were published in *The Lancet*.[28] These reports, which deal exhaustively with the subject, should be read by all those concerned in the organization of central sterile supply. Since the original report was published, some doubt has been cast as to whether high-vacuum autoclaves remove air from tightly-packed containers as effectively as had at one time been thought. The matter is still under investigation. Here it is wished to make one point only. The centralization of packaging makes it possible to ensure that containers are not packed too tightly; but are packed in such a manner that subsequent sterilization is facilitated. Those charged with the supervision of autoclaves should keep in touch with the Medical Research Council's various pronouncements since finality on this subject is unlikely to be reached before this book goes to press.

Hot-air

91 The Medical Research Council has also recently published the findings of its working party on the uses of hot-air for syringe sterilization. The [29] methods of sterilization advocated in the Council's memorandum are as suitable for the sterilization of ward instruments as they are for syringes. All hot-air sterilization should be conducted in accordance with the procedures recommended.

Gas

92 The use of ethylene oxide was developed during the second world war by the American army for the sterilization of articles which would be damaged by high temperatures. It is now widely used by American industry for the sterilization of plastic products and other surgical materials. Ethylene oxide has, however, many disadvantages:

(*a*) In certain circumstances it may be explosive.
(*b*) The degree of humidity is critical; and if sterilization is to be effective, needs to be carefully regulated both in the sterilizing chamber and within the package to be sterilized.
(*c*) It takes a comparatively long time to sterilize—from four to twelve hours.
(*d*) Continuous control has to be maintained throughout the cycle.
(*e*) It is expensive.
(*f*) Sterility cannot be guaranteed when the level of contamination is high and when there is the possibility of organisms being protected by the medium in which they lie. Constant bacteriological testing of the loads actually being sterilized is, therefore, necessary.

Its use in England has been almost entirely confined to the disinfestation of agricultural products and powders. Attention has recently been drawn to its possible uses in hospitals, by the production in America of specially designed autoclaves and gas containers. Because, under hospital conditions, control is unlikely to be as efficient

[27] Sykes G (1958), *Disinfection and Sterilization*, E and F N Spon, London
[28] *The Lancet* (1959), *i*, 425
Ibid. (1960), *ii*, 1243
[29] Medical Research Council (1961), *The Sterilization, Use and Care of Syringes*, HMSO London, No. 40

as that in industry, the strength of the gas has been reduced from 80 per cent to 20 per cent. This lessens the explosive hazard; but there is reason to think that some degree of sterilizing efficiency has been sacrificed to safety. The experimental work done to-date has not been reassuring. Research into its effectiveness is still continuing. Meanwhile, events are overtaking it. First, the disposable equipment which is sterilized in America by ethylene oxide is now being sterilized in the British Isles by irradiation. Secondly, the facilities for doing this are rapidly expanding. Thirdly, irradiation is proving a surer method of effecting sterilization than is ethylene oxide. Fourthly, as irradiation is used more widely its cost is likely to fall. Fifthly with the development of new materials it is probable that more and more items of equipment which cannot be made disposable will in fact be made heat-resistant and, therefore, will be sterilizable by this more certain method. So far as can be seen future uses of ethylene oxide in hospitals are likely to be limited to the sterilization of such things as heart-lung machines which cannot be properly sterilized by other means under hospital conditions.

Chemicals

93 The following appreciation on chemicals and their uses is based on the advice of Dr A G Signy, who is a member of the Trust's Advisory Panel for these investigations. Chemical compounds have long and traditionally been used as disinfectants in hospital practice. There is no doubt that, used intelligently, disinfectants with powerful germicidal actions will produce sterile fields of work, and they have their place in hospital disinfection techniques. However, in the past, germicides with a wide but unselective action have been used, and in practice it has been found that many bacteria are resistant to their action—for example, bacillus *Proteus* and *Pseudomonas Pyocyaneus* are notoriously insensitive to the action of commonly used chemical disinfectants, spores cannot be killed by phenols, alcohols, etc., and viruses are insensitive to most. Until recently therefore, when the more selective chemicals were introduced, the wide range germicides were often unsuccessful.

94 Recommended disinfectants of the cruder 'white fluids' and 'black fluids' are still used in lavatories, drains, on floors and furniture, in the fond hope that the bacteria on these surfaces will be killed. There is no doubt that bacterial counts are markedly reduced by such applications, but sterility is not achieved. The time required for disinfectant action is frequently not observed, and many compounds need up to one or two hours to achieve their full and satisfactory sterilizing action. Great strides have been made with newer germicides, and particular mention should be made of hexachlorophene, the quaternary ammonium compounds, chlorhexidine, and similar compounds which have been brought into prominence by their effectiveness in reducing the staphylococcal populations of wards. The incorporation of the quarternary ammonium compounds into blankets for sterilization has been a success, and the use of hexachlorophene for hand disinfection, particularly in view of its compatibility with soap, is strongly recommended.

95 Lastly, formalin has been known as a standard technique for chemical sterilization, although its action depends on the liberation of an adequate concentration of formaldehyde in a humid atmosphere, and therefore acts as a gas. This technique is used for the disinfection of rooms, wards and furniture, and is a very effective method of killing vegetative bacteria, viruses, and even spores. Formaldehyde is also used in low-temperature autoclaves for the disinfection of clothing, mattresses, etc., in fever hospitals.

Irradiation

96 The technical points of sterilization by irradiation are fully discussed by Sykes.[30] It may, however, be of help to hospital authorities to consider whether sterilization by irradiation has any possibilities at hospital or group level. The most important limitation is that of cost. Firm figures are not available, but a study of costs provided by two manufacturers has shown that although they may vary in detail between one supplier and the next, the total costs are broadly comparable. An extract from one of the supplier's estimates may provide some indication of the scale of cost involved. A small rotary cylinder system with a throughput of 30 cubic feet per 24-hour day would involve:

(*a*)	Plant and shield . .	£17,000 approx.
	Source . . .	£10,000 „
	Total Capital	£27,000 approx.

[30] Sykes G (1958), *Disinfection and Sterilization*, E and F N Spon, London

(*b*)	Direct running costs (supervision, operation, maintenance, electricity, and source replacement) . .	£3,000 per annum

A monorail system, with a throughput of 100 cubic feet per 24-hour day involve:

(*c*)	Plant and shield . .	£60,000 approx.
	Source . . .	£9,000 ,,
	Total Capital	£69,000 approx.
(*d*)	Direct running costs (as above) . . .	£7,000 per annum

(The output of 30 and 100 cubic feet mentioned earlier is equivalent to that of 5 and 12 cubic foot autoclaves respectively, over somewhat less than an 8-hour day.)

97 Thus direct running costs amount to 5/6 per cubic foot and 4/– per cubic foot for the two machines respectively. If for any reason the plant were to be idle during the 24 hours, the costs per cubic foot would increase. In this connection, the firm selling the installations mentioned above are frank enough to state:

> '. . . However, when the figures (for cost) are considered it will always be found that irradiation methods are more costly' (than steam and hot air).

98 It is therefore concluded that on grounds of cost alone, there is unlikely to be a case for the use of irradiation for sterilization at hospital or hospital group level. But, as the size of irradiation plants increases, so do the costs per cubic foot drop; and the case become less strong if larger plants were to be worked at, say regional, level. But here such matters as packaging, transport, and the need always to have goods awaiting sterilization might create administrative difficulties. Taken all in all the prospects of using irradiation for sterilization purposes within the hospital service do not look promising.

99 But it must not be concluded that hospitals are unlikely to use irradiated products. Indeed the reverse is the case. Disposable products sterilized by irradiation are likely to be of the greatest value to hospitals. It is hoped that manufacturers will make many more irradiated products available to hospitals particularly as the method promises sure sterilization. It is at manufacturers' level that the economies of large-scale production make sterilization by irradiation an economic process.

Filtration

100 Within the context of central sterile supply filtration is only likely to be employed for sterilizing water in the operating theatres. Further details of water filtration are discussed in paragraphs 87 (*a*) and 190 (*b*).

Pasteurization

101 The majority of surgical instruments will withstand sterilization by steam under pressure. This is generally accepted as being the only sure method of doing so. Recently there have, however, been attempts to avoid autoclaving endoscopes because of the possible damage to such delicate instruments. Experiments have been made with pasteurization, a process successfully used for making milk 'safe'. However, neither milk nor surgical instruments are *sterilized* by this process, whether it is done by the 'holder' technique or the 'flash' method.[31] Heat-resistant bacteria and spores will survive these temperatures and pasteurization is therefore *NOT* recommended as a substitute for autoclaving, especially since it has been shown that cystoscopes, for example, will stand up to repeated autoclaving.[32]

[31] The 'holder' process raises the temperature to 63°C, maintaining it for 30 minutes. An alternative method known as the 'flash' or high-temperature short-time process, consists of heating the materials to a temperature of 72°C for 20 seconds.

[32] White H P W, *A Textbook of Genito-Urinary Surgery*, 2nd ed. 1961, Livingstone, Edinburgh, 180

Chapter 6 Storage, Distribution and Collection

Storage general—types of storage—distribution—local distribution—peripheral distribution—reserve sterile supplies—major disaster—collection—local collection—peripheral collection.

Storage General

102 It was at one time thought that a sterile store and a small bulk store would cover the storage needs of CSSDs. But, more recently, the full importance of properly organized storage arrangements has come to be recognized. A number of developments have brought this change about.

(*a*) Manufacturers are daily increasing the range of their disposable products. This increases the need for storage but decreases the amount of work to be done in CSSDs.
(*b*) Disposable paper is replacing linen as a packaging agent. A larger storage area is required for paper because it is so bulky in quantity.
(*c*) The use of high-speed autoclaves makes it possible to sterilize a load in about half an hour. The storage of large sterile stocks can, therefore, be avoided. It is more convenient to store packs in an unsterile state and to sterilize them shortly before issue.

It is becoming more evident that each type of storage should be properly controlled and organized.

Types of Storage

103 There are three types of storage required in a CSSD:

(*a*) Bulk store.
(*b*) Unsterile pack store.
(*c*) Sterile store.

(*a*) *The Bulk Store* Appendices E, F and J list the different types of pack which have to be issued. The variety of these packs necessitates over a hundred different items being held in store, ranging from tiny items such as safety pins to big items such as packaging paper. A check will have to be maintained on the quantities held in store; their rate of usage; the different lengths of time manufacturers take to meet demands and their reliability in doing so. In each instance it is important to ensure that supplies do not run out, because the absence of a particular item may dislocate the smooth working of a hospital. Storekeeping should not be made the responsibility of the CSSD superintendent, whose primary concern is sterilization. The supplies officer has the knowledge, organization and staff for the job and he should be responsible for ordering supplies and storing them. But a suitable system is required whereby issues can be made from the hospital's central stores to the CSSD, without involving the superintendent in unnecessary paper work. An initial float of the main items required should be issued to the CSSD to cover, say, their needs for two weeks. Subsequently, the summaries of issues of sterile supplies to the wards and departments could be used to calculate the replenishments required to the CSSDs bulk store. Issues to the CSSD would be made on requisitions from the superintendent. It is important that there should be close co-operation between the CSSD and the supplies officer so that any anticipated changes in consumption, due to changes in technique, may be catered for. Should local circumstances make it necessary to hold bulk stores in the CSSD, storage space additional to that mentioned in paragraph 32 will be needed and additional staff will be wanted for store-keeping.

(*b*) *The Unsterile Pack Store* A hospital's demand for sterile supplies varies greatly from day to day, but the work of the CSSD must run smoothly and a steady rate of output should be maintained. Some means, therefore, should be found to avoid a reflection of this variation in demand on the daily work of the CSSD. If it is properly controlled and used, the unsterile pack store can fulfil this need. Later, in paragraph 106, the use is recommended of a specially designed form on which the wards and departments can requisition their daily requirements. The CSSD should use the summaries of these forms as a basis for planning in advance the output required to make good the issues. Weekly planning will be found satisfactory. Provided an adequate reserve is maintained to meet maximum demand when it arises, output can be based on the average demand. By these means the daily work in the CSSD can be planned in advance and the tempo of work will remain constant on all days, hectic days being avoided. It is suggested that packs should be removed from the unsterile store to meet immediate requirements, thus reducing to a minimum the period elapsing between sterilization and use. It is not

advisable to apply this system of stockpiling to re-usable equipment, otherwise large and uneconomic stocks would have to be held. Such equipment should be reprocessed and issued with a minimum delay consistent with proper work planning.

The unsterile pack store can be divided into two areas, the permanent store where prepared packs are stored for as long as a week in bulk bins (see paragraph 40) and the temporary store where filled cardboard boxes on mobile shelves await autoclaving (see paragraph 64 (*c*)). Cardboard boxes are selected from these shelves to make up individual orders, either by ward or hospital, and are packed into bulk containers for autoclaving. At Cambridge, local distribution is made in the container in which the boxes are autoclaved; for peripheral distribution boxes have to be handled twice, in that they are removed from the autoclaving container and packed into a more robust 'trunk' for travelling.

(*c*) *Sterile Store* Practical experience has shown that, with the high-speed of modern autoclaves, it is unnecessary to hold stocks of sterile supplies to meet an *anticipated* demand. It is better and more convenient to sterilize supplies to meet a *known* demand. It also avoids to some extent the laborious task of checking packs for date-expiry. At Cambridge, where both large and small stocks of sterile supplies have been held experimentally, it has proved necessary to hold only the special procedure sets, such as lumbar puncture and re-usable equipment in the sterile store. Some supplies will be received from the manufacturers pre-packed and sterile. It is suggested that these, once their outer wrapping is removed, should be held in the sterile store of the CSSD and issued with the locally prepared sterile packs. The issue of them should not be made the responsibility of the supplies officer or pharmacist. Conditions in their stores may be unsuitable for sterile goods; whilst it is also confusing for the nursing staff to have to order sterile supplies from different sources.

Distribution

104 In accordance with the principle given in paragraph 16, the distribution of sterile packs and the collection of contaminated articles should always be undertaken separately. These two services are separately considered. The need for a distribution system has already been discussed in paragraph 18 and the cost of it is discussed later in paragraphs 140–144. With the assumption that this need is accepted, it is intended to discuss distribution under two heads:

Local	.	to the wards and departments of the hospital in which the CSSD is situated;
Peripheral	.	to other hospitals in the group.

Local Distribution

105 Three different systems of distribution have been tried:

(*a*) *The 'One-for-One' System* By this system a load of standard composition is delivered daily to each ward and unused stock from the previous day's issue is returned.

(*b*) *The 'Milk-round' System* This envisages the daily topping up of each ward's stock to an agreed level.

(*c*) *The 'Grocery' System* This requires wards to send requisitions to the CSSD from which deliveries are made in accordance with demand.

(*a*) *The 'One-for-One' System* This system has certain advantages. The composition of the load which is based on wards' average requirements is known in advance and the delivery containers, each holding about 1½ days' supply for one ward, can be prepared in advance of delivery at a time convenient to the CSSD. The changeover at the ward is quickly accomplished, which helps to reduce the chance of the delivery trolley blocking busy corridors. But the system also has appreciable disadvantages. Ward consumption of sterile dressings varies greatly from day to day. If a standard load is delivered every day, there are many days on which the containers are returned with some of the contents unused. Further, some items are only required infrequently. It is wasteful to carry these backwards and forwards. Other items are very small, for example, safety pins. These can only be taken round in bulk and issued should a ward need them. The system, therefore, inevitably becomes half a 'one-for-one' system and half a 'milk-round' system (see below). It was for such reasons that this system, having been tried at Cambridge, was abandoned.

(*b*) *The 'Milk-round' System* It was thought that the principle of delivery adopted by London dairies might have some application. Each day a complete range of supplies in the quantities likely to be wanted was taken to the wards in order to leave at each one, the items it

required. In practice, this concept proved illusory. First, the range of items far exceeded those of the milkman. Secondly, the issue of supplies at the ward took too long, and this in turn caused the delivery trolley to interfere with the corridor traffic. Thirdly, the size of trolley necessary to hold the range of supplies was too cumbersome for one orderly to manage. This system proved even less practicable than the previous one.

(*c*) *The 'Grocery' System* By this system all wards fill in a requisition form for their needs. The orders are made up in the CSSD in a similar way to that in which a grocer makes up an order for a housewife. They are then delivered on a trolley to the wards.

106 The difficulties of the 'milk-round' and the 'one-for-one' systems, had, at least, demonstrated two factors that were of importance in the design of a more convenient system.

(*a*) The bulk of the supplies to be delivered was so great that space could not be afforded to carry anything which was not needed that day.
(*b*) It was better to assemble the supplies beforehand in the comparative peace of the CSSD than to attempt to sort them out in the turmoil of a hospital passage.

This 'grocery' system has thus provided a practicable and economical solution to the delivery problem. The use of pre-printed requisition forms has proved to be of assistance to sisters when assessing their needs, whilst the time taken to fill them in has proved less than was anticipated.

107 If this system is to be as successful as it should be, it is essential for the ward staff to show proper restraint in what they order. Hoarding must not be allowed. If the staff are free to indulge in the traditional habit of hoarding, it will be found that more stock than is necessary will be required, because much of the sterile stock will be sitting unused on ward shelves. This is a waste of hospital resources. Once the ward staff have become confident that they can obtain what they want when they want it, and once a proper discipline of control and co-operation is established between the wards and the CSSD, there should be little reason for the wards to resort to hoarding. It is, therefore, thought that a system which allows the wards to requisition their daily needs is the one most likely to commend itself to most hospitals.

108 It will be appreciated that whichever system is used, it is necessary for a record of issues to be kept. The requisition form used at Cambridge comprises a ready basis for summarizing the issues (see paragraph 103 (*b*)). The design of the form is shown at Appendix K.

Peripheral Distribution

109 The opportunity has not yet been forthcoming at Cambridge to try out a system of distribution to peripheral hospitals on the scale originally hoped for. The following suggestions are, therefore, put forward tentatively as a basis for further experiment.

110 First, it is wished to make a basic assumption. It is considered that a group CSSD should not attempt to deliver sterile supplies direct to all the wards in all the hospitals it serves. There would be too many; and, if it were to do so, sooner or later confusion would be likely to occur. If this basic assumption is accepted, each hospital in the group—with the exception of the hospital in which the CSSD itself is situated—should establish a small room as a CSSD sterile sub-store. This should be in charge of a full or part-time storewoman, depending on the size of the hospital. She should be trained to:

(*a*) Requisition daily on the CSSD for the sterile supplies needed to maintain her sterile stock at a suitable level.
(*b*) Distribute daily sterile supplies to wards to meet their requisitions, which should be submitted to her.
(*c*) Undertake daily collection from wards of contaminated articles for return to the CSSD (see paragraph 121).

The size of room required for the CSSD sub-store will, of course, depend upon the size of the hospital it serves. But it is thought that a room of some 200 square feet should be adequate for, say, 48 hours' sterile stock for 500 beds. In effect there will probably be only 24 hours' supply in the store, because each day the CSSD will deliver to each hospital sufficient supplies to replace those which have been delivered to the wards. In order to keep the stocks correctly turned over, it will be necessary to separate them into two 24-hour lots. For example, the shelving holding the stocks can be arranged on either side of the storeroom. That on the left holding those for delivery to-day, that on the right those for tomorrow. On the third day the procedure would be reversed. This system can also meet emergency needs. A separate

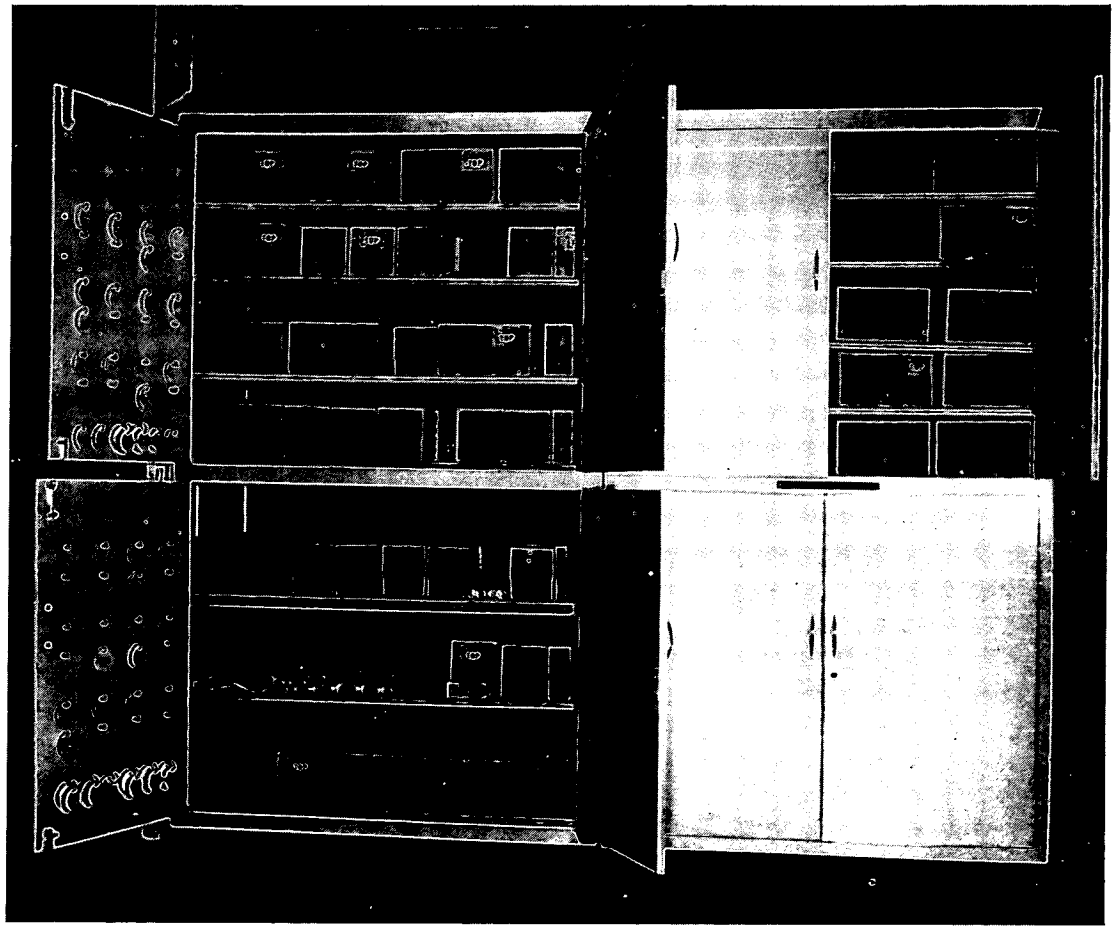
office for the storewoman is unnecessary. A desk and telephone in the store should meet her needs. A trolley similar to that used for local delivery will be required and it should be reserved for sterile supplies.

111 It is important that the sub-store which is established in each peripheral hospital should be regarded as part of the main CSSD, and not as part of the hospital in which it is situated. The storewoman in charge should have received training in the CSSD and be fully aware of what goes on in that department. Thus she can be the CSSD's representative in the hospital she serves.

Reserve Sterile Supplies

112 It is important that a reserve of sterile supplies should be readily available 24 hours a day, seven days a week. This is one measure which can help in the prevention of hoarding both locally and in the peripheral hospitals. Thus, if nurses make an inaccurate forecast of their day's needs or if an emergency occurs, there should be a stock of sterile supplies ready to meet such contingencies. Telephoning the CSSD and sending staff to collect their requirements, is time-wasting and disruptive to work, both in the wards and in the CSSD. Reserve supplies may be held in a cupboard or storeroom, which should be in a position convenient to the majority of consumers. It should be readily accessible and not, for instance, placed in an administrator's office. There should be no formalities attached to or hindrance in, the use of this reserve store. The capacity of the store should allow the contents to be arranged so that they are easily located and shelves should be clearly labelled. A plan of the lay-out displayed on the door and automatic lighting of the cupboard will be found helpful.

The photograph below illustrates a way in which a



39 A cupboard adapted for the storage of reserve supplies

corridor cupboard has been adapted for the storage of reserve sterile supplies for 300 beds.

113 If nursing staff are to be encouraged to use the reserve supply rather than to go to the CSSD, the CSSD must guarantee the quantity and the range of the supplies held in reserve. Stocks have to be replenished daily and to do this it is necessary for the CSSD to know what has been removed. This information can most easily be provided by the nurse who removes the item. A simple means of recording such information is by attaching descriptive tags to each pack, and providing on the door of the cupboard hooks labelled for each ward and department. The tag would be removed from the pack taken and hung on the appropriate hook. The tags on the hooks thus indicate:

(*a*) supplies taken by each ward and department;
(*b*) the total replenishment required.

If the tag is not removed from the pack the omission is obvious when the empty box is collected by the CSSD from the ward. It is suggested that the same system should be followed in the peripheral hospitals. Whether the reserve sterile supplies are set aside in the CSSD sub-store, or held in a separate cupboard, will depend on the position of the former. As the CSSD guarantees the quantity and range of articles in the reserve supply, so should the storewoman in the peripheral hospitals.

Major Disaster

114 All hospitals should have a major disaster plan and the supplies to cope with a large scale emergency which, in the event, can be brought into use at a moment's warning. Sterile packs to take to the scene of the disaster could well be made the responsibility of the CSSD; the range and content of such supplies being agreed by the hospital authorities. It is suggested that sterile supplies for this type of emergency use should be packed in a way similar to the theatre's emergency packs, described in paragraph 69 (*f*). The storage of these stocks should be with the stretchers, blankets and other items which are held ready for loading into the ambulance. The CSSD should be responsible for replacing date-expired packs at six-monthly intervals.

Collection

115 In describing a system for collection there is a fundamental weakness in that the transport of contaminated articles around the hospital is undesirable. But it is equally undesirable to ask the nurses to decontaminate their equipment—and how could they carry out decontamination effectively? Full consideration has been given to this weakness, but in devising a practicable system the dilemma is inescapable.

116 A system for collection will be described under two heads:

Local . from the wards and departments of the hospital in which the CSSD is situated.
Peripheral . from the other hospitals in the group.

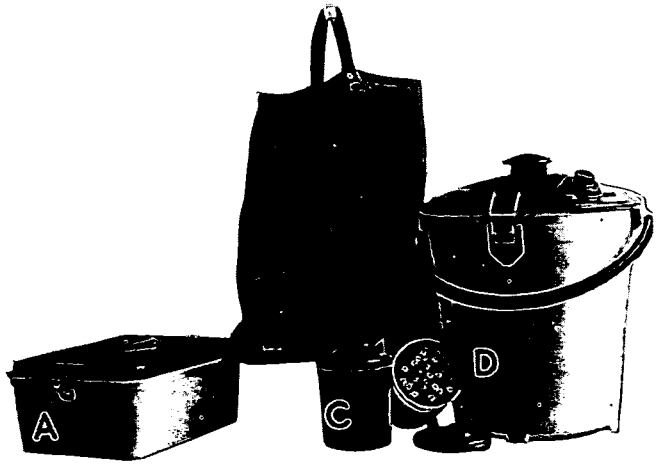
Local Collection

117 Contaminated articles returnable to the CSSD for reprocessing fall into four categories:

(*a*) Syringes and other small glassware.
(*b*) Empty aluminium containers.
(*c*) Needles.
(*d*) Instruments, utensils and rubber goods.

118 For the collection of these four categories of equipment it has been found convenient to provide the wards with four different receptacles. They are either wholly red or have red lids to indicate that their use is only for contaminated articles. The receptacles are readily obtainable from hardware stores and they are inexpensive.

(*a*) At A in the photograph below is shown a box with a clip-on lid which has been found suitable for holding syringes, Adson's manometers, glass tubes, etc.



40 Receptacles for the collection of re-usable items

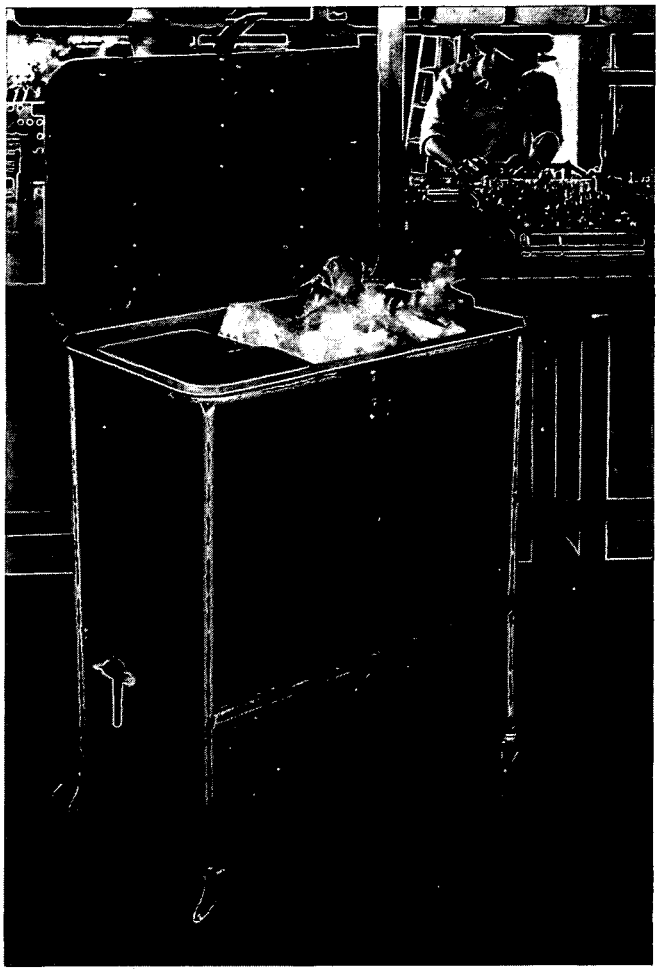
(*b*) At B is shown a washable nylon bag for the collection of empty aluminium containers. It is not felt that the containers require a more secure receptacle as they can be considered potentially clean.

(*c*) At C there is a small plastic pot with a well-fitting lid. This is for the collection of non-disposable needles. As can be seen from the open pot, the inside contains a piece of plastic foam into which the needles are stuck.

(*d*) The bucket labelled D is large enough to hold most of the instruments, utensils and rubber goods which a ward may use. It has a clip-on lid.

119 The only items which present a collection problem because of their bulk are the large drainage bottles. At Cambridge these have to be collected in wire crates. Plastic-coated wire is preferable because it reduces the noise during transport. If the capacity of a particular receptacle is inadequate, it has been found better for purposes of handling to duplicate the receptacle rather than to double its size. All the receptacles described in (*a*) to (*d*) are kept in the ward's dirty utility room and are emptied and replaced daily. Contaminated articles may be placed in containers partially filled with an antiseptic solution or in dry ones. Both systems have been tried at Cambridge. To place the used articles in an antiseptic solution may lessen the numbers of bacteria, it also helps to keep the contaminant moist. But it was found that there were overriding disadvantages. First, the weight was too great to be transported; secondly, it was found that splashing *en route* was liable to occur; thirdly, more often than not articles were not covered by the solution; and finally, to obtain the best washing results soaking in the CSSD was still necessary. It was decided that, since all the receptacles have close fitting lids, contaminated articles should be collected dry.

120 When the collection round was first undertaken at Cambridge each receptacle was replaced with an empty one. The buckets proved bulky to transport and required a large area for storage in the CSSD unloading bay. An improved practice which is now in use is to line the buckets with plastic bags. Contaminated articles in their disposal bags are placed in the plastic bag. The neck of the bag is closed with a malleable strip before it is returned, along with the other receptacles, to the CSSD. The bucket remains in the ward. A large, plastic-lidded container on wheels has been found more convenient for collection than the traditional type of open-shelved trolley. The container illustrated below is only a prototype. A larger one is about to be brought into use, which will hold receptacles from ten busy wards.



41 The collection trolley

On reaching the CSSD washroom the receptacles are emptied and the contents placed in their respective washing baskets for soaking in the sink.

Peripheral Collection

121 The same system as outlined for local collection applies equally well to the peripheral hospitals, the collection containers being firmly closed and wheeled into a van for return to the CSSD. The point has been made in paragraph 16 that contaminated articles should

always be kept separate from sterile supplies in order to obviate the danger of the two getting mixed. To meet this requirement each peripheral hospital in the group will also need a small room in which the contaminated articles from the wards can be kept for collection by the CSSD van. A room of 100 square feet should be big enough for a hospital of 500 beds. No special fittings are necessary but the floors and walls should be treated in a similar manner to a ward's sluice room since both should be easy to wash down and clean.

122 It is again wished to emphasize the importance of keeping the collection of contaminated articles separate from the delivery of sterile supplies. It is a hazardous practice to combine delivery with collection which means that contaminated articles and sterile supplies are on the same van at the same time. The best plan may be for the van to make two journeys; the first to deliver sterile supplies and later a second to collect contaminated articles.

Chapter 7 Financial Considerations

General—difficulties of assessing demand—capital cost of establishing a CSSD—running costs general—the cost of dressings—the cost of labour in the CSSD—the cost of delivery and collection—the cost of disposable equipment—incidental developments—savings.

General

123 The aims of central sterile supply are set out in paragraphs 1 and 2 of this book. Paragraphs 3 and 4 outline the scope of central sterile supply departments. It cannot be expected that all the improvements in sterilizing practice which it is hoped to introduce can be achieved without some increase in cost. An improved service will, however, bring its own dividends in terms of savings in nurses' time and a reduction in the chance of infection: a special understanding is needed on the part of hospital authorities to appreciate the full and ultimate significance of changes which *prima face* will seem costly. The present arrangements for the financing of hospital services may tend to pay more attention to the 'current' year's finance than, say, to the long term effect on maintenance expenditure of expensive schemes of improvement, but such practice has never been obligatory. Nevertheless it must be recognized that, when faced with financial stringency or chance of competing schemes, hospital authorities do have a tendency to restrict their view to the practical issues of the 'current' year and relegate possible future savings or improved effectiveness to the world of theory. At the same time it behoves the authorities to examine the financial implications of the establishment of CSSDs in some detail, and this chapter, which does not pretend to be definitive, seeks to set out the main considerations to be borne in mind.

Difficulties of Assessing Demand

124 Those central sterile supply departments which have so far been set up have had to be constructed without an assessment of what the ultimate demand on the department is likely to be. This is to some extent inevitable with pioneer work of this kind. That these departments have worked as well as they have is in part due to how good the guesses have been; and in part due to the flexibility of the design of such departments as have been built. It cannot be doubted that a more accurate assessment of demand, than has been possible heretofore, would help hospital authorities planning CSSDs. But, at once, some difficulties arise, for example:

(*a*) The demand for ward instruments.
(*b*) The demand for ward dressings.

(*a*) *Demand for Ward Instruments* Wards and departments generally hold a stock of instruments according to their needs. These are cleaned and sterilized as required. Items needing servicing or repair are sent to the appropriate department. Replacements are requisitioned for those broken, discarded or lost. There will be no record of the frequency of use, and the total cost of providing a sterile instrument will not readily be identifiable.

(*b*) *Demand for Ward Dressings* An assessment of the demand for ward dressings, even if not so difficult as that of ward instruments, is still not easy. Dressings are issued to wards and departments, and items which are required to be sterile are usually packed into metal drums and sent to the hospital autoclave. Cost is derived from:

(*i*) dressings used both clean and sterile.
(*ii*) nurses' labour.
(*iii*) provision, replacement and repair of drums.
(*iv*) autoclaving, that is collection and delivery of drums, provision and maintenance of autoclave equipments, labour, fuel, etc.

The total cost of dressings and the source of other costs may be known or ascertained with reasonable facility. But, so far as estimating what the demand on a CSSD is likely to be it is not easy to determine either the quantities of dressings used or the use to which those dressings are put. These two examples show how difficult it is to forecast what the demand is likely to be, and for some time to come this question can only be answered by an inspired guess.

Capital Cost of Establishing a CSSD

125 This can best be considered under the heads:

(*a*) Premises for existing and new hospitals.
(*b*) Processing and other equipment.
(*c*) Initital supply of instruments and syringes for the wards.

(*a*) *Premises* Clearly the whole question of adapting existing buildings or putting up new ones must

be decided on local considerations. Above all, however, it should be borne in mind that it might be false economy to reduce capital expenditure, if by doing so the chance were lost of reducing maintenance expenditure over a long period. In establishing the CSSD at Cambridge, the question did not arise. There was no available building and a new one had to be put up. Paragraph 28 gives an idea—but not more than that—of the amount of space likely to be required. The new department at Cambridge consists of 3,000 square feet and cost £15,000 or £5 per square foot. This figure is inclusive of services and fittings but not furniture and equipment.

If a CSSD is to be put up as part of the building programme of a new hospital, no facilities for ward sterilization need be provided. This dispenses with any need to supply wards with boilers or steam sterilizers. It may even be possible to dispense with taking steam to the wards. This would save many thousands of pounds.

(*b*) *Processing and Other Equipment* Appendix A lists the furniture and supplies which were installed in the CSSD at Cambridge. Appendix B similarly lists the equipment installed there. As a general guide in estimating the cost of fittings and equipment for a CSSD, an approximate price has been put against some of the items listed. The cost of items for which no price is given will vary according to design, finish. etc. Broadly, the cost of equipping the CSSD at Cambridge with furniture and equipment was a little more than the cost of the building and services, that is about £19,000.

(*c*) *Initial Supply of Instruments and Syringes* It is unlikely that instruments already in use will be sufficient, in good enough repair and of suitable design for the needs of central supply. The difficulties in assessing the demand for instruments have already been discussed in paragraph 124 (*a*). Yet some estimate of the numbers required has to be made. If it were possible to use the same instruments and syringes every day only a small stock would be necessary. But this would be wasteful of labour because of the resulting inability to organize the work in the CSSD in proper batches and because of the need for repeated deliveries and collections. On the other hand, if the practice were to hold too large a reserve of instruments and use them infrequently, a greater capital cost than necessary would be involved. Some assessment between the two extremes is called for. E. M. Darmady has estimated the cost of surgical instruments for the hospitals at Portsmouth as follows:

Table II Cost of ward surgical instruments per bed to be served by CSSD (Instruments for Outpatient and Casualty are not included)

Specialty	*Gross Cost* (excluding allowance for instruments already held by the wards)
	£ s. d.
Obstetrics and Gynaecology	8 16 10
Surgical, Plastic Surgery	5 3 10
Medical, etc.	2 19 0
Geriatrics, Psychiatry	1 8 10

It is suggested that the number of instruments required can be assessed in the following way:

(*i*) One and a half times an average day's *usage* should be allowed in the wards for use today.
(*ii*) One average day's *usage* should be held in sterile store for issue today and use tomorrow.
(*iii*) One day's *usage* should be being processed in the CSSD.
(*iv*) A small reserve should also be available to meet peak demands, 5 day-week working and travelling.

Based on the above assessment the total stock required amounts to some four to five times the average daily usage.

126 It will usually be found simpler to assess the number of syringes needed than the number of instruments. If thought necessary, a record can be made of the number and size of syringes used and from this the average daily usages can be assessed. The assessment described at (*i*) to (*iv*) above can then be applied to estimate the total number of syringes likely to be required.

Running Costs General

127 When *The Planning and Organization of Central Syringe Services*[33] was written in 1957, it was found that running costs consisted of two main items only, labour costs, including delivery and collection, and replacement of syringes. There were no other factors of importance. These circumstances do not apply in the case of CSSDs. The costs of dressings, disposable equipment, and the bulk of goods to be delivered and collected are all factors that affect running costs to an extent that does not occur in syringe services. This means that there are more items

[33] Nuffield Provincial Hospitals Trust (1957), *The Planning and Organization of Central Syringe Services*, London, 36

to be kept under constant surveillance. By October, 1961, most of the sterile supplies for the United Cambridge Hospitals were being provided from the CSSD. But since the service is still developing, cost figures extracted at that time cannot be an exact costing for the group. It is felt, however, that presentation of estimated costs (based on a period of nine weeks in October/November, 1961) demonstrates the relationships of the various costs arising (for example, labour, dressings, etc.) and indicates the probable order of total costs. These estimated gross costs are given in Table III below.

Table III Estimated Gross Annual Cost of the CSSD at Cambridge Based on a period of 9 Weeks—October/November 1961

		£s per year	
1	Salaries and Wages		
	(*a*) Superintendent and Orderlies	5,800	
	(*b*) Cleaners	400	6,200
2	Materials Issued (Sterile Packs)		
	(*a*) Dressings	5,320	
	(*b*) Medical and Surgical (i.e. disposable needles, foil ware, sutures and disposable sundries)	3,300	
	(*c*) Linen (paper towels, etc.)	800	
	(*d*) Packing Materials (paper bags, foil caps, etc.)	1,230	10,650
3	Replacement of re-usable instruments, syringes, catheters, etc.		4,500
4	Replacement of re-usable containers and sundries		800
5	Sundry materials (detergents, etc.)		60
6	Fuel, Power and Water		1,250
7	Staff Uniforms		30
8	Rates		350
9	Other Costs (transport, clerical staff, maintenance, etc.), say,		650
	TOTAL *per year, say,*		£24,500

128 It will be appreciated that some of the costs shown in Table III above represent a continuation of costs which the hospital has always had to meet. The cost of ward dressings, replacement of medical and surgical equipment (see Table III items 2 (*a*) and (*b*)) are cases in point. With the introduction of a CSSD such costs are transferred to the department where, in addition, certain new charges also arise. Hospitals will want to know how much *more* a CSSD is going to cost them.

The *additional* direct charges incurred at Cambridge are shown in Table IV, which shows the gross costs of Table III *less* those that the hospital has always had to meet.

Table IV Estimated Additional Cost of CSSD at Cambridge (based on Table III)

			£s per year	
1	*New Items*			
	(*a*) Salaries and wages (Item 1)		6,200	
	(*b*) Materials Issued			
	(*i*) Medical and Surgical (Item 2(*b*))	3,300		
	(*ii*) Linen (Item 2(*c*))	800		
	(*iii*) Packing materials (Item 2(*d*))	1,230	5,330	
	(*c*) Sundries (Items 4, 5, 7, 8 and 9)		1,890	13,420
2	*Increase in Cost of Other Items*			
	(*a*) Materials Issued—dressings		500	
	(*b*) Fuel*		750	
	(*c*) Replacement of re-usable instruments		200	1,450
	TOTAL ADDITIONAL COSTS INCLUDED IN TABLE III			14,870
3	*Estimated Cost of Developments Outstanding*			
	Additional cost of Disposable Gloves			2,400
			TOTAL	17,270

*It is thought that the savings in respect of ward boilers will be insufficient to meet the full cost of heating, lighting and processing in the central department.

129 It would be inappropriate to incur the expense of a CSSD unless the ward procedures were of a similar high standard. The improvement in ward procedure may, therefore, incur additional expenses. The cost of introducing certain measures at Cambridge are set out in Table V below.

Table V Cost of Incidental Developments Arising in the Wards on the Introduction of CSSD at Cambridge

	£'s per year
(*a*) Paper bags, for disposal of used dressings	750
(*b*) Disposable refuse bags	750
(*c*) Disposable plastic mattress and pillow covers, etc.	3,250
TOTAL	£4,750

130 Paragraph 149 onwards discusses certain savings which might be effected on the introduction of a CSSD. Such savings would arise under the following heads:

(*a*) Replacement of re-usable needles (superseded by disposable needles).

(*b*) Stainless steel replacement by foil ware.

(*c*) Saving on replacement of ward boilers and drums (paragraphs 151 and 154).

(*d*) Reduction of laundry costs by the use of paper.

(*e*) Wages of autoclave attendant (paragraph 152).

(*f*) Upkeep of ward sterilizing rooms (paragraph 153).

The extent to which these savings are realized will, of course, depend upon the efficiency of the administration of the hospital concerned. But every effort should be made to realize as many as possible, since savings can be appreciable.

131 Further details of running costs will be considered in the following sequence:

The cost of dressings including packaging materials.
The cost of labour.
The cost of delivery and collection.
The cost of disposable equipment.
The cost of incidental developments.

The Cost of Dressings

132 *Economy of Dressing Packs* The cost of dressings is appreciable. Any economies that can be achieved in the contents of dressing packs is worthwhile. A comparison of the contents and the manufacturer's price for two similar packs for similar purposes is revealing.

Table VI Contents and Price of Similar Dressing Packs

Contents	*Dressing Packs*	
	A	*B*
Large Pack		
Pieces of cotton wool	2	–
Cellulose square	–	2
Cotton wool balls	6	10
Gallipot	1	1
Gauze swabs 16 ply, 4″ × 4″	4	–
'Zobec' swabs, 3″ × 3″	–	4
Dressing Towel (paper)	1	–
'Clinical sheet' (paper)	–	1
Price	1/4½d.	1/1d.
	C	*D*
Small Pack		
Gallipot	1	1
Cotton wool balls	2	4
Gauze swabs 8 ply, 4″ × 4″	2	–
'Zobec' swabs, 3″ × 3″	–	2
Dressing towel (paper)	1	–
'Clinical sheet' (paper)	–	1
Price	8¾d.	7d.

There is little difference in the contents of these packs, but Pack A is 25 per cent dearer than Pack B, and C is 17 per cent dearer than D. It is likely that cotton wool and thicker and larger gauze swabs account for the increased cost. Yet both packs are used for similar purposes.

133 It is appreciated that the quality of materials, as well as the quantities used, influence the price of the packs. It is not wished in any way to challenge the autonomy of a hospital in deciding what quantity and quality of materials should go into its packs. A glance at Table VI should serve to indicate how a critical examination of the contents of dressing packs may suggest economies without loss of efficiency. It may be mentioned here that the total annual expenditure on sterile dressings at Cambridge is of the order of £5,000 per year (see Table III).

134 *Manufacturers* v *Hospital Produced Packs* Manufacturers have recently placed on the market pre-packed dressings and hospitals will wish to know whether it is cheaper for them to pack their own or to buy them from a manufacturer. A sample of 909 large, 803 medium and 911 small packs produced during normal work at Cambridge were costed and time studies taken of the labour involved in packing. The costs were as follows:

	£	s.	d.
Materials used	87	15	0
Labour (approx.)	15	0	0
TOTAL	£102	15	0

135 A manufacturer kindly co-operated by quoting a price for unsterile packs. His quotation for the same quality and quantity was £139 14s. 0d. If large quantities were ordered, a reduced price of £132 14s. 7d. was quoted.

136 A word of caution is necessary in interpreting these figures.

(*a*) The hospital cost of £102 15s. 0d. takes no account of overheads. Overheads are incurred whether or not manufacturers' packs are bought.

(*b*) The main element of cost in all packs is that of the materials. Labour cost only represented about 17 per cent of the costs of the hospital pack. Such a proportion does not give manufacturers much scope to reduce their costs by efficiency in production. Any dramatic reduction in manufacturer's costs cannot, therefore, be expected.

(*c*) The hospital pack was adequately packed for the conditions obtaining. The manufacturer's product had to be better packed because of increased handling and transport.

137 It will thus be apparent that those hospitals which have good facilities and are organized on an adequate scale can achieve economy by packing their own dressings. Nevertheless, smaller hospitals or those with labour difficulties or poor facilities might find it worth their while to buy manufacturers' packs and accept the increased direct cost likely to be incurred. In the work that

has been done to date no instance has yet been found in which a product produced by a manufacturer is cheaper than the same product produced by the hospital for itself. Most manufacturers maintain that, with a possible exception in the case of catheters, there are unlikely to be any dramatic reductions in the cost of commercially produced articles. The point is important since there is a general impression that these articles are likely to be the cheaper.

The Cost of Labour in the CSSD

138 It will be seen from Table III that labour is still the largest single item of cost in a CSSD. It may also not generally be appreciated that a CSSD needs to be run like an efficient factory and not like other hospital departments. It is the failure to appreciate this point that has led CSSDs in America to employ as many as between 4 and 14 persons per 100 beds served (paragraph 26). At Cambridge in January 1962 the total staff employed consisted of one superintendent, one deputy and the equivalent of 11 full-time orderlies. These staff served 519 general acute, 123 maternity and 166 geriatric beds, that is 808 beds in all (excluding two theatres, the labour wards and surgical gloves) a ratio of 1·4 orderlies per 100 beds. The CSSD superintendent considered that, if her department were to take on these additional responsibilities, the number of orderlies required might be in the region of 2 per 100 beds. If there is a proper discipline amongst the staff and if the work is properly organized on the lines advocated in Chapters IV and VI, there should be no cause for numbers employed to be higher. Of course, in a group in which there is a high proportion of 'general acute' beds some slight increase on 2 per 100 beds might be justified. It is unlikely, however, that with proper facilities and organization of work the staffing levels in CSSDs ever need rise above 2·5 per 100 beds served.

139 Some mention must be made here of the grading of CSSD personnel. Ancillary staff, under which broad heading come the CSSD orderlies, is governed by the Ancillary Staffs Council. The Council determines the wages and salaries to be paid. Existing gradings include grades for sterilizer attendants and needle sharpeners. It is not considered that either of these grades has much application under CSSD conditions. High-vacuum autoclaves are small and fully automatic. The orderly has only to load them, which does not entail much physical effort, and press the button. Conditions now are therefore very different from those in which an attendant had to operate a large and complicated sterilizer without supervision. Again, needle sharpening requires no special skills. With practice there is little that cannot be learned by an orderly in a week. The introduction of disposable needles leaves few needles to be sharpened, and a special grade for needle sharpeners is unnecessary. In any case under CSSD conditions both sterilizer orderlies and needle sharpeners are supervised, and thereby relieved of total responsibility. Detailed differentation between jobs should be avoided, particularly as all members of the staff should be able to turn their hand to any of the tasks in the CSSD. Not all CSSD staff should be on the same rates. A proportion should be on one of the higher grades covering tasks such as packing lumbar puncture sets or folding theatre linen. Some orderlies should be graded as charge hands, to encourage them to accept some of the responsibility of supervising others. It is suggested that the basic grade for CSSD orderlies should be Group 4, that is one higher than that of ward orderly; that a proportion of the staff might be on Group 5 (special set packer or folder of theatre linen) and a proportion on Group 6 or 7 (CSSD charge hand). It is suggested that the basis for the grading of the superintendent and deputy should be on the number of beds served.

The Cost of Delivery and Collection

140 Present methods of delivery within a hospital are by trolley or by hoist, that is they are primarily manual. Whatever method is employed it will be found that considerable time and, therefore, cost is involved. Eighteen wards and six departments at Cambridge required an average total of six daily trips for delivery and two daily trips for collection. Eight wards and five departments in two nearby hospitals in the group require two daily trips with a van for delivery; one trip a day is required for the collection of their contaminated articles. During a period of two weeks, delivery and collection were found to occupy 42½ hours per week of orderly time—nearly 12 per cent of the total time available. It is, therefore, important to ensure that delivery and collection are undertaken with a proper regard for economy. The arrangements for delivery will involve all or some of the following elements of work:

(*a*) Orderlies' time spent delivering.
(*b*) Orderlies' time spent travelling beside a driver.
(*c*) Drivers' time spent waiting whilst orderlies deliver.

(*d*) Drivers' time spent driving.
(*e*) Running expenses of vehicles.
(*f*) Provision and replacement of vehicles.

141 It will generally be agreed that a delivery service (element (*a*)) represents work as important to a hospital as is the preparation of packs. The cost of this service must therefore be accepted. But economies should be possible under elements (*b*), (*c*), (*d*), (*e*) and (*f*). It is only necessary for orderlies to travel beside the drivers (element (*b*)) if they are required to deliver to each of the wards of the hospitals to which they are going. If, as recommended in paragraph 110, peripheral hospitals maintain their own sterile sub-stores, it should be possible for the drivers to deliver supplies and the need for the orderlies (element (*b*)) disappears. Delivery direct to a sterile store should delay the drivers less than waiting whilst the orderlies deliver to the wards. If delivery is made into the sterile sub-store of peripheral hospitals element (*c*) is thus also reduced.

142 Savings under elements (*b*) and (*c*) are however not likely to be very great. Elements (*d*), (*e*) and (*f*) can be the source of much greater economies. In Cambridge, where the distances are limited to a few miles, delivery presents no problem. Distribution is done on a special run of a van which is also used for other hospital purposes. Later, as more wards come onto central sterile supply, more journeys, or even perhaps a special van, may become necessary. But, as the total round trip for such a van is unlikely to exceed 100 miles a week, running costs should be low. The position is, however, very different in the area CSSD at St. Mary's Hospital, Portsmouth. From there distribution is undertaken to hospitals at Southampton (25 miles), Winchester (27 miles), Gosport (15 miles), Alton (32 miles), and Basingstoke (40 miles).
There the total average weekly mileage of the vans covering such distances is about 1,770 miles and the costs involved include the following items:

	£ *per year*
Wages of orderlies whilst travelling and delivering	2,800
Wages for drivers	4,800
Petrol, oil and insurance of vehicles	1,200
Vehicle replacement (1 per year)	1,800
TOTAL	£10,600

To justify such sums it is necessary to offset them by greater efficiency in large-scale production. The only possible source is labour in the CSSD and, as so much of the work will have to continue to be manual, savings to offset high delivery costs would be difficult, if not impossible, to achieve.

143 If, on the other hand, five separate CSSDs were to be established to serve the five groups, the total mileages covered, instead of being 1,770, as at present, would be more of the order of 500–750 miles a week. The distances therefore involved in taking vehicles from Portsmouth to the vicinities of the groups would be eliminated for both outward and homeward journeys. The cost of maintaining a vehicle and driver on the road amounts to about 1s. 3d. per mile. It is therefore important to reduce the mileage to a minimum. In the instance quoted the establishment of five group CSSDs, instead of an area one, might lead to economies amounting to as much as £5,000 per year in the costs of distribution and collection.

144 To sum up, if distribution and collection are to be organized with proper regard for economy, attention should be given to the following points:

(*a*) A daily delivery from a CSSD should be made to all large hospitals within not more than, say, a 10 mile radius of the CSSD.
(*b*) Small hospitals might be supplied with their needs once or twice a week only.

In any event the cost of delivery and collection should be kept under constant review.

The Cost of Disposable Equipments

145 It has been argued in paragraph 6 that, even though it may prove more expensive for a hospital to do so, disposable needles and surgical gloves should be used and disposable catheters should be introduced as soon as possible; priority being given to these three commodities. It may be of help here to give some guidance as to the expenditure likely to be involved in each case. Consideration of the cost of disposable syringes will be given later.

(*a*) *Disposable Needles* If a hospital has no syringe service they will have to work out, from ward and department records, the number of injections given and therefore the number of disposable needles required per day. From this the annual cost, after deducting the cost of re-usable needles, can be estimated assuming that

disposable needles of good quality cost an average of 2d. each.

If a hospital already has a syringe service, somewhat different calculations are involved. If the syringe service is an efficient one, the cost of needle processing (including replacement of needles) is probably about 1¼d. per needle. If it is less efficient, the cost per needle may be as high as 1¾d. Any syringe service should be able to estimate the number of needles which it processes per year. From this, the saving to set against the cost of disposable needles can be calculated.

(*b*) *Disposable Surgical Gloves* The central processing of surgical gloves involves the provision of processing machines, skilled labour and materials as well as the replacement of gloves as they become unfit for use. Replacement is the largest single item of cost. The cost of processing a given number of gloves will not therefore vary widely from one CSSD to another.The following figures were obtained from Cambridge, and relate to an annual use of 40,000 pairs.

Processing of Re-usable Gloves

Capital	£
Rotary glove washer, dryer and powderer	620

Running Expenses	£ *per year*
1¼ full-time orderlies	575
Paper bags at 60/- per thousand	120
Glove wallets at 57/- per thousand	114
Powder sachets at 16/- per gross	222
Powder, mending solution, electricity at 1½d. per unit, replacement of Bripac boxes	40
Replacement of gloves at 3/3 a pair	1,300
TOTAL	£2,371

Paragraph 62 (*h*) mentions that a pair of gloves may be used three or four times. Recent work, however, tends to show that to expect five uses may be excessive and that their 'safe-life' may average nearer three uses, than five.

Assuming three uses per pair, a comparison of the cost of re-usable and disposable gloves would therefore be as follows:

Replacement of Re-usable Gloves (theatre processed no charge for labour)	£ *per year*
40,000/3 pairs at 3s. 3d.	2,166 say 2,200

Centrally Processed Re-usable Gloves		
Replacement of gloves (see above)	2,166	
Add labour, materials (CSSD processing)	1,071	
	3,237	say, £3,250

Cost of Disposable Gloves		
40,000 pairs of disposable gloves at 1s. 9d. per pair (unsterilized)	3,500	
Packing-cost of labour and materials.	240	£3,740

It will thus be seen that disposable gloves will cost 80 per cent more than gloves processed in the theatre suites (nursing time not included) and 15 per cent more than gloves processed in the CSSD. Once again mention must be made of the waste of nurses time involved in glove processing. This nursing time is something which should be saved, bearing in mind the comparatively small cost involved.

(*c*) *Disposable Catheters and Tubing* It is difficult to give firm guidance on the cost of disposable catheters and tubing. Evidence is not available. But paragraph 59 indicates how difficult it is to clean and sterilize a

Table VII Issues of Catheters and Rubber Tubing over a Four Week Period

Type of catheter	*Issues*							
	Male Medical (51 beds)	Male Surgical (26 beds)	Female Surgical (27 beds)	Gynaecological (49 beds)	Urological (26 beds)	Female Medical (27 beds) Intensive Therapy (6 beds)	Children (26 beds)	Total issues (238 beds)
Eynards	14	—	—	—	20	—	—	34
Jaques small	24	4	26	58	16	29	36	193
Jaques large	15	79	64	96	29	16	—	299
Tiemans	19	—	—	—	11	—	2	32
Suction (Jaques, small)	24	48	—	12	276	6,200	28	6,588
Ryles tubes	2	28	7	6	18	4	—	65
Flatus and rectal tubes	12	6	4	27	16	—	2	67
Tubing for drainage bottles	7	16	2	32	35	12	1	105
Other tubing	10	8	3	—	—	8	8	37
Stomach tubes	—	1	4	—	5	—	5	15
Dowse's	—	—	—	24	—	—	—	24

catheter. Modern treatments have tended to increase the numbers of catheters used. Table VII on p. 61 shows the issues over a four week period of catheters and tubing to seven wards (238 mixed beds) at Cambridge.

As long as the numbers used are as great as is shown above, and as long as manufacturers charge as much as, say, 2s. 3d. for a disposable small Jaque's catheter, hospitals are unlikely to be able to afford to use disposable catheters in preference to re-usable ones. To do so would involve charges running into thousands of pounds per year. Manufacturers seem to be aware of the need to reduce their prices. One manufacturer is now quoting disposable Jaque's catheters at 9d. and another is considering a change of materials which will bring the price down to 1s. 2d. These steps are all to the good. It seems likely, too, that manufacturers will re-organize their processes so as to effect still further reductions in the price of catheters. In the meantime the following policy is suggested:

(*i*) The medical staff might consider for which procedures a disposable catheter is essential. It could then be used for such procedures and the range extended as money becomes available.
(*ii*) The remainder will have to continue to be processed in the CSSD using methods designed to give the highest standard of cleanliness possible.

Disposable Syringes

146 It is recommended in paragraph 8 (*b*) that hospitals should run their own syringe service and leave disposable syringes for others who have no access to syringe services. There may, however, be occasions on which this is not possible; or on which, for special reasons, a hospital may wish to use disposable syringes. The following details are therefore given to help in assessing cost.

147 When *The Planning and Organization of Central Syringe Services*[34] was written in 1957, it was found that the cost of syringes produced in three hospital syringe services varied between 4·75d. and 5·9d. This sum represented the cost of a complete syringe and needle, packed and sterilized. With increases in wage rates it is probable that the average cost in a hospital syringe service to-day would be about 6d. per sterile syringe complete with needle. Sterile disposable syringes complete with needles cost from 5·6d. for a 2 ml. size to 12·25d. for a 20 ml. size. On the basis of the average ratio of sizes found to be used in 1957, the average cost overall for disposable syringes would be about 7½d. The increased cost of using sterilized disposable syringes complete with needles over central processing costs would, therefore, be of the order of 25 per cent, and there would remain the need for the processing of syringes and needles for those procedures for which suitable disposables are not yet available. At present only the 2 ml. size of disposable syringes can be bought for less than the average cost of the reprocessed article. The use of this one size as a disposable might result in an increase in the cost of processing the balance of a hospital's need.

[34] Nuffield Provincial Hospitals Trust (1957), *The Planning and Organization of Central Syringe Services*, London, 35

Incidental Developments

148 It has been the experience in some hospitals that the introduction of central sterile supply reveals the necessity of improving certain services which, even if not directly part of central sterile supply, are at least indirectly concerned with it. Examples are:

(*a*) The use of disposable bedpans and urinals.
(*b*) The disposal of soiled dressings.

It is hoped that some guidance on the cost of such services will help.

(*a*) *Cost of using Disposable Bedpans and Urinals*
In paragraph 182 it is suggested that disposable bedpans and urinals might be adopted. Installation involves the provision of water supply, electric power, and soil pipe for disposal. Eight machines were installed at Ancoat's Hospital, Manchester at the following cost:

Capital Cost		£
Installation		
Removal of bedpan washers, provision and connection of soil pipe, connection to water supply and making good surrounds.	665	
Electricity supply	280	
		945
Equipment		
Eight machines at £275 each	2,200	
33 fibre glass carriers were also required, at 50/- each	82	
		2,282
TOTAL CAPITAL EXPENDITURE		£3,227

(Costs will vary according to the site. In this hospital costs were high as erection involved the use of

scaffolding extending over three floors for the connection of soil pipes.)

The usage of bedpans and urinals at Ancoat's Hospital is shown in the following Table.

Table VIII Usage of Disposable Bedpans and Urinals

Specialty	*Beds*		*Average Use Weekly*	
			Bedpans	*Urinals*
General. . . Surgery . . .	Male	16		
	Female	16		
	Side rooms	1		
		33	180	100
General. . . Medicine . . .	Male	16		
	Female	16		
	Side rooms	4		
		36	345	185
Orthopaedic . .	As above	36	450	440
Mixed . . .	Male	16		
	Female	16		
	Side rooms	2		
		34	175	125

Excluding orthopaedic beds, this amounts to 1,110 bedpans and urinals each week, i.e. 560 per bed per annum at a cost of £7 per bed per annum. For the orthopaedic beds the use totals 1,290 or £16 per bed per annum.

(*b*) *Cost of Disposing of Soiled Dressings* At Cambridge, dressings are now all disposed of into polythene bags (see paragraph 177 (*a*)) and the use in the wards of paper towels has increased the number of bags required. The same bags are used for domestic ward rubbish. Flowers, particularly in women's wards, increase the amount of rubbish. Shortly after introduction the use of polythene bags was found to be:

(*i*) Dressings . surgical wards 6–8 bags per day
medical wards 3–4 ,, ,, ,,

(*ii*) Rubbish . female wards . 2 ,, ,, ,,
male wards . 1 ,, ,, ,,

The overall consumption of 16 wards was at the rate of 30,000 bags, say *£420 per year*

More recently the number of bags used has increased and costs are now about £700 per year. It will, however, be appreciated that some saving of porters' time can be set against this cost.

Savings

149 When the existing sterilizing facilities are removed from the wards certain savings may be expected. The following may not all apply, nor is the list necessarily complete, but it may serve as a guide as to where savings may be found.

150 *Fuel for Boilers* A saving will accrue from the termination of boiling in the wards. Sterilizers are often too big for the job they are doing; they are often left boiling unnecessarily; incorrect setting or failure of thermostats is not uncommon. Consequently fuel costs are liable to be inflated. In the Birmingham General Hospital (365 beds) 20 instrument and 20 bowl sterilizers will be removed. In the Royal Infirmary, Sunderland (300 beds) 11 instrument, 10 bowl and 2 combined sterilizers have been removed. The following figures were estimated by the respective hospital engineers as the savings that might result:

Table IX Savings of Fuel for Ward Boilers

No. of sterilizers	*Estimated total annual steam consumption '000 lb.*	*Estimated total annual saving** £	*Average annual saving per sterilizer* £
Birmingham 40	3,400	900	22
Sunderland 23	1,550	400	17

*Excludes labour and overheads.

In the casualty department at Lister Hospital, Hitchin, a 4 kw. bowl sterilizer of 1 cubic foot working capacity is in use most of the day and is kept simmering during the night. Metering over a period of nine weeks indicated an annual consumption of 7,500 units at 1d. per unit, say, £30. Since this is probably more than normal use, it appears that fuel costs would be in the region of £20 per year per sterilizer, though it may depend upon the boiler plant whether this value in steam could in fact be saved.

151 *Maintenance of Ward Boilers* Costs of maintenance vary with the age of the machines, the hardness of the water used, etc., but do not appear to be high. At both Birmingham and Sunderland, maintenance costs were estimated at between £5–10 per ward boiler per year. The annual cost of replacement of boilers is likely to be appreciably higher.

152 *Autoclaving* Changes in the methods of autoclaving will affect the net cost of introducing central sterile supply. In the one extreme the change may involve the simple transfer of machines and labour from one site to another; in the other, a multitude of machines may be superseded by the installation of two machines in a central department. Where autoclaving was previously de-centralized labour may be saved or transferred, and overtime charges cut. In the Birmingham General Hospital, the autoclave was operated by five theatre porters who together spent some 40 hours weekly on autoclaving. On the introduction of a CSSD work will be reorganized and one person saved. In the Royal Infirmary, Sunderland, a full time (female) autoclave attendant was employed. On the introduction of CSSD she became redundant and was transferred. This change therefore saved a clearly identifiable wage charge to be offset against new costs. At the Lister Hospital, Hitchin, a downward displacement autoclave was in use. This was manually operated, had a long time-cycle and working it took up much of a porter's time day and night. It was subsequently fitted with an electric pump and automatic controls, thus saving much of a porters' time as well as creating several hours of spare time on the autoclave.

153 *Upkeep of Ward Sterilizing Room* The maintenance of the fabric and fittings of ward clean utility rooms can be a costly and troublesome business. Condensation causes paint to flake, and damages plaster, wiring, fittings and window frames. Where conventional decorating materials are used, redecoration will be required at short intervals. In the Sunderland Group of hospitals various 'cures' for internal damage were tried. Anti-condensation paints gave a measure of protection and had a life of 12 months, against the 6 months of conventional paints. Installation of insulated false ceilings with anti-condensation finishes proved satisfactory for a longer time but were more expensive initially; and there remained the deterioration of window frames and other fixtures. In a normal period of 12 months this group (2,200 beds, 85 wards) spent approximately £2,500 in holding its own against the damage done by steam condensation in ward sterilizing rooms.

154 *Dressing Drums* Some hospitals, without introducing centralized methods, have changed from metal drums to cardboard boxes for packing dressings for autoclaving. In such cases, savings in cost will already have been assimilated. Where the changeover is made to coincide a worthwhile saving may be achieved. Standards of maintenance of metal drums vary widely; and where high standards are maintained, costs also may be high. Large numbers of drums are used, particularly in theatres, and prices range from about £3 for a given size of plated drum, £8 for stainless steel to £15 for a stainless steel Continental pattern. Replating and repairs are often expensive items. The following figures from the United Bristol Hospitals (855 beds) demonstrate this point:

1st April, 1958 to 31st March 1959	£
New issues to replace irreparable drums	759
Repairs	897
Total cost of maintaining drums in use	£1,656
1st September 1960 to 31st August 1961	
Less cost of cardboard boxes	722
Saving shown at Bristol between the two methods of packing	£934

155 *Nursing Duties* It has not been possible to carry out surveys before and after the introduction of central sterile supply to establish the time saved, but comments from nursing staff who have experience of this system suggest a saving of the order of four hours a day for ward sterilizing and packing of dressings, in addition to an appreciable time saved in actual dressing time. Such savings are unlikely to result in a reduction in the numbers of nurses required, but should facilitate a reduction of working hours (where this has not previously been possible) or leave more time for bedside nursing.

Part 2 Wards and Operating Theatres

Chapter 8 General Considerations

Implementation of a central sterilization service—sterilizing facilities—standardization—rinsing—CSSD and nurse training—the education of junior medical staff.

Implementation of a Central Sterilization Service

156 It has been stated in paragraph 2 that one of the two objectives of central sterilization is to take some of the work off the nurse so that she can devote more time to her patients. That this objective is of paramount importance is becoming increasingly obvious for the following reasons. First, fewer people are joining the nursing profession; secondly, the hours of work are becoming progressively shorter; thirdly, early ambulation and a quicker turnover of patients throws an increased burden upon the nurses; and fourthly, the number of untrained auxiliaries who now supplement the ward staff require detailed supervision. It is therefore vital that nurses should be relieved of any tasks that can suitably be undertaken by those less highly qualified; and certainly those which need not be undertaken by nurses. Thus the onus of providing the nurses with a high standard of sterilizing service, and of keeping them supplied with the equipment they need, is placed wholly on the CSSD.

157 In the early stages of planning central sterile supply it is necessary to persuade the ward sister to play an active part, to enlist her enthusiasm and to encourage her to give her views. During the changeover from traditional practice to central supply it is the ward sister who will have to spend many hours re-educating the nursing staff and the doctors in the use of packs and equipment to which they are as yet unaccustomed; and it is from her that the CSSD superintendent will expect assistance in making the project a success. The ward sister is, in the last analysis, the central sterile supply department's most valuable ambassador; for it is in her that the medical staff have always placed their confidence, and to her that they have given responsibility for the care of their patients. If a sister is aware of the advantages of central supply and has reason to be confident in the system, then a little revolution will have been accomplished quietly, simply and painlessly.

158 It may be of help to give a summary of the measures which can be taken before, and during the introduction of a full central sterilization service.

(*a*) The system should be clearly and fully explained to the medical and nursing staff. Discussion and suggestions should be encouraged.
(*b*) Those who show special interest can be sent to an existing CSSD that they may understand it better. This will enable them to make the scheme sound more attractive to their hesitant colleagues.
(*c*) It is desirable that the new service should at first be introduced only to one or two wards. The staff on these wards should be wholly receptive to the idea, because there will certainly be teething problems, and their full co-operation will be needed to overcome them. The success of the new system in these wards will help to convince the others.
(*d*) Apart from the limited advantages of the interim measures already discussed in paragraph 8, there is little to be gained by introducing a central sterilizing service piecemeal to a ward. The boilers should be removed or sealed the day that sterile supplies are delivered, as confusion can result from the use of two different systems at the same time. The introduction of CSSD has been found most successful where a side-room can be used temporarily as a clean utility room during the conversion of the existing one. Shelving, a work surface, and a hand sink in the vicinity are all that are necessary. If there is no room available, a prefabricated cupboard can be erected in a bed space. It may be difficult to spare a bed space or a room for this purpose; but, with careful planning, the conversion of a clean utility room including re-painting of tiles, general redecoration and the fitting of cupboards and shelves can be completed in five days.
(*e*) It has been found that, initially, it is a good policy to supply the ward staff with everything they ask for. Demands may be unjustified and apparently unreasonable. But until confidence is gained,

demands should always be met. Later, with the sisters' co-operation, stocks should be reduced to a more realistic level.

(*f*) One of the responsibilities of those who are planning the expansion of the service, is to keep the medical staff and the sister of the ward it is next proposed to changeover informed, and to invite their comments.

(*g*) It will be necessary to have a reserve supply cupboard (see paragraph 112) and this should be sited in a central position within the hospital. The contents should include the whole range of items provided by the CSSD. It is to this cupboard and not to the CSSD that ward staff should come if a particular item runs short.

159 Every change of system will provoke some complaints, and it can safely be said that a new CSSD will be no exception. Complaints will reach the department, whether or not it is to blame for the trouble. Some of these will be irresponsible. The superintendent of the CSSD should investigate each complaint personally as soon as possible and speak to the person who has lodged it. One hospital which has recently introduced a CSSD holds a weekly meeting for all those who wish to make complaints. None is accepted in the corridors, at the lunch table or over the telephone. This restrains the inveterate grumbler and ensures that the complaint is put forward in a clear and responsible manner. It also ensures the complainant of a reasonable hearing and the satisfaction of knowing what action is to be taken. Provided the size and complexity of the changeover are appreciated, and plans carefully made, the staff will be proud of their CSSD and feel that hospitals without them are less fortunate than themselves.

Sterilizing Facilities

160 It has been argued in Chapter I that the CSSD should undertake the sterilization of everything that it is practicable for it to do. Notwithstanding the acceptance of this doctrine, there will always be pressure to leave some sort of facility for sterilization in the wards. The arguments will run, 'What is to be done if the nurse suddenly wants something that she has not got?' 'What will happen if the autoclaves break down?' What will happen if there is a fire in the department?' Such arguments should be resisted. First, it is the task of the CSSD to provide the wards with all their requirements and to hold adequate and accessible reserves to meet all reasonable contingencies. In any case, the speed of modern autoclaves and hot-air ovens make replenishments quick and simple. Secondly, the chance of two of the autoclaves breaking down simultaneously is too remote to justify provision for such an eventuality. Even if they should, there will always be some sterile stores in the ward cupboards, in the reserve store and in the CSSD sterile store to keep the wards going until repairs can be completed. Thirdly, on grounds of cost it is not reasonable to expect sterilizing equipment always to be duplicated. It has been the general experience of hospitals which have introduced a CSSD that, if the wards are left with the means of effecting sterilization in parallel with the delivery of sterile stores from a CSSD, they will tend to use half one system and half another. Such action defeats one of the objects of establishing a CSSD, which is to carry out sterilization under properly controlled conditions. When central sterile supply is introduced to a ward, all sterilizing equipment in that ward must be taken out at the same time as the centralized system is introduced. If for any reason this is not possible then all ward and departmental boilers should be turned off and sealed to prevent them being used.

Standardization

161 In paragraph 53, mention has been made of the need for standardization. With the introduction of central sterile supply it will be necessary to question whether particular items of equipment can be modified to meet a wider range of needs and whether, in fact, some items are necessary at all. Nursing staff should be prepared to examine afresh their routine procedures and customs, in order to see where it is possible to make individual concessions for the common good. These points can most conveniently be discussed at meetings of the nursing procedures committee. A central department cannot undertake to provide differently composed dressings packs for similar procedures. Indeed, it is only practicable to ask it to supply a limited basic range to cover all procedures together with supplementary items separately packaged. The size, thickness, and number of gauze swabs in a pack, the range of aluminium foil receptacles, and the quality, size and shape of disposable dressing towels, and the sterile fields will all have to be standardized. An approved and acceptable dressing technique should be evolved and applied throughout the hospital so that supplies can be employed to the best advantage. A dressing technique is described in detail in paragraph 171.

Rinsing

162 The advantages and disadvantages of rinsing have already been discussed in paragraph 47. It has also been said that one of the two aims of central supply is to relieve the nurse of unnecessary tasks. If she is to be asked to rinse the equipment she has used before it is returned to the CSSD, that aim is undermined. It is inconvenient and laborious for her to handle articles twice, and it is of little or no assistance to the CSSD. The second and maybe even more important aim of central supply is to reduce the spread of infection. It is difficult to collect any evidence as to whether or not rinsing is a practice to be frowned upon. The opinion of some authorities is that it does not matter; of others that it must be avoided. It will however be accepted by all authorities that in many instances the nurse is in no position to know whether an item she has just used is contaminated or not. She may well in her innocence infect her fingers, her apron, the taps and the door handle and by such means spread infection. It seems, therefore, that to forbid rinsing of used items in the wards is a safe and reasonable precaution, and also a factor in reducing nurses' work. This is the policy adopted at Cambridge.

CSSD and Nurse Training

163 The introduction of central sterile supply involves the nursing staff in many changes in technique. In considering this important consequence of central supply there is first, the more immediate action to be taken in re-educating the present nursing staff in the use of sterile packs, and secondly, the long term policy for training those nurses who grow up with central sterile supply.

(*a*) *Re-education of the Nursing Staff* The changes which will have to be mastered in the preparation of treatments are many. This is further considered in the next chapter. It is, however, important to begin the re-education of nurses in the new techniques before they have to apply them. It is suggested that special meetings of the nursing procedures committee should run concurrently with those for CSSD planning. The tutor, CSSD superintendent, and representatives from the wards and departments should attend such meetings and be jointly responsible for evolving the new packs and for modifying procedures where desirable. When the department is ready to open, demonstrations should be arranged by the superintendent for members of this committee and for representatives of the staff from those wards it is proposed, first, to changeover. At these demonstrations they can learn how the different packs are prepared, how they should be used, and how they should be disposed of. Such visits will also enable them to appreciate the amount of work involved in the processing and packing of equipment. Once the staff in the trial wards have mastered the use of central supply, the staff from other wards should be encouraged to come and learn from them. Time and trouble spent in this way will later be amply rewarded.

The sister tutors are closely concerned with nursing techniques and will amend their class-room instruction of student nurses, to include demonstrations in the use of sterile packs side by side with practice in the traditional methods of preparation. It is, however, wished to underline the importance of instructing the staff nurse. She is responsible to the sister for supervising the day-to-day work of the nurses and for assisting the medical staff, and will need to be clear as to the correct usage of sterile supplies.

(*b*) *Training the Nurse* Those responsible for the training that a student nurse receives will be concerned lest the introduction of CSSD should leave the newly-trained nurse inadequately prepared to meet the needs of her patients, where there is no central sterilizing. Provided the traditional method of sterilization and the handling and care of equipment are taught in the classroom and that a pack system is adopted on the lines advocated in paragraph 51, there is nothing to prevent a nurse from learning what equipment is required for each procedure: she still has to select each item separately when preparing the trolley. So far as her instruction in the CSSD is concerned, the authority in each hospital will, of course, decide what it considers to be necessary. But it would appear that one or two visits to the CSSD during training would meet her requirement.

The Education of Junior Medical Staff

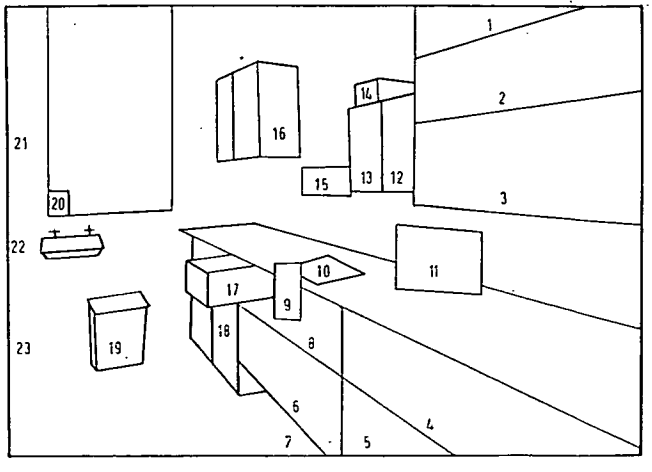
164 The introduction of central sterile supply has caused some discussion on the impact it will make on nurses' training. Yet little has been heard on another aspect of this subject, the education of junior medical staff and students. It is the experience of those who have

had the responsibility of introducing central sterile supply to their hospitals that the medical staff are also in need of tuition and guidance on the aims and use of CSSD. With proper instruction, medical staff can contribute much, both in co-operation and understanding, to the smooth running of central sterile supply.

165 The responsibility for explaining new equipment and techniques to the doctors is often left to the sisters and nurses, if only because there are more non-teaching than teaching hospitals. It is wished to stress the importance, in the context of CSSD, of a more positive policy, for educating junior medical staff. Initial instruction in the aims of CSSD and the proper technique for using sterile packs should be given to students before they reach the wards, (this is in fact being done in those teaching hospitals where there is central supply). The nursing staff can then make a further useful contribution in furthering the students' education in the application of CSSD after they enter the wards. Thus by the time the students are qualified, and take up posts in the provinces, they are well informed on these matters.

But what of those doctors who are already housemen and junior registrars? Who is to instruct them? Some arrangements to instruct them will have to be made in all hospitals with a CSSD; and it is suggested that the proper person to give this instruction is one of the medical staff. In the teaching hospitals the surgical tutor already fills the role in other fields, and there seems to be no reason why CSSD matters should not be included in his curriculum. In the non-teaching hospitals, there is a possible choice between the Medical Superintendent, the Control of Infection Officer and the Resident Surgical Officer. A decision as to who accepts the responsibility will be influenced by the degree of interest shown by the person to be concerned. Whoever is made responsible for educating the doctors, it is wished to underline the importance of the task. It is not one which can lightly be dismissed. A lack of understanding by the medical staff of the principles and practice of CSSD can lead to a loss of the benefits normally to be expected from it.

42 Diagram 3



Detail of Layout in Ward Clean Utility Room

1–6 Storage for dressing and supplementary packs
7 Storage for empty containers
8 Disposal bags
9 Disposal bag attached to hypodermic tray
10 Hypodermic tray
11 Sterilized drainage bottles
12 Dispenser for instruments
13 Dispenser for syringes
14 Stock of disposable needles
15 Dispenser for miscellaneous items
16 Disposable transfusion sets and solutions
17 Partitioned catheter drawer
18 Lotion cupboard
19 Waste basket for paper towels
20 Disposable face masks

Out of Picture

21 Hand towel dispenser
22 D.D.A. cupboard
23 Parking space for three small trolleys

Chapter 9 The Use and Disposal of Dressing Packs

Ordering supplies—arrival and storage of supplies—paper hand towels—dressing techniques—giving an injection—the departments—disposal.

Ordering Supplies

166 It has been shown earlier, in paragraph 106, that wards and departments should requisition daily the sterile supplies they require from the CSSD. A suggested type of form which is in use at Cambridge is shown at Appendix K. It is a traditional habit of nursing staff to hold in their possession a store of supplies of all kinds, in case of need. If this habit is continued large quantities of CSSD supplies will lie unused on the ward shelves instead of being in circulation. Not only will this mean unnecessarily large working stocks for the CSSD, and thereby an increased cost to the hospital, but it will also tend to increase the work to be done, since sterile packs will become date-expired and will have to be returned to the CSSD for re-processing. Everything should therefore be done to reduce wards' sterile stocks to the lowest possible level. Practical experience of the use of central sterile

43 A small but well-arranged ward clean utility room—the diagram opposite shows the detailed arrangement and storage of supplies

supply has, however, shown that once the nursing staff have gained confidence in the system and have adapted themselves to forecasting their daily needs—using the reserve supply cupboard for needs they cannot foresee—a reasonable working level of stock can be achieved.

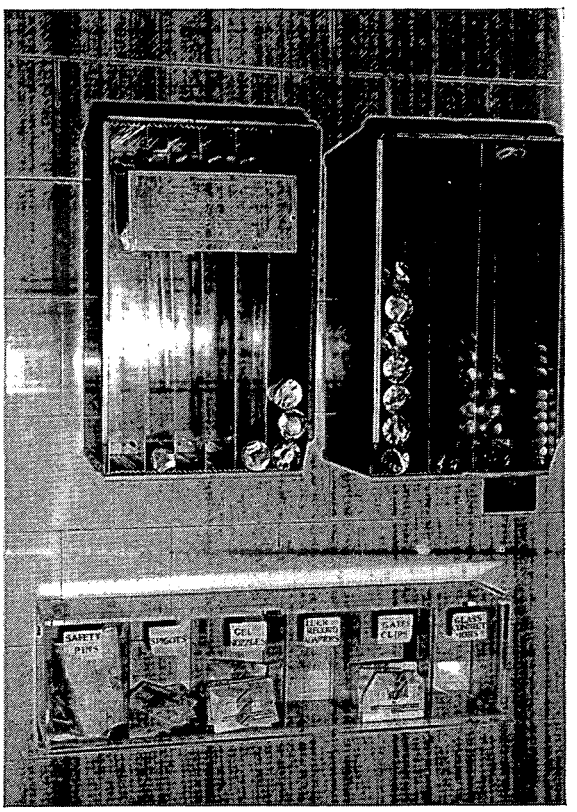
Arrival and Storage of Supplies

167 The sterile supplies reach the ward in the cardboard boxes described in paragraph 63. They should not be left lying in the passage outside the clean utility room but should be taken inside, the contents checked against the accompanying list, and the container put on one side as a receptacle for the empty but clean cardboard boxes which will eventually be returned to the CSSD. At the same time as the sterile supplies are delivered the container holding the empty cardboard boxes should be returned. It cannot be too strongly stressed that the used equipment from the dirty utility room should never be returned on the same trolley as the one which delivers clean or sterile supplies. A photograph of sterile supplies on ward shelves is shown on p. 69.

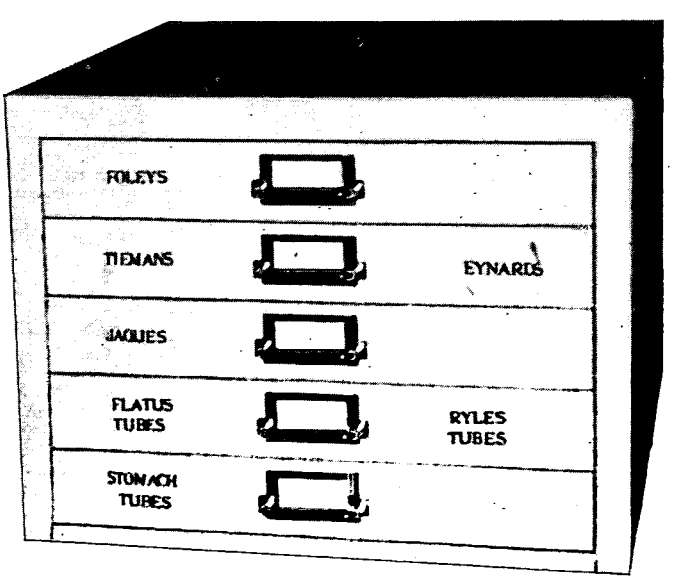
Storage of Hot-air Sterilized Packs In paragraph 81 it is stated that boxes of dressings and supplementary packs are stamped at the time of sterilization with an expiry date of 28 days. It is also explained there that a closer control over hot-air sterilized packs obviated the need to show an expiry date—indeed there is no practicable means of doing so. It is therefore recommended that instruments, syringes and non-disposable needles should be stored in dispensers which ensure that these items are used in sequence. The aluminium containers and glass tubes holding syringes, instruments and needles respectively are loaded at the top of the dispensing container and taken out from the bottom as is done with a slot machine.

Storage of Small Miscellaneous Items A similar principle to that described above has proved useful and economical of space for the storage of tiny items, such as spigots, safety pins, adaptors, etc. It was found that the smallest cardboard box held too many for the average need, and it was decided to replace the cardboard box with a paper bag. Date stamping is, of course, possible with bags and a wise precaution because the use of their contents is so variable. The dispensers which are shown in photograph 44 were made in the hospital workshop.

Storage of Catheters Wards will require to hold two or three of each size of the catheters they use. It has been found wasteful of space to store them in cardboard



44 Syringes and instrument dispenser hanging above a perspex dispenser for small miscellaneous items



45 A practicable and tidy method of storing sterile catheters

boxes. Several types of catheter are now available prepacked and sterilized from the manufacturers. These are suitably wrapped for storage in drawers. The catheters which have to be processed by the CSSD can be similarly wrapped in two paper bags, and stamped with an expiry date. Either a partitioned drawer or a nest of drawers can be used for their storage. In Diagram 3 a partitioned drawer is shown; in the photograph on p. 70 a metal cabinet of five drawers is illustrated.

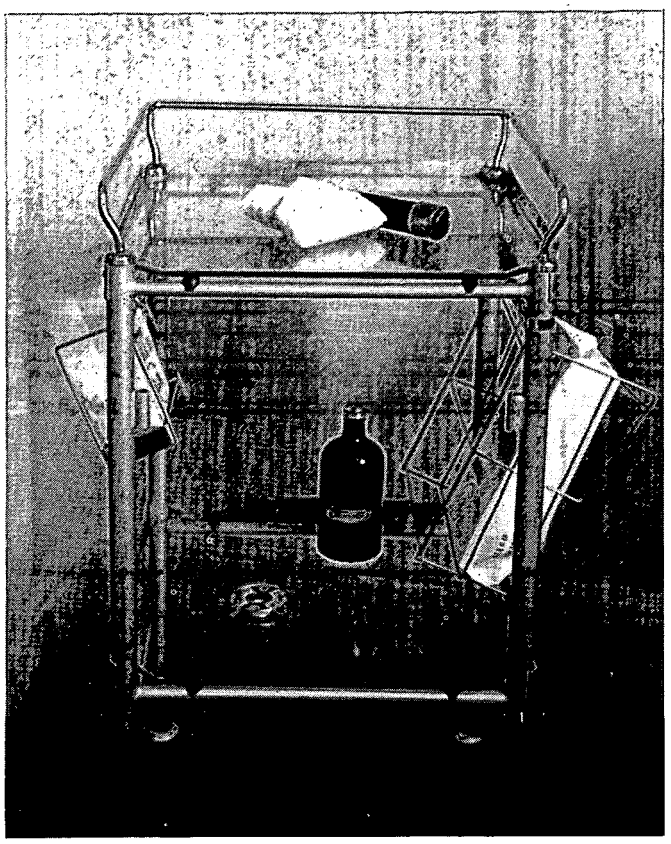
Paper Hand Towels

168 Nurses and doctors have to wash their hands frequently when doing dressings and carrying out treatment, and cotton hand towels in some form are provided at hand basins. This practice is now generally accepted as unhygienic, since the towel is a communal one and may be used many times before it is replaced. It is consequently a potential source for the transmission of infection. In the past few years, hospitals have attempted to introduce one of the available types of paper hand towel, but without much success. The cotton hand towel is still to be seen at the sink for those who prefer to use it. This is understandable, because the results of experimental trials at Cambridge showed without exception that paper hand towels were unpleasant to use and deficient in absorbency. An experimental trial was made of the paper currently used for the wrapping of dressings and for dressing towels, (see Appendix A). The results were successful and all members of the medical and nursing staff now accept this substitute. The most efficient size of towel was found to be 15 inches wide and 15 inches long. The manufacturers have all but met this requirement from production by providing a roll of paper towelling 10 inches wide and perforated at intervals of 17 inches. An enclosed dispenser is obtainable with the towel and can be affixed to the wall above the sink. Photograph 46 shows the towel and dispenser.

46 The paper hand towel dispenser in use

Dressing Techniques

169 With the required range of sterile supplies readily available on the shelves in the clean utility room, the task of preparing a treatment is quickly accomplished. The photographs and descriptions given overleaf illustrate the simplicity of setting trolleys with the pack system.



47 The setting for a simple dressing

Top Shelf A small dressing pack, and an aluminium container holding four pairs of dissecting forceps and dressing scissors, provide the sterile equipment for replacing a simple dressing.

Lower Shelf All that is required on the lower shelf is a lotion and a reel of adhesive tape.

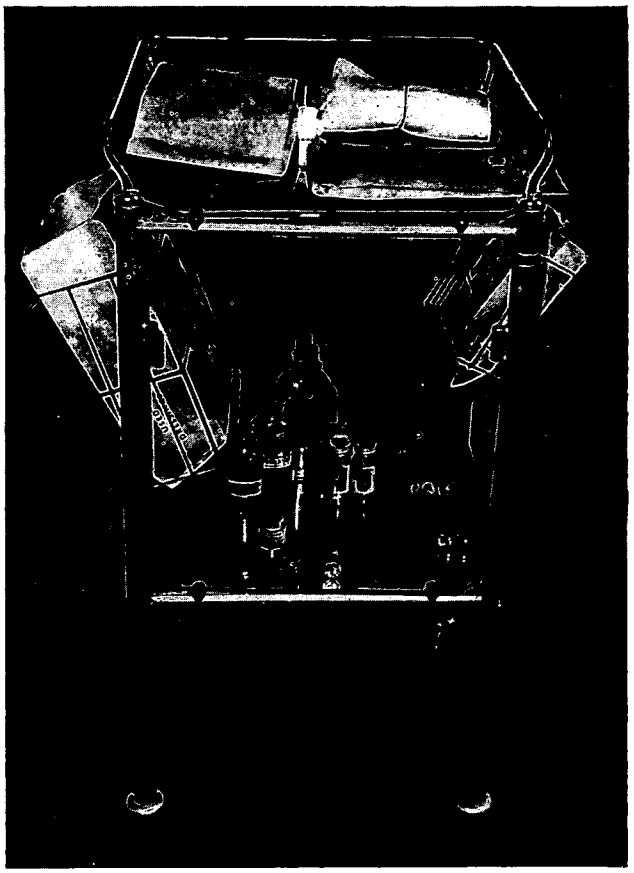
Disposal On either side of the trolley is a basket for holding the paper disposal bags. That on the right is for used dressings, that on the left for used instruments.

48 Packs prepared for a simple dressing

The small dressing pack has been opened to form the sterile field, revealing the dressings, a paper towel and a gallipot in the upright position to receive the lotion. The instruments have been tipped out of their container onto the sterile field. When the nurse has washed and dried her hands she can proceed to do the dressing. Two pairs of forceps are provided to remove the dressing, leaving one pair for attending to the wound and a further pair for applying the fresh dressing. The scissors are provided for cutting the adhesive tape.

Top Shelf A medium dressing pack, a disposable foil tray and gloves are as much as can conveniently be placed on the top shelf.

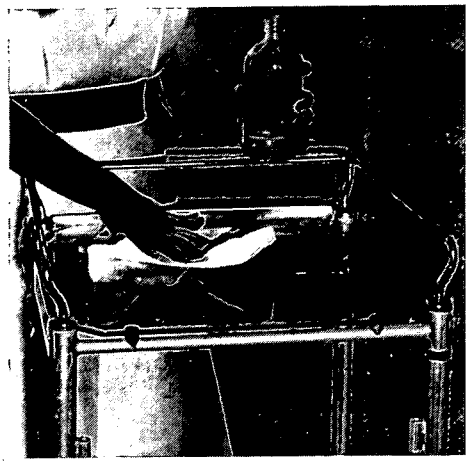
Lower Shelf A cardboard box containing an Adson manometer, luer-fitting adaptor and rubber tubing; three sizes of Howard Jones's needles in glass tubes; syringe and needles for injecting the local anaesthetic; local anaesthetic; skin cleaning antiseptic; collodion; and universal containers complete the sterile and clean equipment necessary for lumbar puncture. The provision of disposal bags is the same as for the simple dressing.



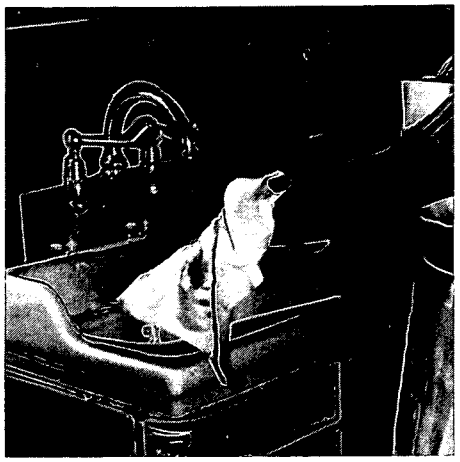
49 The setting for lumbar puncture

50 Packs prepared for lumbar puncture

The medium dressing pack is larger and allows a more liberal sterile field than does the small pack. Two gallipots, two paper towels and dressings are enclosed. Again, it should be noted that the gallipots are in the upright position. The foil tray is provided in case it is necessary to return an instrument to the trolley before it is finished with. Antiseptic is poured into the gallipots, the 'local' syringe is tipped into the foil tray ready for charging and the gloves in their paper wallet are tipped out of the bag onto the trolley. The nurse then removes the paper-wrapped manometer and adaptor from the cardboard box and opens the paper bag. In doing so she avoids contaminating the mouth of the bag. She offers the contents of the bag to the doctor who, having washed and dried his hands and put on the gloves, assembles the instrument and puts it in the tray. The trolley is now ready for the treatment to begin. The lumbar puncture needle, which can be selected without opening its glass container, should remain protected by this until immediately before use. In the photograph opposite, the shaft of the needle is covered by the fine glass tube in which it was supported in the test tube.

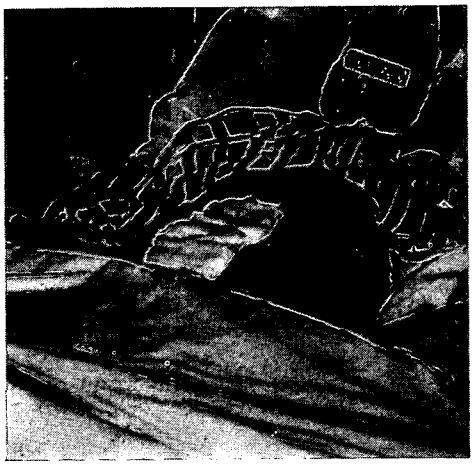


1 Before it is laid the dressing trolley should be cleaned with hibitane in spirit and dried with a fresh paper towel



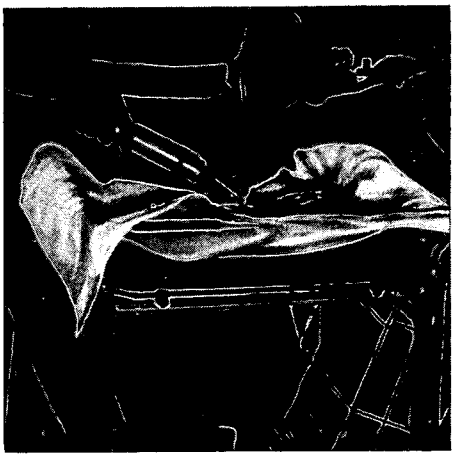
2 The nurse now washes and dries her hands on a soft paper towel before selecting the sterile supplies she will need

3 The trolley is laid with a dressing for an abdominal wound. A large dressing pack has been selected, together with a container holding 4 dressing forceps and dressing scissors, and a supplementary pack of cotton wool balls. Lotion and adhesive plaster complete the setting. Two disposal bags are placed in their respective carriers. The large bag is for refuse, the small for instruments

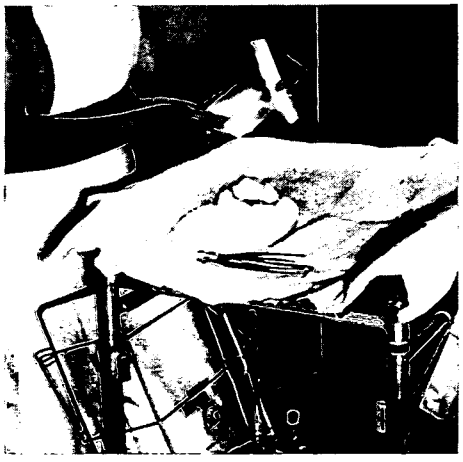


4 Before the trolley is wheeled to the bedside the screens or curtains are pulled and the patient's position and bedclothes adjusted

5 At the bedside the nurse opens the dressing pack to form a sterile field



6 The capsule of the container is removed and the instruments carefully tipped out, care being taken not to touch the sterile field with the container. The empty container is placed on the lower shelf of the trolley



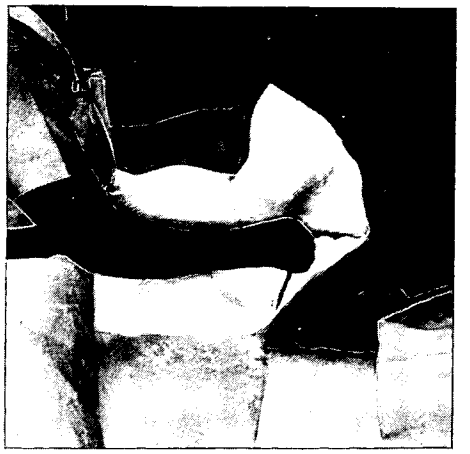
7 The bag holding the extra cotton wool balls is held away from the sterile field, torn across and the contents are then dropped onto it

8 Antiseptic lotion is poured into the gallipot which previously had been packed in the upright position. The setting is now ready for the dressing to begin. Nurse cuts or removes the fastening of the patient's dressing

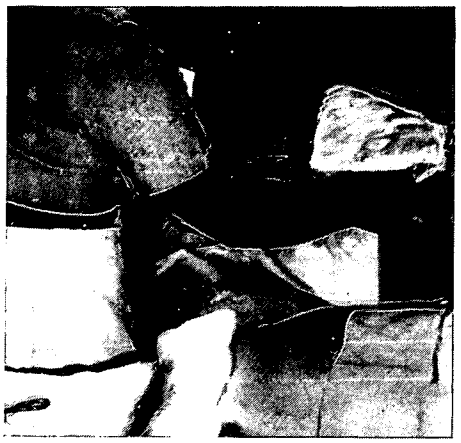
9 The nurse re-washes her hands and dries them on a disposable paper hand towel. It will be noticed that the towel dispenser is placed on a high level so that the water drips off her elbows rather than her finger tips

10 With two pairs of dressing forceps to allow her better manipulation the nurse removes the soiled dressing and puts it straight into the large disposal bag

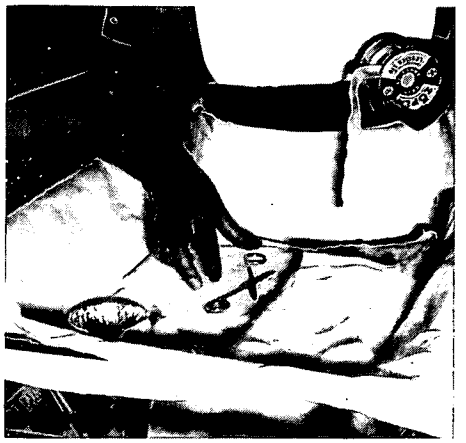
11 The two pairs of forceps are now considered contaminated and are discarded into the small paper bag



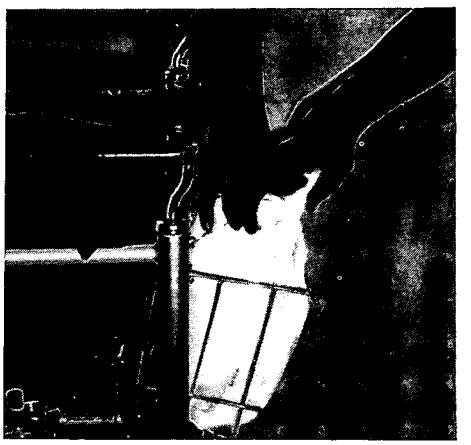
12 With two pairs of fresh forceps a disposable paper dressing towel is laid adjacent to the area to be dressed



13 The dressing is completed and the dissecting forceps are discarded into the small disposal bag



14 The adhesive strip required to secure the dressing is cut with the scissors provided in the container for this purpose. They are then added to the other instruments in the small disposal bag. A nurse should not use the scissors in her pocket. It is easy to transmit infection from one patient to another by using the same scissors without terminal disinfection



15 The paper field, gallipot and any remaining bits are rolled up tightly and added to the soiled dressings. The neck of the bag is closed and screwed up

16 The patient is made comfortable and the trolley is wheeled to the dirty utility room, where the refuse bag is put into a polythene disposal sack

17 The instruments in their bag are placed in the CSSD collection pail

18 Nurse now washes and dries her hands before repeating the steps described in 1–17

170 It is the duty of a hospital's procedure and cross-infection committees to decide the aseptic discipline for carrying out a dressing in their hospital. There are, however, certain principles which must be observed in the preparation and use of sterile packs, and so long as these are conscientiously adhered to, an efficient and unexceptionable technique will be safeguarded. The important principles are as follows:

1 Packs required for one treatment only should be selected from the shelves. Every effort should be made to ensure that packs are not left on a trolley waiting to be used, and that the lids of containers, such as cardboard boxes, are replaced immediately a pack is withdrawn. These precautions will reduce to a minimum the aerial contamination of the outside of the packs.

2 The surface of the trolley on which the packs are placed should be clean and dry.

3 The trolley should hold only those clean articles; for example, lotions, bandages, elastoplast, etc., which are needed for a particular treatment.

4 The sterile packs should be opened after the patient has been prepared and at the last convenient moment before he receives his treatment.

5 The pattern of folding should allow the dressing packs to be opened with the fingers in such a manner as not to contaminate the contents or the sterile field from which the nurse is to work.

6 The contents of the pack should have been previously arranged in the order in which they will be used; the gallipot being immediately accessible to receive a lotion.

7 If the sterile setting is contaminated in any way, or lotion is accidentally spilled on the sterile field, the setting should be discarded and a fresh one used.

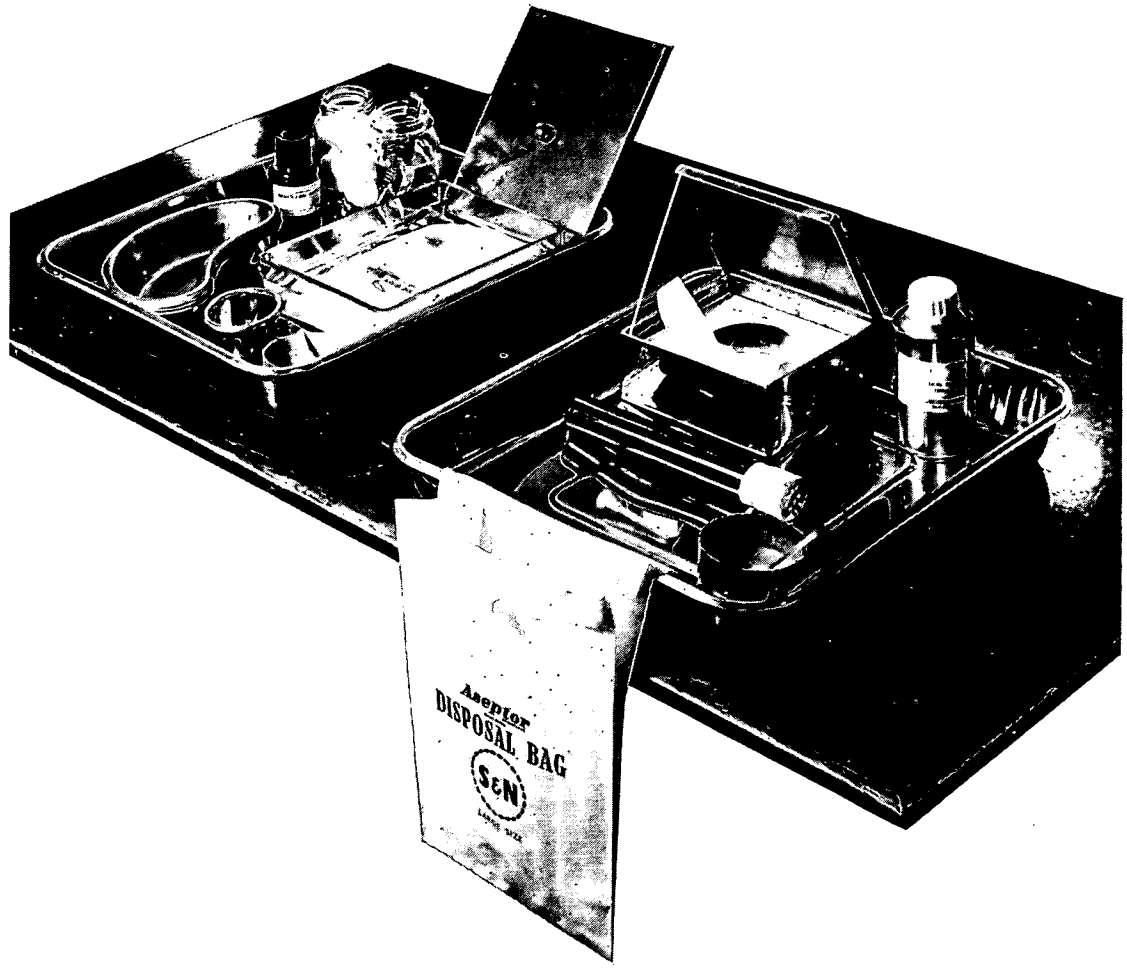
8 The dressing removed from a wound, together with the instruments used for its removal, should be placed immediately into paper bags identified for these purposes.

9 When the treatment is completed all contaminated articles should at once be deposited in their respective containers, which should be kept in the dirty utility room. Further handling of articles and containers must be reduced to a minimum.

171 The series of photographs on pp. 74 and 75 are based on the foregoing principles and illustrate the discipline adopted at Cambridge for carrying out a dressing. It was agreed by those responsible for training the nurses that it would be more realistic if the basic dressing technique were to be suitable for use by one nurse only. If the staff are available, or if the complexity of the treatment demands otherwise, a second nurse can perform useful service.

Giving an Injection

172 The increasing number of treatments requiring an injection underlines the necessity to reduce the amount of preparation and to make the task a simple one. It has been the accepted practice for wards to keep a hypodermic tray containing gallipots for disinfectant, kidney dishes for carrying the syringe, a jar of cotton wool balls or lint squares to clean the skin, syringes, needles and other items. With possibly the exception of syringes and needles, many of these items were boiled, at most, once a day and a cloth was used to protect the tray from dust.



52 A traditional hypodermic injection tray alongside an improved and simplified setting

173 Separately packed syringes and needles are now provided for each injection. After the syringe has been charged it can be returned to its container and carried in this to the bedside. No kidney dish is therefore required. An efficient disinfectant[35] can now be obtained in an aerosol can. This obviates the need for forceps and gallipots, whilst the use of sterilized medical wipes has been found more convenient than cotton wool balls. The box of wipes should be kept in a sterilized stainless steel box with a spring lid to reduce contamination by dust. The photograph above illustrates the two settings for hypodermic injection. That on the left is the traditional type of hypodermic tray, that on the right the modified setting. The simplicity of the latter will be noted.

35 Verdon P E (1961), *J.clin.Path.* **14**, 91

The Departments

174 *Outpatient Department* The outpatient department is concerned with consultation rather than treatment. A dressing is however occasionally required and this need can be met from the standard range of supplies described in the foregoing chapters. But some clinics, such as ENT, urology, and gynaecology, present a problem in that they require the use of large numbers of instruments for examining purposes. Although many of the instruments

are used in a clean rather than a sterile state, it is desirable that they should be sterilized between each usage. Where should this be done? In paragraph 3 (*a*) it has been argued that theatre instruments should be sterilized in the theatres and the suggestion made that the same reasoning applies in the case of instruments used in certain clinics. To keep a busy gynaecological clinic supplied with speculae from a CSSD would involve a heavy financial outlay on these instruments. It is, therefore, felt it would be impracticable to undertake their sterilization in the CSSD and that, as with the theatres, these instruments should be left in the outpatient department for the staff to autoclave.

Cystoscopes are complex and delicate instruments and therefore present a greater problem in cleaning and sterilization. Much has been written on the subject of their processing. Steam sterilization, and pasteurization are both recommended as being effective.[36] Because of the complex design of these instruments, the importance of achieving a high standard of cleanliness first is paramount. Work is continuing on the development of ethylene oxide as a possible agent for the sterilization of cystoscopes.

It is of interest to note here that, if some measure of standardization could be achieved in the sizes of ENT speculae, manufacturers would be more likely to produce a disposable substitute.

175 *Casualty Department* It has been found at Cambridge that the day-to-day needs of casualty treatments can be met from the standard range of supplies, including ward dressing instruments. Instruments for minor operations are processed locally. Most casualty departments have a theatre for such work and it should be fitted with a small autoclave for sterilizing the instruments.

176 *X-Ray Department* Special provision has to be made for the needs of the X-ray department. There are procedures, such as arteriograms, which require special syringes, needles, and cardiac catheters as well as sterile dressings, drapes, gowns and gloves. The standard range of theatre packs meets most of the needs, but the equipment itself, with the exception of cardiac catheters, has to be specially prepared in the CSSD. Cardiac catheters are difficult to clean; they cannot be sterilized by steam or hot air. A limited range of disposable cardiac catheters is now available; but until the range is comprehensive, some will have to be processed locally. It is more convenient to process the catheters in the X-ray department, although the guide wires, which will withstand steam sterilization, can be done in the CSSD. Soaking, followed by prolonged flushing with water, is the most satisfactory method of cleaning. 'Sterilization' can only be attempted by soaking in an approved antiseptic. When placing cardiac catheters to soak, care must be taken to expell the air bubbles from the lumens of these lengthy catheters, so that the antiseptic is in contact with them.

Disposal

177 *Dressings* Although the primary concern of this book is with central sterile supply, reference to disposal must be made if only for the reason that, if the arrangements are inadequate and the general level of hygiene is low, the advantages of central sterilization may be weakened. In the Trust's booklet[37], it was recommended that used dressings should be placed directly into small paper disposal bags. Since its publication, the suitability of paper bags for the disposal of individual dressings has been confirmed and they are now widely used in hospitals. But how should these paper bags, the disposable items and paper packaging be disposed of? Let us consider the methods of disposal which are available.

(*a*) The general method is to place used dressings and refuse into large bins or disposable sacks in the dirty utility room, from which they are removed once or twice daily by porters. They are ultimately burnt in the central incinerator. With this system it is important to ensure that:

(*i*) The bins are lined. This precaution facilitates emptying and keeps the bins in a hygienic condition.
(*ii*) The liners and sacks are not overfull, and that their necks are securely fastened before removal.

It has been found that polythene is a more suitable material than paper for disposable bin liners and sacks. It is equally strong, equally waterproof and similarly priced; but it is more malleable, its slippery surface facilitates filling and it is more easily closed when full. Information on the cost of using polythene disposal bags can be found in paragraph 148 (*b*).

36 White H P W, *A Textbook of Genito-Urinary Surgery*, 2nd ed. 1961, Livingstone, Edinburgh, 180

37 Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 49

53 A polythene disposal sack in use in a dirty utility room

(*b*) Newly-built hospitals and those in the planning stages have had disposal chutes incorporated in their design. Of recent years there has been a marked improvement in the functional design of chutes and most of the criticisms levelled against them have been met. Where disposal chutes are available to the wards, the same refuse collection methods as described above can be followed. Disposable sacks and liners would in these circumstances be collected at the bottom of chutes by porters and taken to the incinerator. It is preferable if wrapped refuse is placed directly into the chute and not allowed to accumulate in the ward.

(*c*) There is one further method of disposal that should be considered.[38] Small incinerators have recently been installed in the dirty utility rooms of a few hospitals. Such installations have the advantage that disposal is immediate. It is claimed that incineration is complete and the process clean. Sufficient evidence is not yet forthcoming to confirm such claims. Certain facts are, however, known. First, gas is a more efficient incinerating agent than electricity. But a gas supply to the ward will be an appreciable additional expense unless it is also wanted for other purposes. Secondly, temperatures about 800 degrees centigrade are required to melt disposable aluminium foil dishes. Such temperatures are difficult and expensive to achieve. Thirdly, the ash box has to be emptied. This is liable to create dust. It is of interest to note that it is rare to find incinerators installed in the wards of the more modern hospitals in America or on the Continent.

178 It is relevant at this point to mention the ease with which a hospital incinerator can deal with the daily loads of refuse. It has sometimes been argued that, if paper and disposable products are introduced into hospitals on the scale suggested in this book, the hospital incinerator will prove too small to deal with all the debris. This difficulty has not been encountered at Cambridge, in spite of the fact that the incinerator was installed 50 years ago. The air which is inevitably trapped inside the paper bags and the polythene sacks aids combustion and they are easily burned. No problems have arisen as a result of incineration of aluminium foil and plastics.

179 An efficient central incinerator[39] affords the ideal system for the disposal of contaminated material. But it is imperative that it should incinerate wet as well as dry dressings, plastic and foil products as completely as possible without creating fumes, smoke and dirt.

180 *Linen* If contaminated dressings are a source of infection, equally so are soiled and contaminated bed linen. Handling of soiled bed linen should be reduced to a minimum and laundry bags securely fastened and removed from the dirty utility rooms as soon as possible. Many hospital cross-infection committees have already made the rule that sluicing of fouled linen and accounting for soiled linen should be done elsewhere than in the ward.

38 British Standards, 3107 (1959), *Small Incinerators for the Destruction of Hospital Dressings*

39 British Standards, 3316 (1960), *Large Incinerators for the Destruction of Hospital Waste*

54 Sorting and counting of soiled linen in a dirty utility room

This is a real and constructive contribution to a reduction in the spread of infection. The particular method adopted for the disposal of soiled and foul linen must, however, be evolved by the hospital concerned in the light of its local circumstances. The Trust's previous publication[40] showed that there were then a number of hospitals which continued to allow these dirty tasks to be done in the ward. The photograph above vividly illustrates the squalor of such practices.

181 *Bedpans* In 1958, when *Present Sterilizing Practice in Six Hospitals* was written, it was stated:

> '. . . One of the most unsatisfactory things noticed during the survey was the inefficient cleaning of bedpans by the bedpan washers. None of them was fully automatic and many were misused by the nursing staff . . .' and later '. . . Work is continuing on the better design of bedpans and bedpan washing . . .'

Much experimental work has been done in the wards at Cambridge on the problem of cleaning bedpans. The latest fully automatic machines have been installed, temperatures have been checked, high-pressure pumps fitted, different detergents and different designs of bedpans have been tried. Yet no machine has been found that will remove all traces of faecal matter from the bedpans. This is reported in an article in the *Nursing Times*[41] which states:

> '. . . Using the Dishlex Rinser and Disinfector, 71 per cent of the bedpans in the male ward and 75 per cent of those in the female ward had visible contamination in them after the processing. Using the Dent and Hellyer model B55 the figures were 51 per cent and 55 per cent respectively . . .'

182 This seems too low a standard of cleanliness to accept from the expensive machines now being put into hospitals. Any machine used must clean effectively. In the light of the experimental work done it seems doubtful whether any machine can be designed to wash a bedpan clean. It would be wrong to assume that faecal-contaminated bedpans are not sterile. Indeed, it was clear that the temperatures reached in the machines tested were usually high enough to kill the bacteria, although the bedpans were still visibly contaminated with faeces. But this is not good enough. Meanwhile, disposable bedpans have come onto the market. The bedpans are made of papier-maché which fits over a fibreglass frame. After use, the shell with its contents is taken to the ward sluice room, where it is 'posted' into a disintegrating machine. This machine disposes of the shell and the excreta without further handling by the nurse who is not involved in any cleaning process. Each patient gets a new

[40] Nuffield Provincial Hospitals Trust (1958), *Present Sterilizing Practice in Six Hospitals*, London, 50

[41] Carroll V M (1961), *Nursing Times* **57**, 211

bedpan liner. The framework, with which a patient does not come in contact, remains clean, but it can be disinfected or sterilized if thought necessary. Urinals, also of papier-maché, can be dealt with in the same way as bedpans.

183 The disintegrating machine stands 3 feet high on the floor and requires an area of 5 square feet. The cost of using disposable bedpans is discussed in detail in paragraph 148 (*a*). It will be appreciated that with such arrangements the nursing staff are saved a singularly unpleasant task and the patient is assured a clean bedpan. In general, this method of disposing of bedpans, urinals and their contents seems promising. And, if later the machine can be developed to include the disintegration of soiled dressings, it might well provide the answer to some of the ward's disposal problems.

184 The preceding paragraphs have only touched on a few of the important steps which should be taken to avoid obvious infringements of elementary hygiene. The standard of hygiene should be examined critically. If the importance of its contribution is underestimated, the full benefits of central sterilization can never be reaped.

Chapter 10 The Operating Theatres

General—sterile packs general—basic packs—drapes and mackintoshes—sterile water—anaesthetic equipment—maternity.

General

185 In considering the service of central sterile supply to the theatres, it is presumed that they will process their own surgical instruments. Nevertheless, a theatre's sterile requirements are still many and varied and the changeover to central sterile supply is a more complex operation than in the case of the wards. So much depends on the layout of the theatre suite; the storage accommodation available; and the intensity of the demand that specific advice cannot usefully be offered. Each case can only be considered in the light of its own particular circumstances. Theatres designed and built many years ago have often an ill-defined work flow and poorly-found facilities. Contaminated articles and sterile supplies may have to be dealt with in the same area; the trolleys prepared in the theatre itself; whilst storage accommodation is often inadequate. It is for the committee planning central supply to decide how best to improve the theatres' facilities. It may be of help however to give an outline of the more important points which require consideration.

(*a*) *Sterilization* Steam sterilization of instruments is more effective than boiling; the instruments also will be dry after sterilization. Dry instruments are not only preferable to wet ones but they facilitate the use of paper, when it becomes available for the replacement of linen trolley-towels and drapes. It is therefore recommended that a high-speed instrument autoclave should replace boiling water 'sterilizers'.

(*b*) *Storage* Supplies should be ordered daily on the type of requisition forms shown at Appendix M, and delivered to the theatres by the CSSD. To allow for emergency operations it is thought that the level of stock held in the theatre should be sufficient to cover a 36-hour rather than the 24-hour period which is allowed for the wards and other departments. Secure, dry storage in the form of a cupboard with a capacity suitable for 36 hours' supplies, and sited within the theatre suite, is all that is necessary. The sterile contents of this store should be properly organized so that they are used in the sequence of their sterilization. The theatre sister will probably be responsible for checking packs for date expiry.

(*c*) *Work Flow* Where possible there should be a clearly defined work flow from contaminated through clean to sterile. More particularly, the area in the theatre suite reserved for the preparation of sterile packs on the trolleys, and the sterilization of instruments, should be separate from the theatre proper. It is in the preparation area that sufficient sterile supplies should be held for one operating session. Open shelving or a trolley is convenient for this purpose. It is even more important that the dirty utility area should be separated from both the theatre and the sterile preparation area. Storage accommodation will be required in the dirty utility room for the collection of syringes, glassware and utensils, which should be removed daily by the CSSD for reprocessing. Debris and used linen should be removed as frequently as possible from the theatre suite.

Sterile Packs General

186 The advantages arising from the use of basic and supplementary packs in the wards and other departments have been discussed in paragraph 50 *et seq.* It is reasonable also to apply this principle to theatre packs. Standardization and simplification of theatre requirements is important, and more so when there are a number of theatres to be supplied, either within one hospital or throughout a group. Standardization and simplification can only be achieved where individuals are prepared to sacrifice some of their personal preferences for the good of the whole. Careful thought and preparation will help to reduce the variety of drapes and dressings required for the different specialities. For example, a basic pack can be common to both gynaecological and urological specialties. The items required for surgical procedures often vary so little that, with modifications, a composite drape and dressing pack could have a wide use, individual needs being provided in supplementary packs.

Basic Packs

187 A method of packaging has been described in paragraph 69. There remains to consider the range of

basic packs. It is suggested that this can simply be divided into five categori:

(*a*) Composite.
(*b*) Supplementary.
(*c*) Bowls and utensils.
(*d*) Special procedure sets.
(*e*) Emergency sets.

(*a*) *Composite Packs* There are two types of composite pack. First, the gowns and hand towels required by the surgeon and his assistants; and secondly, the drapes and dressings for the trolleys and patients. The preparation of hand towels and gowns has already been described in paragraph 69 (*a*). Gloves should be separately packed and a method of doing this is described in paragraph 62. It has been found more convenient at Cambridge to pack gloves, by size, in cardboard boxes. Caps and masks, presumably used clean, should remain the responsibility of the theatre. The numbers and the variety of drapes and dressings contained in a pack must be left for the theatre superintendent to agree with her surgeons and the CSSD superintendent. Further consideration will be given to their wrapping in paragraph 188.

(*b*) *Supplementary Packs* It has been suggested that in order to achieve maximum flexibility, and a wider use of the drapes and dressings packs, the particular needs of different operations should be packed individually. A method of packing them is described in paragraph 69 (*c*).

(*c*) *Bowls and Utensils* If the theatre autoclaves are large enough, the problems of packaging and transport can be avoided by sterilizing bowls, jugs and trays locally. This arrangement allows the theatre sister a wider choice of range and numbers than if the CSSD were to do it. But it does involve the nurses in processing. If bowl packs are to be processed and sterilized in the CSSD, it will be necessary because of their weight to reduce the numbers used to a minimum, and to agree on two or three basic sets. Large hand bowls are awkward to pack and bulky to store. A reduction in their size might be considered. It is also for consideration whether stainless steel could not be replaced by polypropylene. This new material is easy to sterilize, promises to be reasonably durable, is lighter in weight, and cheaper than stainless steel. Manufacturers already provide a limited range and if the demand were large enough, they would probably increase it. Disposable aluminium foil has a use in theatres for such purposes as gallipots, ligature dishes, etc. A method of packaging bowls is described in paragraph 69(e).

(*d*) *Sets for Special Procedures* Apparatus for such procedures as lumbar puncture, aspiration and intravenous cutting down, etc., which may occasionally be required for use in the theatres, can be obtained from the CSSD, as also can spinal anaesthetic equipment. Since the latter will be exclusively and probably infrequently used by the theatres, it is suggested that such sets should be packaged to remain sterile for six months. This long expiry date can be achieved by adding an additional layer of packing.

(*e*) *Sets for Emergency Use* More than in other departments is it necessary to hold sterile composite sets for use in an emergency. Sets for such emergency procedures as cardiac massage, embolectomy, tracheotomy and bronchoscopy may be prepared and held in readiness for use in any part of the hospital. The range and the custody of such sets should be decided by the theatre superintendent. It is again suggested that the sets should be packaged so as to allow prolonged storage.

Drapes and Mackintoshes

188 In extending the service of central supply to the theatres, the question of 'sterile' mackintoshes inevitably arises, since it is a general practice to use them on trolleys and on the patient. It is not always appreciated however that neither mackintosh nor jaconet can be sterilized by the means available in the hospital. Nylon might be a suitable substitute were it not for the facts that it develops an electro-static charge and has a liability to pinhole. A water repellent paper would not have such disadvantages. Manufacturers are now trying to produce a paper which is conformable, silent, and water-repellent. Not only would this paper make an efficient and protective wrapping, but it would also be suitable for draping the trolleys and the patient. It is suggested that, until a properly water-repellent paper is available, a paper from the available range should be used in conjunction with linen. Trolley surfaces should be clean and dry before they are laid with sterile packs; and theatre staff should endeavour to work in dry conditions.

189 There is now available a specially treated cotton material, which possesses a certain degree of water-repellency and is therefore to be preferred to balloon cloth and other similar materials. Details of this special material are given in Appendix A. At Cambridge it has

been in use for some months and has been found satisfactory. The policy at Cambridge is to use a layer of paper lined with one of these special cotton towels for wrapping all dressings and drape packs. It is also replacing the balloon cloth drapes.

Sterile Water

190 The source from which sterile water for topical use can be obtained has been discussed in paragraph 84. There it was concluded that although sterilized water in sealed flasks was in every way desirable, the quantity of water used in some British theatres could make the scheme unrealistic. There are however theatres in this country where the use of water for general purposes has been reduced to a point where a bottled supply has become a workable system. All surgeons and theatre staff should endeavour where possible to work in drier conditions. A supplementary supply of water may be required for urological surgery. For this a small filter described in paragraph 87 (*a*) could be used. A method of using bottled water with a supplementary supply is briefly described below.

(*a*) *Water Flasks* Storage space for a 36-hours' supply of bottled water will be required in the theatre suite. Flasks sufficient for one session should be held in the sterile preparation room. For hot water, a heated cupboard will be necessary in which to store the flasks.

(*b*) *Supplementary Supply*

(*i*) *The Filter Press* The demand for cold water in theatres is limited so it is probably better for the filter to be attached to the hot water supply. Sterile water from the filter can be collected in lidded sterile jugs. The sterilizing and cooling down processes of the filter itself take about three hours. It is more convenient, therefore, to renew the filter pads and sterilize the press at the end of the day's work.

(*ii*) A potential source of sterile water has been discussed in paragraph 87 (*b*). The superchlorination/dechlorination process is promising, but there is more experimental work to be done. If the tests prove satisfactory the problem of providing theatres with a ready supply of sterile water at a selected temperature should be resolved.

Anaesthetic Equipment

191 The following paragraphs are based on information received from E A Pask and A G Signy (members of the Advisory Panel) and on the results of experiments conducted in the Department of Anaesthetics at the Medical School, King's College, Newcastle-upon-Tyne.

192 Present practice for sterilizing anaesthetic equipment in Britain relies upon the use of a boiler in or adjacent to the anaesthetic room. Many items of equipment are used at frequent intervals and are boiled between uses. Some are considered so intricate or fragile that modified boiling procedures are used in which there is an element of compromise.[42] Other equipment, such as face-masks, corrugated breathing tubes and expiratory valves are not sterilized, but cleansed with soap and water with or without a 'disinfectant'. More complicated equipment, such as circle absorption machines or devices for securing intermittent positive pressure respiration is cleansed only at infrequent intervals and attempts at sterilization are only made if it is known that they have been used for a patient whose exhalations are believed to have contained a dangerous infection, for example, patients with 'open' tuberculosis, poliomyelitis or staphlococcal pneumonia.

193 With the introduction of CSSD the elimination of local 'sterilization' by boiling is the aim. The provision of equipment from CSSD to meet anaesthetists' needs therefore presents some special problems:

(*a*) *Intravenous Infusion Equipment* Anaesthetists' needs for syringes and needles are heavy, but present no other special problems. Continuous infusion sets for anaesthetists' use must allow for rapid infusion of blood if heavy operative loss occurs. The sets must either incorporate means which can cause the infusion of up to one pint in three minutes (200 ml. in one minute) or it must be possible to apply a blood-pump to the set.

Indwelling intravenous needles or cannulae are often used by anaesthetists and some of these are difficult to clean and therefore to sterilize. A disposable sterile diaphragm which may be fitted to conventional or disposable needles is now available and it is suggested that this, in combination with a suitable needle, will perform the functions of a Gordh needle. Certain other indwelling needles (for example the Mitchell needle) could probably be sterilized by dry heat, provided that the external rubber parts, which do not need to be sterile, were separated and separately supplied.

(*b*) *Equipment which is introduced into the Bronchi, Trachea or Pharynx* Commonly used items include,

[42] McCallum F O, and Noble W C (1960), *Anaesthesia* **15**, 307

laryngoscope blades, pharyngeal airways, endotracheal tubes, plain and cuffed, and intra-bronchial and intra-tracheal suction catheters. There is no special difficulty in supplying sterile pharyngeal airways through CSSD, apart from the need for greater numbers in each hospital. Laryngoscopes do, however, present a problem in that in the absence of demand, each laryngoscope is at present only fitted with three blades of varying sizes. There is reason to think that instrument manufacturers, if asked, would provide as many blades as are required, all to fit the one handle. In this event laryngoscopes blades can also be supplied through CSSD. It has already been stated that catheters, and particularly the narrower tubes, cannot be cleaned with any certainty and that the longer their length, the more difficult they are to sterilize. Intra-tracheal and intra-bronchial catheters must be numbered among those which are particularly resistant to cleansing and sterilizing. Manufacturers have not yet produced a disposable tubing soft enough, yet rigid enough for use as intra-bronchial and intra-tracheal suction catheters; yet this is what is required. Until a satisfactory disposable substitute is available, theatre and CSSD staff will have to continue to clean and 'sterilize' these suction tubes.

Cuffed endotracheal tubes are expensive. But their intimate and continued contact with the intermediate respiratory tract requires that they should be sterilized between uses.[43] It is however important to guard against the risk that sterility may be purchased at the price of mechanical unreliability, for patients must not be subject to the hazards of kinked tubes or herniated cuffs.[44] Experimental evidence from trials carried out in the Department of Anaesthetics suggests that high quality cuffed endotracheal tubes will survive at least six cycles in a modern high-vacuum autoclave without dangerous damage to the mechanical properties of tube or cuff. The CSSD can conveniently undertake this sterilizing service for the anaesthetic department but, first, it will be necessary considerably to increase the present stocks of tubes. The number of times a tube is used must of course be carefully recorded. It is suggested that the tubes should be indelibly marked each time they are autoclaved. This responsibility can be borne by the CSSD, and the tubes marked as they are packed for autoclaving.

[43] Joseph J M, and Shay D E (1952). *J.Amer.med.Ass.* **149,** 1196
[44] Stark D C C, Green C A, and Pask E A (1962). *Anaesthesia* **17,** 12

(*c*) *Equipment into which the Patient breathes, but which does not come into contact with the Respiratory Tract* A requirement that a freshly sterilized mask, expiratory valve, breathing tube and reservoir bag should be provided for every patient on a busy out-patient or dental operating list would be difficult indeed to meet.[45] There is little or no good evidence in the literature of the transmission of infection from patient to patient via an anaesthetic machine.[46] Experimental work[47] suggests that when heavily infected bacterial aerosols are ventilated into an anaesthetic machine, comprising the standard McGill arrangement or a circle absorber circuit, it is difficult to recover any heavy concentration of bacteria from the machine by subsequent ventilation simulating the breathing of a patient. Thus it seems reasonable to concentrate effort first upon the anaesthetic equipment considered under the headings (*a*) and (*b*) above. Masks should be cleansed by thorough washing with soap and water between uses.[48] Disinfectants appear to be absorbed and concentrated in the material from which the masks are made, and the conditions of warmth and pressure existing under the mask may predispose to irritation of the skin. Though there is no direct evidence of it, it seems reasonable that if the breathing tube and reservoir bag are allowed to become dry, as might occur if they are unused overnight, it may be easier for the patient's breathing to extract from them any infected material which lies upon their walls. These components should be thoroughly washed, at least each day. Special equipment should be reserved for patients known to have open tuberculosis, staphylococcal pneumonia, etc.

Maternity

194 The provision of sterile supplies for maternity hospitals is unlikely to raise any problems. At Cambridge, it has been found that the needs of the theatres and lying-in wards can all be met from the general range of theatre and ward supplies. A specially designed pack is however necessary for delivery, and should contain everything likely to be used, with the exception of instruments, for both mother and child. The instruments should be sterilized locally.

[45] Zeigler C, and Jacoby J (1956), *Anaesthesia and Analgesia—Current Researches* **35,** 451
[46] Stemmermann M G, and Stern A (1946), *Amer.Rev.Tuberc.* **53,** 264
[47] Stark D C C, Green C A, and Pask E A (1962), *Anaesthesia* **17,** 12
[48] McCallum F O, and Noble W C (1960), *Anaesthesia* **15,** 307

Appendix A

Furniture and Supplies Used in the CSSD at Cambridge

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Wash Room	1	Stainless steel soaking sink	Dent & Hellyer Ltd, 4 Golden Square, London, W.1	£75 each	Two sinks are required 43″ long, 16″ wide, 22″ deep—2″ waste—large taps
	2	Under-bench cupboard and drawer unit	Kerridge Ltd (Cambridge), Sturton Street, Cambridge	—	For storing washing powder, bottles, etc.
	3	Under-bench waste unit	As for Serial 2	—	
	4	Steel locker	Office Equipment	—	For protective clothing
	5	Hand towel dispenser	Kimberly-Clarke Ltd, Larkfield, Maidstone, Kent	—	
	6	Detergent non-foaming	Joseph Crossfield & Sons Ltd, Warrington	£3 per cwt.	For use in the Heinicke washer
Glove Room	7	Glove processing bench	As for Serial 2	—	
	8	Disposable surgical gloves	London Rubber Industries Ltd, Hall Lane, Chingford, London, E.4	1/9d. per pair	
	9	Rotary glove mending solution	Manlove Alliott, P.O. Box 81, Bloomsgrove Works, Nottingham	—	
	10	Glove powder sachets	Ethicon Ltd, Bankhead Avenue, Edinburgh 11	16/- per gross	
	11	Glove wallets	E. S. & A. Robinson Ltd, Bristol 1	—	
	12	Glove outer bags	As for Serial 11		

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Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Work Room	13	Pack assembly bench	As for Serial 2	—	
	14	Under-bench single-bin unit	As for Serial 2	—	Can also be used for disposal
	15	Under-bench double-bin unit	As for Serial 2	—	
	16	Linen inspection and folding table	As for Serial 2	—	
	17	Unsterile pack cupboard	As for Serial 2	—	
	18	Linen cupboard	As for Serial 2	—	
	19	Nu Parc chair	Edgleys Ltd, 151 Fleet Street, London, E.C.4	£5	
	20	Shelving	Spur Shelving, Standard Range and Foundry, Watford, Herts.	—	
	21	Bripac cardboard boxes	Smith & Nephew (Southalls) Ltd, 5/7 Singer Street, London, E.C.2	—	
	22	Paper bags	As for Serial 11	—	
	23	Paper sacks	William Palfrey Ltd, The Esplanade, Rochester, Kent	—	
	24	Kleenex dressing towel for wrapping	As for Serial 5	—	Suitable for wrapping ward dressing packs, and for dressing towels
	25	Kleenex dressing towel for hand drying	As for Serial 5	—	
	26	Sterilwrap paper	Bowater Scott Corporation Ltd, Bowater House, Knightsbridge, London, S.W.1	—	Suitable for wrapping theatre packs
	27	Ventile material	John Southworth & Son Ltd, Clitheroe, Lancashire	10/- per yard	A water repellent cotton, suitable for theatre use

**The prices quoted are those obtaining in* 1959/60. *They are for indication only. Current prices can be obtained from manufacturers.*

Location	Serial No.	Item	Source of Supply	Price approx.	Remarks
Work Room (Cont.)	28	Pressure sensitive tape	Minnesota Mining & Manufacturing Co., Ltd, 3M House, Wigmore Street, London, W.1	—	As well as being adhesive the tape indicates whether it has been autoclaved
	29	Bag and box marker	Speedry Magic Marker	—	Obtainable from any stationers
	30	Pencil for notice board	W. H. Smith & Sons	—	Van Dyke, Multi 666 (Eberhard Faber)
	31	Klintex papers	R. Whitelaw & Co., Ltd, 44 Great North Road, Newcastle-upon-Tyne	—	Used to indicate whether goods have been through the autoclave
	32	Aluminium foil dishes	Prestige Group Ltd, Prestige House, 14–18 Holborn, London, E.C.1	—	To replace stainless steelware in the wards
	33	Polypropylene bowls	A. W. Gregory & Co., Ltd, 4 Great St Thomas Apostle, London, E.C.4	—	To replace theatre stainless steel bowls. 6″ bowl costs 1/6d
Syringe Room	34	Aluminium containers	W. H. Bailey & Son Ltd, Medical Supply Association, Wigmore Street, London, W.1	—	For syringes and ward instruments
	35	Container Capsules	Ideal Capsules Ltd, Edinburgh Avenue, Slough, Bucks	—	Pleated type
	36	Container capsules	The Alka Company, Maxwell Way, Gatwick Road, Crawley, Surrey	—	Milk bottle type
	37	Syringes	Chance Bros. Ltd, Glass Manufacturers, 29 St James's Street, London, S.W.1	—	All glass—interchangeable—metal nozzle
	38	Ward instruments	As for Serial 34	—	
	39	Tiered baskets	Hardware Stores	—	
Sterile Store Room	40	Metal cabinet for catheter storage	Office equipment	—	
	41	Storage cupboard	As for Serial 2	—	

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Sterile Store Room (Contd.)	42	Disposable catheters	William Warne & Co., Ltd, India Rubber Mills, Barking, Essex	—	
	43	Disposable Gordh adaptors	Shrimpton & Fletcher Ltd, Surgical Needle Makers, Premier Works, Redditch, England	—	
	44	Disposable blood sugar needles	As for Serial 50	—	
	45	Disposable blades	Swann-Morton, W. R. Swann & Co., Penn Works, Oulerton Green, Sheffield 6	—	
	46	Disposable nylon cannula for venous infusion	As for Serial 42		
	47	Disposable Guest-type cannula	Capon Heaton & Co., Ltd, Hazelwell Mills, Stirchley, Birmingham 30	—	
	48	Disposable hypodermic needles	Gillette Industries Ltd, Isleworth, Middlesex	—	See paragraph 45 (a) for cost
	49	Sutures, silk, nylon, catgut (atraumatic)	Ethicon Ltd, Bankhead Avenue, Edinburgh 11	30/- per dozen	Obtainable double-wrapped especially suitable for issue to wards, casualty, etc.
	50	Sutures, silk, nylon (atraumatic)	Armours Suture Laboratories, Hampden Park, Eastbourne		
	51	Sutures, silk, nylon, catgut (atraumatic)	Cyanimid of Gt. Britain, Ltd, Gosport Plant, 15 Fareham Road, Gosport, Hants.		
Bulk Store	52	Adjustable shelving	Dexion Limited, Maygrove Road, London, N.W.6	—	
Superintendent's Office	53	Filing cabinet	Office equipment	—	
	54	Uniplan desk	As for Serial 19	—	
	55	Armchairs	As for Serial 19	—	

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Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Rest Room	56	Table	As for Serial 2	—	
	57	Sink unit	As for Serial 2	—	
	58	Banquette	As for Serial 2	—	
	59	Cushions	Heal's Contracts Ltd, 196, Tottenham Court Road, London, W.1	—	
Cloak Room	60	Overalls	Practical Uniform Co., Ltd, Ora Works, Oldbridge Road, London, S.W.12	—	
	61	Shoe locker bench unit	As for Serial 2	—	
	62	Hand sinks, shower	As for Serial 1	—	
	63	Clothes hanging baskets	James Sieber Equipment Co., Ltd, Africa House, Kingsway, London, W.C.2	30/-	Each hanger holds an orderly's outdoor wear. A basket, with padlock, to hold valuables, is attached to the hanger

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Appendix B

Equipment Used in the CSSD at Cambridge

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Unloading Bay	1	Collection trolley	WCB Containers Ltd, Shepley Estate, Audenshaw, Manchester	—	
	2	Collection receptacles	Hardware store	—	
Wash Room	3	Heinicke Hydrojet washer	Heinicke Instruments Co., 2035 Harding Street, Hollywood, Florida, U.S.A.	£1,750	1. Requires a hot water supply at 25 lb., p.s.i. 2. Washing baskets are supplied to order
	4	Steril-Aqua water still	Drayton Castle, Ltd, Bridge Works, Bentinck Road, West Drayton, Middlesex	£500	Provides the distilled water rinse for Serial 3
	5	Rotary glove washer	Manlove Alliott, P.O. Box 81, Bloomsgrove Works, Nottingham	£200	A semi-automatic machine. Suitable also for washing catheters and tubing
	6	Rotary glove drier	As for Serial 5	£200	
	7	Ultrasonic needle washer	Dawes Instruments Ltd, 99 Uxbridge Road, London, W.5		
	8	Selecta spray gun catheter rinser	Rybar Laboratories Ltd, 6 Park Avenue, Tankerton, Kent	£16	
Glove Room	9	Rotary glove powdering machine	As for Serial 5	£200	
Work Room	10	High-speed automatic steam sterilizer	As for Serial 5	£3,200	

**The prices quoted are those obtaining in* 1959/60. *They are for indication only. Current prices can be obtained from manufacturers.*

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Work Room (Cont.)	11	British filter	British Filters Ltd, Maidenhead, England	£275	
	12	Pack tying machine	H. Kohler, Esq., Felins Tying Machine Co., 3351 North 35th Street, Milwaukee 161, Wisconsin, U.S.A.	£200	String for use with the machine can be obtained from the manufacturers. British manufacturer's name supplied at the end of this appendix
	13	Perforated aluminium trays	Light Alloy Construction Ltd, 625 North Feltham Trading Estate, Bedfont, Middlesex	£2	Used for the bulk handling of supplies. They withstand sterilizing temperatures
	14	Benesto boxes	As for Serial 1	—	For storing unsterile packs
	15	Trucks	H. C. Slingsby Ltd, 89 Kingsway, London, W.C.2	£25	For carrying Serial 13
	16	Stapling machine	Industrial Stapling & Packaging Ltd, 7 Rathbone Street, London, W.1	£130	For bag closure. Price includes an estimated year's supply of staples
	17	Heat sealing machine	A. H. Bland (Engineers) Ltd, Mitcham Works, Winchester Road, Harlesden, N.W.10	£44	For bag closure
Syringe and Instrument Room	18	Infra-red moving belt oven	Associated Electrical Industries Ltd, Trafford Park, Manchester 17	£550	For the sterilization of syringes and ward instruments. A hood is required to control the 'wild' heat
	19	Trays for loading, Serial 18	Industrial Lowerators Division, Conveyor Cafeterias Ltd, 13–16 Jacob's Well Mews, George Street, London, W.1	30/-	Measure 17″ × 17″, being optimum size for Serial 33
	20	Hot-air oven	Townson & Mercer Ltd, Beddington House, Croydon, Surrey	£122	Fitted with fan and boost heater. It is used for sterilizing special needles, etc.
	21	Capsuling machine	Ideal Capsules Ltd, Edinburgh Avenue, Slough, Bucks	£35 each size	For applying capsules to syringe and instrument containers, and needle tubes
	22	Air compressor	Ingersoll Rand Co., Ltd, 165 Queen Victoria Street, London, E.C.4	£200	For use with Serial 21. A 3 h.p. motor, operating at 200 lb. p.s.i.

**The prices quoted are those obtaining in* 1959/60. *They are for indication only. Current prices can be obtained from manufacturers.*

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Syringe and Instrument Room (Contd.)	23	Container moistener	As for Serial 21	—	
	24	Needle flushing tubes, perspex hood, and tray	Made in the hospital workshop	—	
	25	Syringe dispenser	Surgical Equipment Supplies Ltd, Westfields Road, W.3	£8	Used for syringe storage in the wards
	26	Sterile nail brush dispenser	Down Bros. & Mayer & Phelps Ltd, Church Path, Mitcham, Surrey	£8	For theatre use
	27	Perspex dispenser	Made in the hospital workshop	—	For storing miscellaneous items in the wards
	28	Needle sharpener	Matburn Ltd, Red Lion Street, London, W.C.1	—	
	29	Microscope	Hospital and Laboratory Supplies, 12 Charter House Square, London, E.C.1	£64	A binocular microscope, with 15 diameter magnification
	30	Sterile water flasks (round) Clik-O-Vac caps and collars	The MacBick Co., 243, Broadway, Cambridge 39, Mass., U.S.A.	£2 each	
	31	Sterile water flasks (square) caps and collars	Medical Supply Association, 95 Wimpole Street, London, W.1	£2 each	
	32	Baskets for carrying, Serials 30 and 31	Begg-Cousland, 136 Springfield Road, Glasgow, S.E.	30/-	Specially designed for handling, stacking and storing
Sterile Store	33	Unloader for Serial 18	As for Serial 19	£200	Holds 16 trays, allowing a pile-up period of over an hour
	34	Dolly for removing trays from Serial 33	As for Serial 19	£17	
	35	Delivery containers	Enfield Box Company, 38, Queensway, Enfield, Middx.	—	
Loading Bay	36	Delivery trolley	Made in the hospital workshops	—	
Bulk Store	37	Step ladder	Hardware store	—	

**The prices quoted are those obtaining in 1959/60. They are for indication only. Current prices can be obtained from manufacturers.*

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Cleaners' Cupboard	38	Floor scrubber, vacuum, and polisher	The Kent Floor Machine Co., Ltd, Speke, Liverpool 24	£230	This machine has an efficient filter

Manufacturers of other Equipment Referred to in this Book

Location	Serial No.	Item	Source of Supply	Price approx.*	Remarks
Work Room	39	Steam pressure water sterilizer	As for Serial 5	—	
	40	High-speed fluid sterilizer	Allen & Hanbury Ltd, Bethnal Green, London, E.2	£3,000	
	41	Pack tying machine	Messrs. Automatic Stripping Machines Ltd, 44 Uxbridge Road, Ealing, London, W.5	£200	String for use with the machine can be obtained from the manufacturers
	42	Apparatus for production of physio-chemical sterilized water	Messrs. Dearborn Pittam, The Adelphi, John Adam Street, London, W.C.2		The apparatus is not yet in production in this country but the prototype can be seen, and information obtained from the manufacturers

**The prices quoted are those obtaining in 1959/60. They are for indication only. Current prices can be obtained from manufacturers.*

Appendix C

Plan of the Central Sterile Supply Department at Addenbrooke's Hospital, Cambridge

COMMENTS

General

This is the department which has been the scene of the Trust's experimental work described in the preceding pages. It is a single-storey construction on a restricted site, which to some extent influenced the shape of the building. From this department it is hoped to serve up to a 1,000 beds. With the exception of the syringe room, there are few rooms in which changes have not been found necessary, for one reason or another. These are described in detail below.

Particular

(*a*) *Wash Room* The Heinicke washing machine takes up a lot of space, and this has caused the wash room to be rather too small for convenience. The glove room and wash room have therefore been combined and an additional soaking sink added. (Disposable gloves are used at Cambridge, thus making the glove room available for this purpose.) This additional space has made the wash room about the right size.

(*b*) *Work Room* Many alterations have been made to this room.

(i) The walls between the laboratory and work room have been dismantled, making one large work room. The general area of the laboratory is now used for the inspection and folding of linen, and the assembly of theatre packs.

(ii) No unsterile store was originally planned for, so storage for unsterile packs has had to be provided round the walls of the work room. This is not so satisfactory an arrangement as, for example, a properly organized unsterile store.

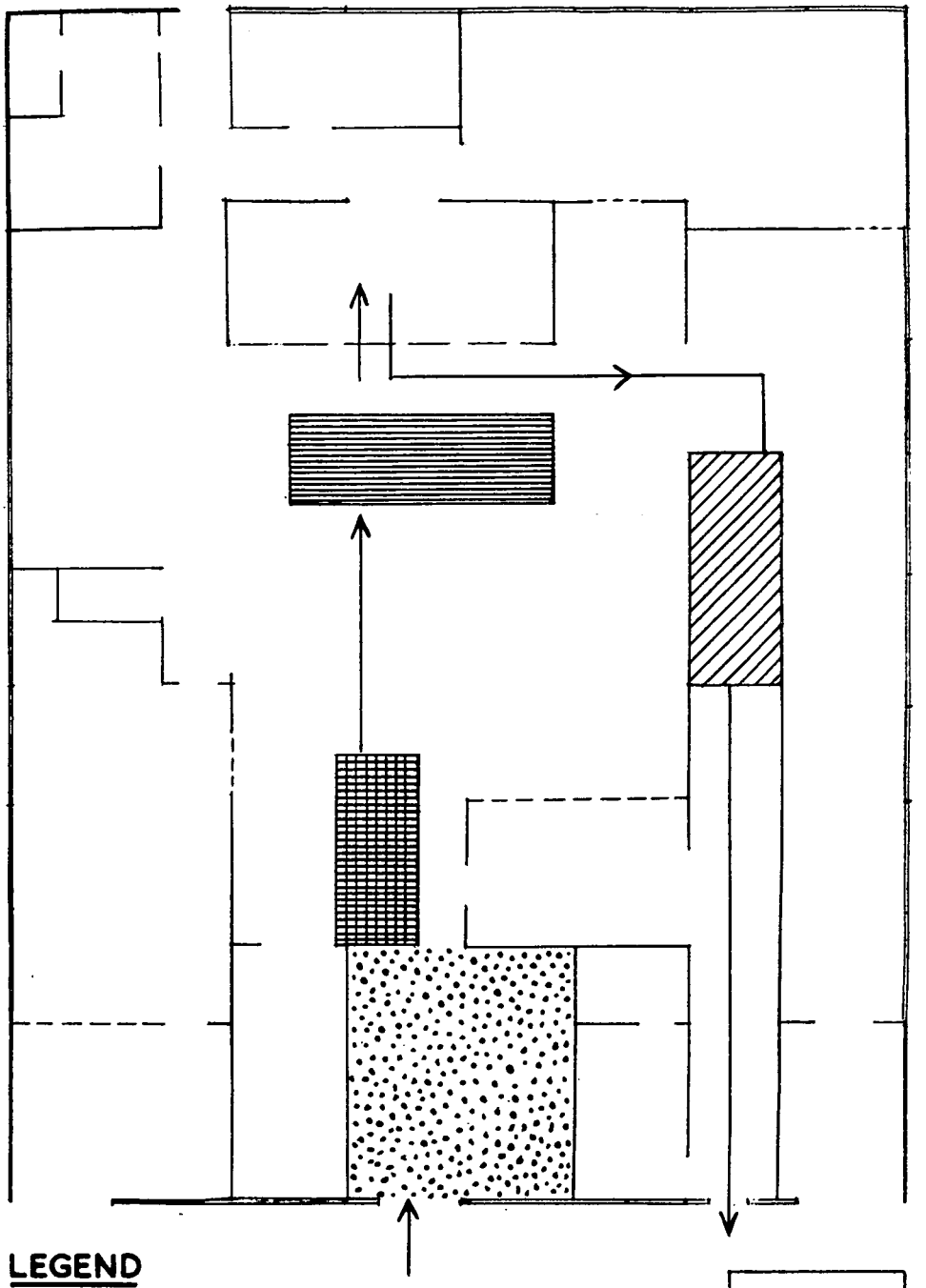
(iii) The volume of clean cardboard boxes being returned has meant that the entrance originally intended for the reception of clean supplies has now had to be wholly reserved for returned cardboard boxes. The general organization for dealing with them is described in paragraph 64, and the different areas over which this work is spread is shown on the trace attached to Plan 2 opposite.

(*c*) *The Autoclave Space* Space for a third autoclave was originally allowed. This space is not required for an autoclave and it has been made available for the storage of clean packs.

(*d*) *Sterile Store* Consequent on the policy of sterilizing on receipt of a requisition rather than in advance of it, some reduction in the space of the sterile store has been possible. This unwanted space has been incorporated in the bulk store. The alterations made are also shown on the trace attached to Plan 2.

(*e*) *Bulk Store* A further entrance direct to the bulk store has been made. This allows returning linen, and stores from the hospital's general store to be taken direct into the bulk store.

(*f*) *Ancillary Rooms* These are, in general, too small.



LEGEND

ROUTE OF CARDBOARD BOXES

RECEPTION FOR CARDBOARD BOXES

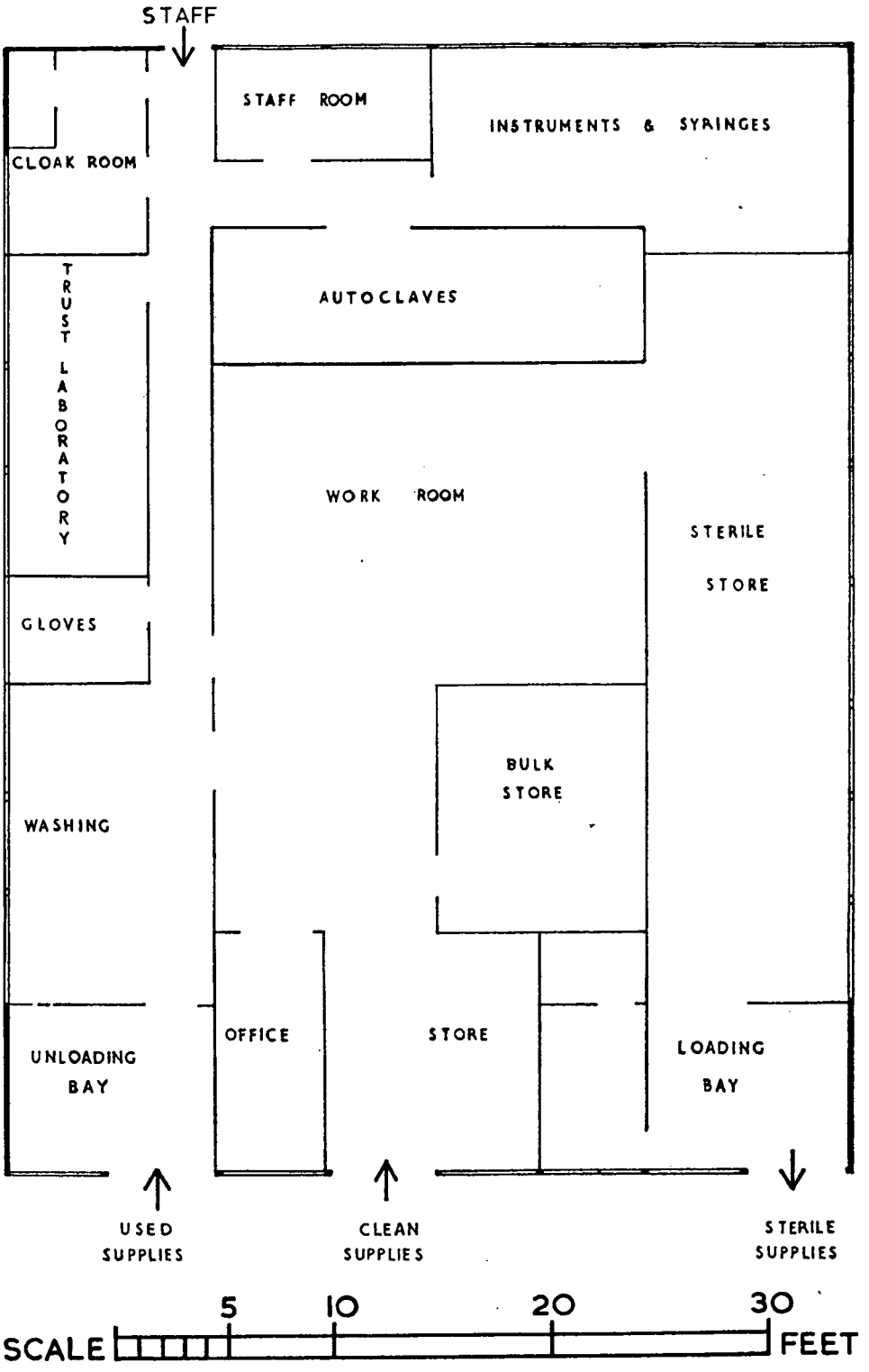
BOX FILLING AREA

AUTOCLAVING AREA

STERILE STORE

Plan 2

Experimental Central Sterile Supply department Addenbrookes Hospital Cambridge



Plan of the Central Sterile Supply Department at the Knightswood Hospital, Glasgow

COMMENTS

General

This CSSD is being constructed at Knightswood Hospital, Glasgow to serve the Western Infirmary, which is three miles distant; no suitable place being available there. It is the intention that this department shall progressively serve up to as many as 10,000 beds in the vicinity.

Particular

(*a*) Contaminated articles will arrive by van at the used articles entrance.

(*b*) Goods from the laundry and the manufacturers will come in the clean goods entrance.

(*c*) After washing-up in the wash room the re-usable goods will be combined with the clean goods, from the bulk store, in the syringe and instrument room and the packing area. From the packing area they will go into the unsterile pack store, thence via the sterilizers to the sterile store where the hot-air sterilized goods will join up with them. The plan therefore envisages a logical work flow through the department.

(*d*) The following features will be noted in particular.

(i) A space of some 1,000 square feet is available for the future extension of either the bulk store or the packing area.

(ii) An unsterile pack store of about 500 square feet is provided. The clean packs will go straight from the unsterile store into the autoclaves and will then wait only a very short time in the sterile store before being despatched.

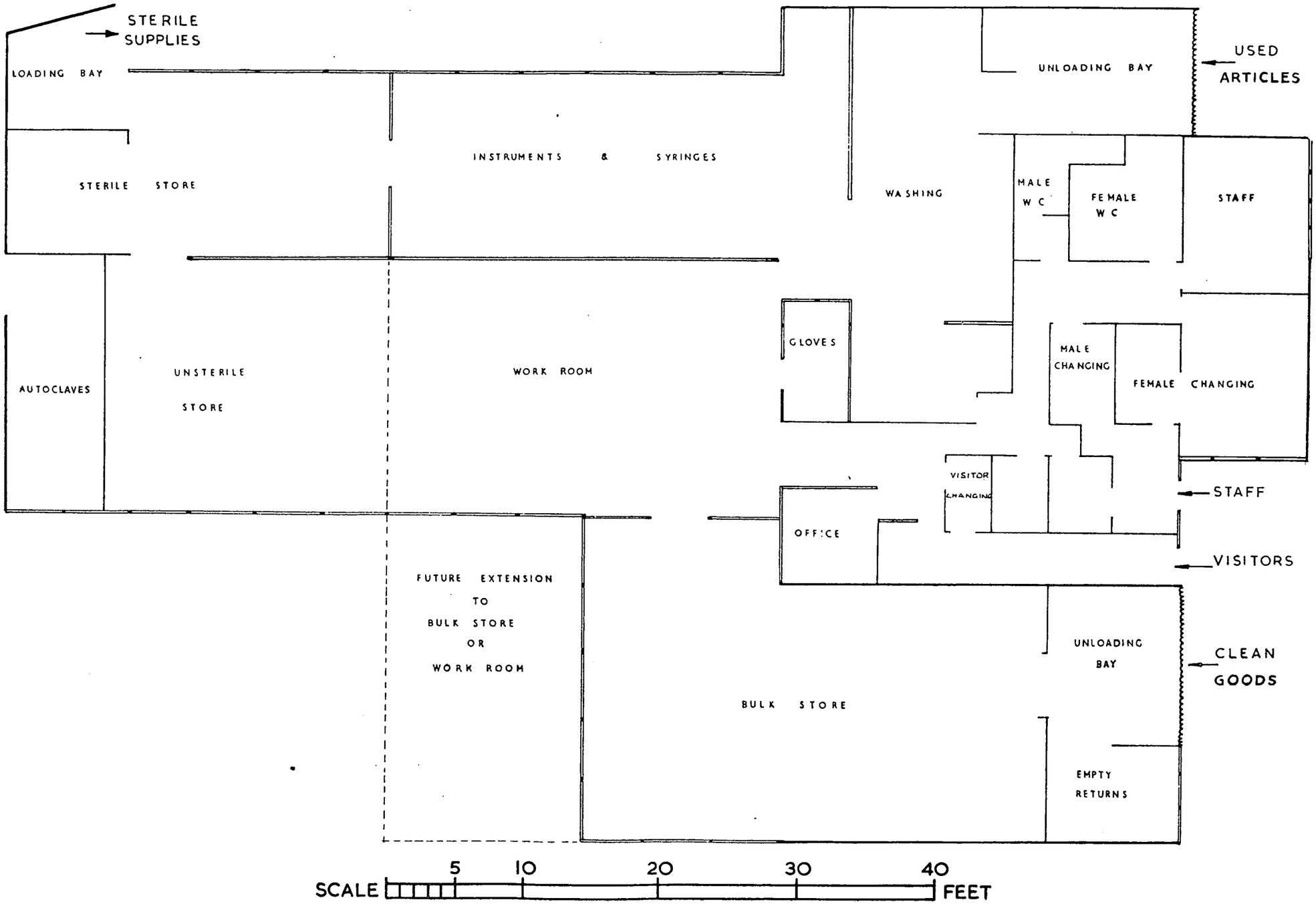
(iii) Adequate provision away from the main working area of the department has been allowed for staff changing and rest rooms. Staff must move through the changing areas before getting to their work, although it is possible for visitors to go straight to the superintendent's office which is centrally placed both for the convenience of visitors and to assist supervision of work.

Remarks

This department gives the impression of having been carefully thought out and planned in the light of knowledge available in 1961. It provides an excellent example for the larger types of CSSD likely to be seen in future.

Plan 3

Proposed Central Sterile Supply department Knightswood Glasgow



Plan of the Central Sterile Supply Department at Musgrave Park Hospital, Belfast

COMMENTS

This department forms part of an experimental building extension to Musgrave Park Hospital, Belfast. It is intended to serve the 600 beds in the hospital. In this two-storey block, one section consists of the ground floor of an X-ray Department and the CSSD; above them is a twin-operating theatre suite. The shape of the department was dictated by the available space adjacent to the X-ray department, and under the theatre suite above, and by the type of construction, i.e. main structural bays 20 feet × 10 feet divided by double partitions encasing vertical service ducts.

The following comments upon the layout and provision have been made as a result of two years' working experience.

(*a*) *Reception and Clean-up* This could be smaller. Two pairs of sinks and an ultrasonic cleaner are adequate.

(*b*) *The Instrument Repair Room* Instruments are not maintained within the hospital. This room is now used for glove processing to limit the aerial spread of powder.

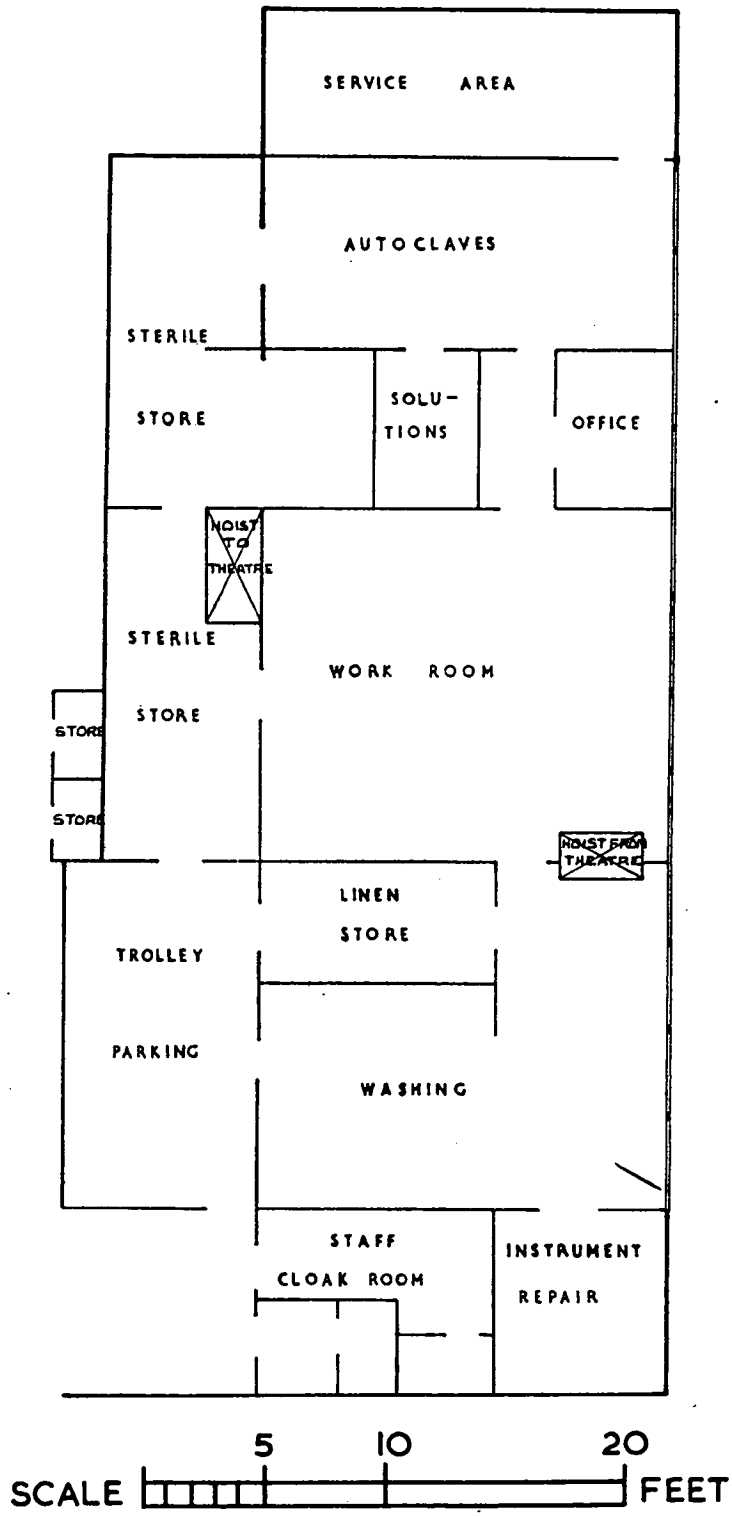
(*c*) *The Work Room* It is a disadvantage having linen storage in an adjacent room with insufficient inspection and folding space in it. The work room could be slightly wider overall as well as containing this area. Built-in packing stations have been removed in favour of specially designed free-standing packing stations.

(*d*) *The Solution Room* This is used for filling large containers with distilled water. The stills should, in the light of present knowledge, be installed over the clean-up sinks.

(*e*) *The Autoclave Room* The pressure steam sterilizers are much larger (50 and 60 cubic feet respectively) than required.

Plan 4

Central Sterile Supply department
Musgrave Park Hospital Belfast



Plan of the Central Sterile Supply Department at the Royal Infirmary, Sunderland

COMMENTS

General

The Sunderland Royal Infirmary is one of the principle but not the largest hospital in its Group. During 1957 and 1958 some members of the medical staff of the Group had been particularly active in improving the sterilization techniques in several of the hospitals. They received a grant from the Nuffield Provincial Hospitals Trust to take their work further and introduce a CSSD experimentally. The following factors influenced the plan of the CSSD.

(*a*) No money was available to set up a large CSSD for the Group, but with the funds provided by the Trust 1,400 square feet of old attic rooms could be adapted, and a small CSSD thereby established to serve the 300 beds in the Royal Infirmary.

(*b*) The area available for the CSSD was so limited that all possible steps had to be taken to reduce the amount of work to be done in it. This was achieved in the following ways:

(i) Dressing and procedure techniques in the wards were carefully studied; equipment and methods were rationalized;
(ii) The policy was adopted of maximum use of disposable equipment;
(iii) To save storage space in the CSSD disposable items were issued direct to the user from central stores and pharmacy. Bulk stores for the CSSD were also held elsewhere in the hospital.

These measures so reduced the amount of work required to run the service that it could be accommodated in the space available.

Particular

(*a*) By giving time and thought to the study of dressing techniques and procedures the hospital has achieved a notable measure of standardization and simplification.

(*b*) Washing and drying of re-usable equipment is done on the first floor. The contaminated processes are therefore kept separate from the clean work and sterile storage which are on the second floor.

(*c*) Syringes, rubber tubing, catheters, gloves and hypodermic needles are all disposable and are not dealt with in the CSSD.

(*d*) Delivery and collection are undertaken twice daily.

Remarks

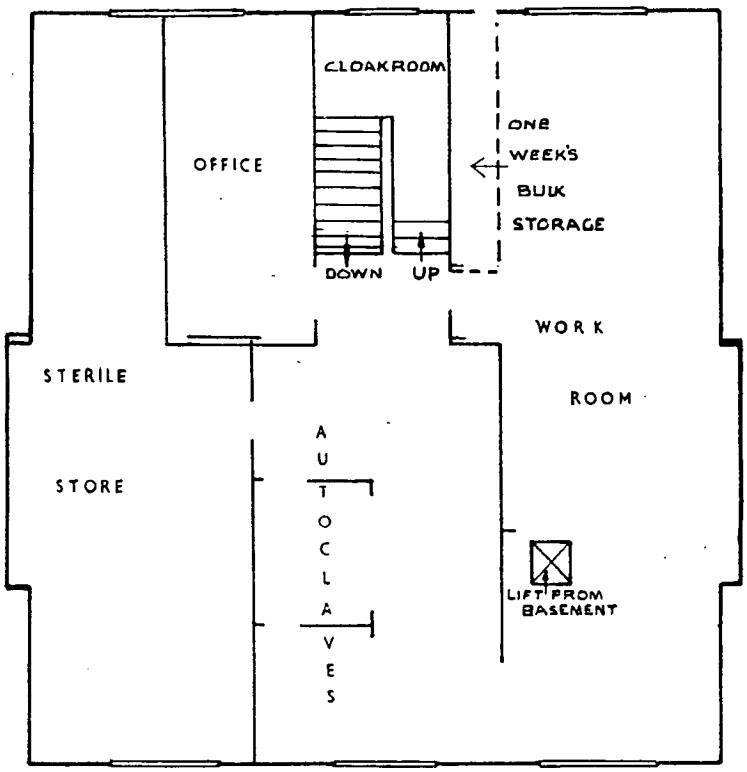
This is a highly individual CSSD suited to the particular requirements of the Royal Infirmary. If it were possible to extend the service to other hospitals in the Group, it is likely that the organization would have to be recast. For example, the following points would require consideration:

(*a*) It would be difficult to ensure that medical and nursing staff outside the Infirmary were adequately familiar with and sympathetic to the special dressing technique used there. The technique allows no sterile working surface other than that afforded by the cardboard box which holds the sterile supplies.
(*b*) The service of delivery and collection would have to be replanned paying due regard to economy of labour. At present one person spends three hours a day on this task.
(*c*) An efficient labour force could not be built up from the cadet labour which is employed at present.
(*d*) Given the facilities of a larger department, syringes could be more cheaply reprocessed than disposable syringes can be bought.
(*e*) The packaging method which allows a single layer only of cardboard as protection against contamination would have to be supplemented.

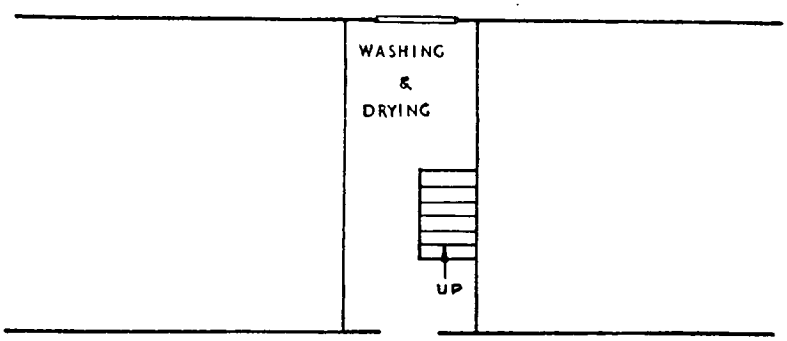
It is thought that in the long run a higher level of efficiency and appreciable financial economies would result from the establishment of a larger department for the Group rather than a series of small departments for each hospital in the Group.

Plan 5

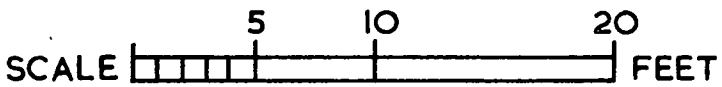
Central Sterile Supply department
Royal Infirmary Sunderland



Second floor layout



First floor layout



Plan of the Central Sterile Supply Department at The General Hospital, Birmingham

COMMENTS

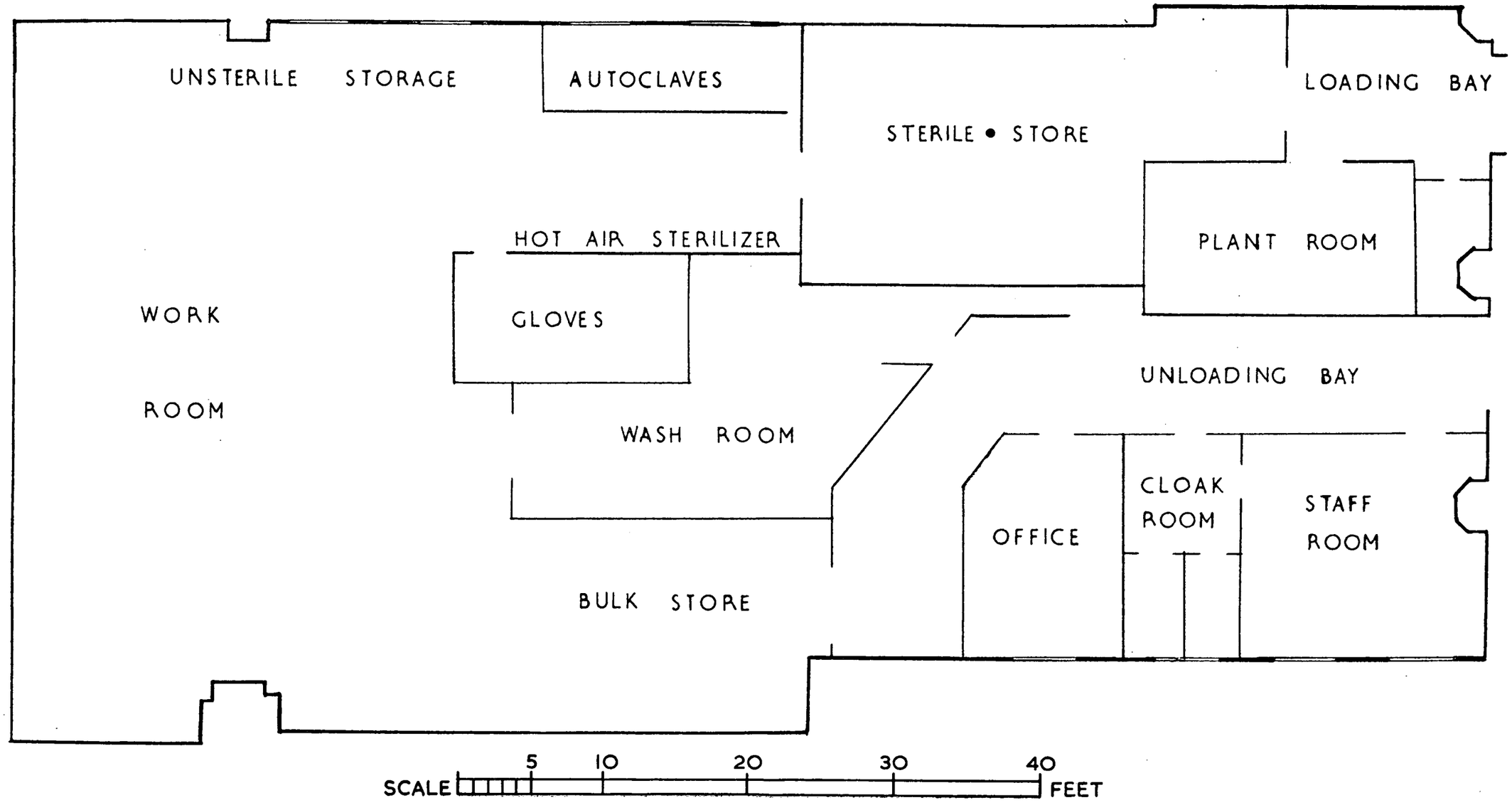
General

This department, which has been under construction for some time, has been adapted out of an old hardware store in the basement of the General Hospital, Birmingham. Structural work is nearly finished and it is hoped that the department will be open early in 1962. The work has been assisted by a grant from the Nuffield Provincial Hospitals Trust.

It is intended to serve 360 beds and large out-patient and casualty departments from this CSSD. Bulk storage is available elsewhere in the hospital.

Plan 6

Central Sterile Supply department
The General Hospital Birmingham



Plan of a Central Sterile Supply Department for the Wessex Region

COMMENTS

General

Opposite is a plan of a sub-regional sterile supply centre for the Wessex Region. It is still only in the project stage. The centre would cover the whole of Portsmouth, Southampton, Winchester, Basingstoke, Alton, and the Isle of Wight, that is five hospital management groups and two mental hospital groups.

Particular

(*a*) The department is to be sited on a hillside which allows a split-level building. The ground floor only is shown. The first floor is devoted to storage, rest rooms and offices.

(*b*) Bulk stores and articles received pre-packed and sterile from manufacturers are delivered directly to and stored on the first floor. These items reach their respective areas of use via lift or a chute.

(*c*) The system is based on a one-for-one exchange principle whereby a fresh pannier of supplies is exchanged daily for a used pannier.

(*d*) There is no provision for an unsterile pack store. With a one-for-one exchange, it is felt to be superfluous. There are, however, limited pile-up areas at the end of each production line for goods awaiting sterilization.

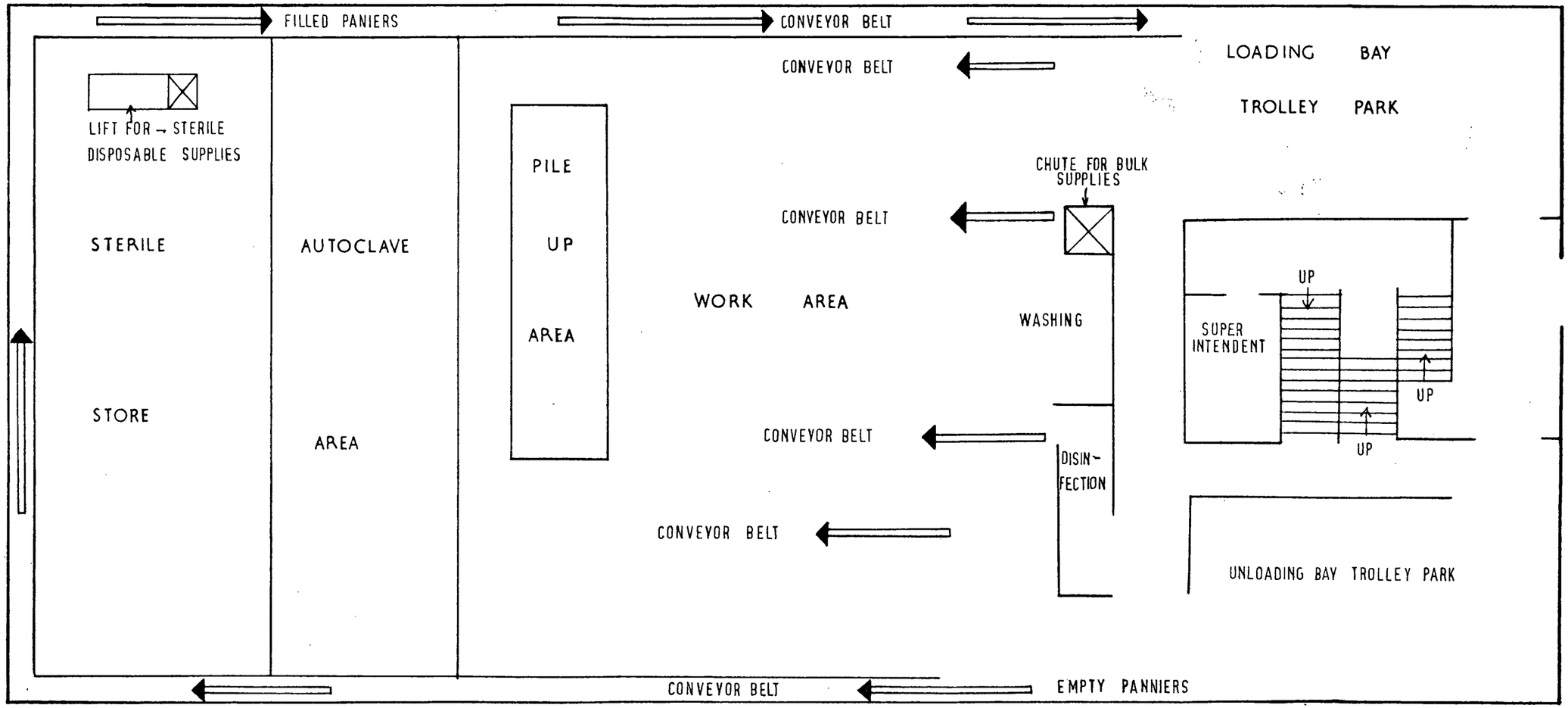
(*e*) The plan is a very highly organized one and for its successful execution depends on a large number of moving belts which feed towards the autoclaves, and indeed right round the building.

Remarks

The plan requires the labour in this building to be efficiently organized and constant so far as output is concerned. The department is thus geared to a particular speed of working and organization. It is debatable whether sufficient data exists on which to plan such a highly organized CSSD and whether a less tightly tailored department might not prove more flexible in practice. This department provides the maximum contrast with that of, say, the Royal Infirmary, Sunderland. It is for consideration whether something midway between these two extremes might not prove the better choice. Nevertheless the establishment of such a centre serving several hospital management groups will provide a large-scale experiment from which much should be learned. This is referred to in the Foreword of this book.

Plan 7

Projected Central Sterile Supply department
Wessex Regional Hospital Board



Appendix D

Efficiency of the Hydrojet Washing Machine

The Test

To assess the efficiency of the Hydrojet washing machine tests using special albumen labelled with radioactive iodine were carried out with the help of D. G. Chalmers, of the Department of Pathology, Cambridge. Chalmers evolved the following technique for the tests. Small batches of between five and twelve syringes were taken out of routine use, bundled together and treated as a unit, when the radioactivity was counted. The size of the batch was found to be convenient to handle for counting and helped to eliminate individual variation. The radioactivity was measured in a counter consisting of a ring of six matched G.M. tubes linked to a clinical monitor. After the first test, it was found that a convenient marker was I^{131} labelled albumen with an activity of 200 μc. This was about 0·5 ml. and was diluted to 2 ml. with normal human plasma. The syringes were filled and emptied once with this contaminant, and then left untouched for three or four hours. The syringes were then rinsed out three times in water and an initial count taken. (Without this rinsing the initial counts would have varied more from batch to batch, and accuracy would have been more difficult to achieve.) It also seemed reasonable in a study of washing to include in the initial count only material that was adherent to the glass. The final counts were corrected against a I^{131} standard to allow for radioactive decay.

The Results

The first test was intended to establish the technique and compare Hydrojet washing with hand washing. The total activity used was too high to be counted conveniently and the results obtained were not in line with those of the tests that followed.

The second test involved two batches of syringes. One batch was washed first in the machine and secondly by hand, and the other batch vice versa. Neither batch was soaked. The percentage of albumen remaining after mechanical washing was 8·6; after hand washing 9·3; and after both treatments, for both batches combined, it was 9·3. In these conditions mechanical washing was as effective as hand washing, but no better.

In the third test the effect of soaking prior to washing was investigated, using three batches of syringes, one soaked overnight in pyroneg, one soaked overnight in savlon, and one batch given no soaking. For both batches receiving soaking, this was done with the plunger and barrel separate. After the mechanical washing the percentage of albumen remaining in the batch soaked in pyroneg was 7·7; in the batch soaked in savlon 3·3; and in the batch receiving no soaking 8·3. It seemed that soaking overnight in savlon has a small effect.

In the fourth test the soaking procedure described for the third test was repeated on one batch. The other two batches were left overnight and then soaked in savlon for five hours with the barrel and plunger separate. They were then washed in the Hydrojet, the last batch receiving an extended washing time of eleven minutes. After overnight soaking the percentage of albumen remaining was 7·6; after five hours' soaking 4·4; and after five hours' soaking and an extended wash 7·8. For tests of this nature the very small differences in the figures are not significant. The results of the tests are summarized in Table 12 below:

Table XII Summary of results

Soaked	*Washed by*	*Percentage of albumen remaining*
None	Machine	8·6
		8·3
None	Machine and hand	9·3
None	Hand	9·3
Overnight in pyroneg	Machine	7·7
Overnight in savlon	Machine	3·3
		7·6
5 hours in savlon	Machine	4·4
5 hours in savlon	Machine (extra time)	7·8

Discussion

The albumen used is guaranteed to contain not more than 2 per cent of unbound iodine. It was noted that the final counts were close to 2 per cent of the original activity, and such results would be obtained if the unbound iodine leeched to the glass, even though all the protein had been removed in the washing process. A control batch of syringes was therefore contaminated with 2 ml. of plasma containing 4 μc. of free sodium iodine, that is a similar solution of unbound iodine, but in ordinary plasma that would leave no activity in the syringes if it were not removed. It was wished to see whether all this unbound iodine would leech to the glass. The batch was tested in parallel with a batch contaminated with labelled albumen, as before. The results showed that some 10 per cent of the unbound iodine was not removed by washing and was presumed to have leeched to the glass. The residual activity in the test batch must therefore be due to protein containing iodine, as leeching can be discounted at levels in excess of 10 per cent of 2 per cent, that is 0·2 per cent, of the initial activity.

The results of these tests, using labelled albumen, show that even with prior soaking washing in the Hydrojet does not produce 100 per cent clean syringes. The tests indicate, however, that the result of washing in the Hydrojet machine under 'production' conditions are probably as good as manual washing under 'laboratory' conditions.

Appendix E

Basic Dressing Packs

The range of packs and their contents listed below meet the basic needs of the following specialities:

(*a*) Medical
(*b*) Surgical
(*c*) Gynaecology
(*d*) Paediatrics
(*e*) Neurosurgery
(*f*) E.N.T.
(*g*) Obstetrics
(*h*) Ophthalmology
(*j*) Orthopaedics
(*k*) Plastic surgery
(*l*) Urology

WARDS

1 *Large pack*

1 outer wrap	(20″ × 30″)
1 dressing towel	(20″ × 30″)
2 cotton wool squares	(8″ × 12″)
4 gauze swabs	(4″ × 4″ × 16 ply)
1 foil gallipot	
6 wool balls	(large size)

2 *Medium pack*

1 outer wrap	(20″ × 30″)
1 dressing towel	(20″ × 30″)
6 gauze swabs	(4″ × 4″ × 16 ply)
2 foil gallipots	
6 wool balls	(large size)

3 *Small pack*

1 outer wrap	(20″ × 15″)
1 dressing towel	(20″ × 15″)
2 gauze swabs	(4″ × 4″ × 8 ply)
1 foil gallipot	
2 wool balls	(large size)

4 *Swabbing pack*

1 outer wrap	(20″ × 30″)
1 dressing towel	(20″ × 30″)
1 foil bowl	(small)
12 wool balls	(large size)

5 *E.N.T. pack*

As for medium pack, but with B.P.C. quality wool balls substituted for hospital quality.

6 *Eye pack*

1 outer wrap	(20″ × 15″)
1 foil gallipot	
4 lint squares	($1\frac{1}{2}$″ × $1\frac{1}{4}$″)

7 *Neurosurgical pack*

1 outer wrap	(20″ × 30″)
2 dressing towels	(20″ × 30″)
2 gallipots	
8 mastoid strips	
4 gauze pieces	(12″ × 36″)

THEATRES

The contents of theatre packs are not listed. No attempt has been made to describe them because terminology and draping techniques vary from hospital to hospital. Surgeons and theatre sisters should decide for themselves how best to standardize the numbers and the sizes of the contents of their packs.

Appendix F

Supplementary Packs

The list below gives details of the packs required to supplement the basic dressing packs:

DRESSINGS	No. in paper bag
Absorbent pads	1
Cotton wool balls	4
„ „ squares	2
Dressing towels—paper	1
E.N.T. pellets	6
Eye pad—single	1
„ „ —double	1
Gauze ribbon (½″ × 36″)	1
„ „ (1″ × 36″)	1
„ roll (4″ × 108″)	1
„ „ (8″ × 108″)	1
„ swabs (4″ × 4″ × 8 ply)	4
„ „ (4″ × 4″ × 16 ply)	6
Kleenex tissues	1
Lastonet (6″ × 12″)	1
Medical wipes	1
Sanitary pad	1
Wicks—small	24
„ —large	24

CATHETERS	
Barium	1
Bronchoscopy	1
Dowse (6 eg.)	1
„ (8 eg.)	1
Eynard (16 eg.)	1
„ (18 eg.)	1
„ (20 eg.)	1
„ (22 eg.)	1
Foley (5 ml. 12 fg.)	1
„ (5 ml. 14 fg.)	1
„ (5 ml. 16 fg.)	1
„ (5 ml. 18 fg.)	1
„ (5 ml. 20 fg.)	1
„ (5 ml. 22 fg.)	1
„ (5 ml. 24 fg.)	1
„ (5 ml. 26 fg.)	1
„ (30 ml. as for 5 ml.)	1
Flatus	1
Jaques (4 eg.)	1
„ (6 eg.)	1
„ (8 eg.)	1

CATHETERS—*continued*	No. in paper bag
Jaques (12 eg.)	1
„ (16 eg.)	1
Rectal	1
Ryle—Simplastic	1
„ —Rubber	1
Stomach (12 eg.)	1
„ (18 eg.)	1
Suction	12
Tieman (14 fg.)	1
„ (16 fg.)	1
„ (18 fg.)	1
„ (20 fg.)	1
Gibbon	1

RUBBER TUBING	
Corrugated (6″ × 1″)	3
Drainage (No. 7 × 42″)	2
„ (No. 10 × 42″)	2
„ (No. 12 × 42″)	2
„ (Lane's) (No. 9 × 42″)	1
Pressure (42″)	1

DRAINAGE BOTTLES	
Bile—10-ounce	1
Chest	1
Lane's	1
Sputum trap	6
Wolff	1

E.N.T. INSTRUMENTS	
Antrum trochar and cannula	1
Aural dressing forceps	1
„ speculum	1
Jobson Horne probe	1
Laryngeal mirror	1
Myringotome	1
Nasal dressing forceps	1
„ speculum	1
Rhinoscope mirror	1
Tongue depressor	1

MISCELLANEOUS	No. in paper bag
Adaptors, luer-record	1
„ polythene	1
Aluminium foil tray	1
„ „ gallipot	1
„ „ receiver	1
Breast pump	1
Burette and bung	1
Cannula, polythene	1
Catheter, adaptor	1
„ holder	1
„ introducer	1
Connections, drip	1
„ glass	1
„ metal covered	1
„ plastic	1
„ 'Y'	1
Curettes	2
Dilators, urethral	1 set
Douche can	1
„ nozzle	1
Forceps, radium removal	1
Funnel, glass graduated	1
„ stainless steel	1
Gate clip	1
Gel nozzle	1
Gloves, 5½	1 pair
„ 6	„
„ 6½	„
„ 7	„
„ 7½	„
„ 8	„
Inhalor mouthpieces	12
Logan's bow	2
Manometer, Adson's	1
„ 'U' shaped	1
Measures, 2 pint	1
„ 1 pint	1
„ 2 ounce	1

MISCELLANEOUS—*continued*	No. in paper bag
Nail brushes	3
Oxford tubes	1
Penile clamp	1
Pipette	1
Razor	1
Safety pin, large	1
„ „ small	1
Speculum, Cuscoe	1
„ Simm	1
Spigot, large	1
„ medium	1
„ small	1
Sponge holder	1
Stopcock	1
Sutures, skin	1
„ catgut	1
Syringe, Canny-Ryall	1
„ Higginson	1
„ Martin	1
„ Riches	1
„ Wardell	1
Thermometer tubes	12
Undine	1

SETS	
Jugular vein	Box
Post-anaesthetic	„
Scalp vein	„
Senoran's evacuator	„
Skin clinic	„
Southey's	„
Sub-dural	„
Tracheostomy	„
Trochar and cannula	„
Trochar (Nelson)	„

Appendix G

Considerations Affecting the Selection of a Suitable Packaging Paper for Basic Dressing Packs

1 The paper used for wrapping dressing packs should have the following qualities:

(*a*) It should allow efficient penetration of steam.

(*b*) It should be of adequate wet strength to withstand the sterilizing process.

(*c*) It should provide an efficient bacterial barrier between atmosphere and the sterile materials it encloses.

(*d*) It should be comformable and possess as good a drape as cloth.

(*e*) It should, without sacrifice of drape, be sufficiently water-repellent to prevent liquid from passing through.

2 Let us consider each of these qualities in turn.

(*a*) *Penetration of Steam* Little difficulty is likely to be encountered under this head. In high-vacuum autoclaves steam can penetrate easily round the folds and through the pores of most papers considered suitable for packaging.

(*b*) *Wet Strength* Most papers will meet this criterion. If they do not, manufacturers can improve them.

(*c*) *Bacterial Barrier* C. L. F. Hunter, P. E. Harbord, and D. J. Riddett have recently shown[49] how different papers vary in the resistance they offer to bacterial penetration and how this resistance can be affected by sterilization. They have also shown that almost any paper is a better bacterial barrier than cotton towels, which have for so long been accepted as satisfactory.

(*d*) *Conformability* It is a convenience to the nursing staff if the paper in which dressings are packed drapes well over the trolley (see photograph 50). More recently R. J. Fallon[50] has shown how soft conformable paper hampers the entry of dust into packs, even if the paper happens to be a poor bacterial barrier. It seems, therefore, that dust penetrates the packs more easily round the folds than through the pores of the paper.

(*e*) *Water-repellency* It is suggested that papers purporting to be water repellent should be tested and only adopted if found to be reliable in this respect.

3 At present the selection of a suitable paper for packaging has to be a compromise, since no single paper possesses all the qualities required. The manufacturers have approached the development of a suitable paper from two angles. One, by reducing the wet strength of a tough Kraft paper to a point where it becomes conformable; and the other by increasing the wet strength of a cellulose tissue so that its natural conformability is matched by the required degree of wet strength. Not much success has been achieved in improving the drape of Kraft paper and its limited draping qualities are still experienced. The treatment of cellulose tissue has, however, been more successful. The paper has been crêped to reduce porosity to an acceptable level, and a sheet has been formed of two- and three-ply, embossed at the edges. Messrs. Kimberly-Clark and Bowater-Scott have both produced a satisfactory wrapping paper by this process. Tests carried out with these two papers showed the three-ply paper to be a slightly better bacterial barrier.

4 To overcome the problem of using a non-water-repellent paper for those procedures where instruments are likely to be dampened, for example, intravenous cut-down, a sterile disposable foil dish is added to the trolley setting. This technique is illustrated in photograph 50. If an accident, such as spilling fluid on the sterile field occurs, the setting is discarded and a fresh pack opened.

5 Development of the right quality of paper to replace theatre cotton drapes is likely to be more difficult since theatre requirements must of necessity be more stringent than those of the wards, particularly with regard to water repellency. The combination of water repellency and drape must be achieved before paper has a use at the operating table.

[49] Hunter, C L F, Harbord, P E, and Riddett, D J, (1961), *Packaging Papers as Bacterial Barrier. Sterilization of Surgical Materials*, The Pharmaceutical Press, London, 166.

[50] Private communication from Dr R J Fallon, Department of Pathology, Ruchill Hospital, Glasgow.

Appendix H

Suitable Paper Bags for Packaging

There are four factors which affect the choice of a paper bag as a suitable wrapping medium for supplementary packs:

(*a*) The type of paper of which the bag is made.
(*b*) Its porosity and weight.
(*c*) Its wet strength.
(*d*) The form in which it is made up.

(*a*) Manufacturers are offering paper bags made up in many different types of paper. But the general opinion is that bleached Kraft is the most suitable.

(*b*) The porosity and the weight of the bleached Kraft is important. A balance must be established between adequate porosity to allow steam penetration on the one hand and the ability of the paper to provide an efficient bacterial barrier on the other. A Kraft paper weighing between 20 and 28 lbs. per Double Crown will be found a sufficiently strong paper with the necessary degree of porosity.

(*c*) Wet Strength—The bag should be of sufficient wet strength to withstand the sterilizing process. A manufacturer who supplies bags for packing items for sterilization will usually provide information on this point.

(*d*) The making up—It is important that the seam and fold of the bag should be formed accurately so that there is no direct entry for dust and bacteria, and that they should be adequately stuck. The glue used should withstand the high temperatures encountered during steam sterilization. As in the case of wet strength, manufacturers will usually ensure that due note is taken of these requirements.

If paper bags are to be obtained at a reasonable price, it is necessary to assist the manufacturers by standardizing the sizes of bags required to meet the packaging needs in central sterile supply departments. At Cambridge it has been found that the following six sizes are suitable for all the items which are packed in paper bags. The items are listed in Appendix F.

	Size	*Example of Item*
Ungusseted Bags	3″ × 3″	safety pins
	3½″ × 9″	douche nozzle
	6″ × 7½″	gauze swabs
Gusseted Bags	3″ × 18″	Catheters
	5½″ × 3″ × 9″	Cuscoe's speculum
	7″ × 3″ × 15″	foil receivers

Methods of bag closure are described in paragraph 56.

Appendix J

Packs for Hot-air Sterilization

The equipment listed below is used with the basic and supplementary packs.

INSTRUMENTS	No. in container
Artery forceps	1
Artery forceps, 1 Dissecting forceps, 1	1 set
Bard Parker handle and blade	1
Crochet hook	1
Michel clip remover	1
Dissecting forceps, 4 Dressing scissors, 1	1 set
Sinus forceps, 1 Probe, 1	1 set
McIndoe's forceps, 2 Fine stitch scissors, 1	1 set
Stitch scissors	1
Intravenous cutting down—containing:	1 set
1 Bard Parker handle	
1 „ „ blade	
2 Mosquitoe forceps	
1 Fine toothed dissecting forceps	
1 „ non-toothed dissecting forceps	
1 „ scissors	
1 Aneurysm needle	
1 Needle holder	
1 Artery forceps	

SYRINGES	No. in container
20 ml.	1
10 ml.	1
5 ml.	1
2 ml.	1
Luer-Lock	1
Mantoux	1
Unit	1

NEEDLES	No. in container
Aspiration, chest	1
„ aural	1
„ child	1
Blood sugar	1
Bowman	1
Brain	1
Cannula, Birmingham	1
„ Guest	1
Foster Carter	1
Gordh	1
Haemorrhoid	1
Infiltration	1
Lumbar puncture	1
Maxwell	1
Mixer	1
Pudendal block	1

Appendix K

Ward Requisition Form (*Disposables*)

The two forms shown cover those disposable and non-disposable items issued to the wards and departments. The forms are designed to facilitate summarizing.

The United Cambridge Hospitals

Central Sterile Supply Dept.

Disposable Packs

All items to be ordered by box, packet or tube

Ward/Dept. _____ Date of issue _____

Value £ s. d.	Item		Req'd	Issued
	Packs			
	Dressings, small	6 per box		
	medium	6 „ „		
	large	6 „ „		
	Eye	12 „ „		
	Swabbing	6 „ „		
	Neurosurgical	6 „ „		
	Absorbent pads	4 „ „		
	Bandages (Lastonet 4″)	1 „ „		
	Bandages (Lastonet 6″)	1 „ „		
	Cannula Guest (Plastic) pre-pkd.	3 „ „		
	Cannula Polythene pre-pkd.	2 „ „		
	Catheters			
	Foley 5 cc pre-pkd	1 per pkt		
	Foley 30 cc „	1 „ „		
	Gibbons „	1 „ „		
	Catgut „	4 „ box		
	Corrugated drainage tube (or sheet)	3 „ „		
	Cotton wool balls	80 „ „		
	Cotton wool rolls	12 „ „		
	Dressing towels	12 „ „		
	E.N.T. pellets	72 „ „		
	Eye pads (single)	24 „ „		
	„ „ (double)	24 „ „		
	Gallipots	20 „ „		

Value £ s. d.	Item		Req'd	Issued
	Gauze			
	Gynae. 4″	3 per box		
	„ 8″	3 „ „		
	Ribbon 1″	3 „ „		
	„ ½″	3 „ „		
	16-ply swabs	144 „ „		
	8-ply „	80 „ „		
	Wicks, small	24 „ „		
	„ large	24 „ „		
	Gel nozzles	6 „ „		
	Gloves size 5½ (pre-pkd.) 6 („) 6½ („) 7 („) 7½ („) 8 („)	6 pairs per box		
	Kleenex tissues	1 pkt. per box		
	Medical wipes	1 „ „ „		
	Needles 1 (pre-pkd.)	100 per box		
	12 („)	100 „ „		
	17 („)	100 „ „		
	20 („)	100 „ „		
	Blood sugar	6 „ „		
	Receivers	6 „ „		
	Rubber (very fine)	12 „ „		
	Safety pins	1 „ pkt.		
	Sanitary pads	12 „ box		
	Skin sutures	4 „ „		
	Spigots	1 „ pkt.		
	Trays	6 „ box		

Sister's Signature _____

Received by _____ *Issued by* _____

Appendix K—*continued*

Ward Requisition Form (*Non-Disposables*)

The United Cambridge Hospitals

Central Sterile Supply Dept.

Non-Disposable Items

All items to be ordered by box, packet or tube

Ward/Dept. _____ Date of issue _____

Value £ s. d.	Item		Req'd	Issued
	Adaptors			
	Luer-record	1 per pkt.		
	Polythene	1 ,, ,,		
	Bottles			
	Bile	3 ,, box		
	Chest drainage set	1 ,, ,,		
	Lanes	1 ,, ,,		
	Sputum trap	6 ,, ,,		
	Wolfs	1 ,, ,,		
	B.P. Handle and blade	1 ,, tube		
	Breast pump	1 ,, box		
	Burette and bung	1 ,, ,,		
	Cannula			
	Guest—Metal	1 ,, tube		
	Catheters			
	Barium	1 ,, pkt.		
	Bronchoscopy	1 ,, ,,		
	Dowse	1 ,, ,,		
	Eynards	1 ,, ,,		
	Jacques	1 ,, ,,		
	Suction	12 ,, ,,		
	Tiemans	1 ,, ,,		
	Catheter Attachments			
	Adaptor (1 per pkt.)	6 pkts. ,, box		
	Holder	6 ,, ,,		
	Introducer	1 ,, pkt.		
	Clips			
	Gate	1 ,, ,,		
	Connections			
	Drip	1 ,, ,,		
	Glass	1 ,, ,,		
	Metal covered	6 ,, box		
	Plastic	6 ,, ,,		
	Y glass with rubber	6 ,, ,,		
	Crochet hook	6 ,, ,,		
	Currettes	3 ,, ,,		
	Dilators			
	Urethral	1 set ,, ,,		
	Douche			
	Can	2 ,, ,,		
	Nozzle	6 ,, ,,		

Value £ s. d.	Item		Req'd	Issued
	Instruments			
	Artery	1 ,, tube		
	Clip removers	1 ,, ,,		
	Dressing	4 ,, ,,		
	McIndoe's and scissors	2 + 1 ,, ,,		
	Mouth (Artery and dressing)	1 + 1 ,, ,,		
	Radium removing	3 ,, box		
	Sinus and probe	1 + 1 ,, tube		
	Funnels	2 ,, box		
	Inhaler mouthpieces	12 ,, ,,		
	Logan's bow	1 ,, pkt.		
	Measures	2 ,, box		
	Myringotome	6 ,, ,,		
	Needles			
	Aspiration	1 per tube		
	Aural aspiration	3 ,, box		
	Birmingham	1 ,, ,,		
	Bowmans	1 ,, ,,		
	Brain	3 ,, ,,		
	Child's chest asp.	1 ,, tube		
	Gordh	3 ,, box		
	Haemorrhoid	1 ,, tube		
	Lumbar puncture (Howard Jones)	1 ,, ,,		
	Maxwell	1 ,, ,,		
	Infiltrating	1 ,, ,,		
	Nail brushes	24 ,, box		
	Penile clamps	2 ,, ,,		
	Pipettes	6 ,, ,,		
	Razors	6 ,, ,,		
	Rubber Tubing			
	Drainage, large medium small	2 of each in one box		
	Flatus	1 per pkt.		
	Lanes	3 ,, box		
	Pressure	2 ,, ,,		
	Tubes			
	Rectal	1 ,, ,,		
	Ryles	3 ,, ,,		
	Stomach	1 ,, ,,		

Value £	s.	d.	Item			Req'd	Issued
			Scissors				
			Dressing	1	,, tube		
			Stitch	1	,, ,,		
			Sets				
			Antrum trochar and cannula	3	,, box		
			I.V. cutdown set	1	,, ,,		
			Jugular vein	1	,, ,,		
			Luer-lock chest	1	,, ,,		
			Lumbar puncture	1	,, ,,		
			Martin chest asp.	1	,, ,,		
			Nelson trochar	3	,, ,,		
			Post anaesthetic	3	,, ,,		
			Scalp vein	1	,, ,,		
			Senoran's apparatus	1	,, ,,		
			Skin clinic	3 sets	,, ,,		
			Southey's	1	,, ,,		
			Sub-dural	1	,, ,,		
			Trochar and cannula	2	,, ,,		
			Speculum				
			Cuscoe's	6	,, ,,		
			Simm's	6	,, ,,		
			Sponge holder	6	,, ,,		

Value £	s.	d.	Item			Req'd	Issue
			Syringes				
			2 cc	1	,, tube		
			5 cc	1	,, ,,		
			10 cc	1	,, ,,		
			20 cc	1	,, ,,		
			Bladder	2	,, box		
			Higginsons	3	,, ,,		
			Luer-lock 20 cc	1	,, tube		
			Mantoux	1	,, ,,		
			Riches	12	,, box		
			Unit	1	,, tube		
			Thermometer tubes	12	,, box		
			U-shaped manometers	2	,, ,,		
			Undines	6	,, ,,		

Sister's Signature _____

Received by _____

Issued by _____

Appendix L

Suggested Pack Requirements for the More Common Procedures (based on Appendices E, F and J)

Procedure	Dressings (Appendix E)	Supplementaries (Appendix F)	Instruments (Appendix J)	Remarks
Removal of clips or stitches	Small pack		Clip removers or Stitch scissors 1 set forceps and dressing scissors	
Catheterization (Female)	Swabbing pack	Catheter holder Foil receiver Catheter		
Catheterization (Male)	Medium pack	Catheter introducer Foil receiver Catheter Penile clamp Gel nozzle		
Extensive dressing, with shortening of drain	Large pack	1 Absorbent pad safety pin	1 set of forceps and dressing scissors	Additional cotton wool balls, gauze, wool, gallipot can be added, if required
Paracentesis abdominis	Medium pack	Southey's tubes and tubing Pint measure Foil receiver Drainage bottle Absorbent pad	Bard Parker handle and blade	
Perineal swabbing	Swabbing pack	Pint measure Sanitary pad		
Bladder washout	Medium pack	Wardell syringe Pint measure Foil receiver Spigot		
Chest Aspiration	Medium pack	Pint measure 3-way adaptor Foil tray	Local syringe and needles Luer-Lock syringe Aspirating needles	

Appendix M

Theatre Requisition Form (*Disposables*)

The two forms shown cover those disposable and non-disposable items issued to the theatres. The forms are designed to facilitate summarizing.

The United Cambridge Hospitals

Central Sterile Supply Dept.

Disposable Packs

All items to be ordered by box, packet or tube

Theatre _____ Date of issue _____

Value £ s. d.	Item		Req'd	Issued
	Bandages			
	Crepe	6 per box		
	Fast edge	6 „ „		
	Moorfields	6 „ „		
	Gauze			
	Fluffies	12 „ „		
	Gauze rolls (Raytec)	12 „ „		
	Gauze strips (6 per pkt.)	12 pkts. „ „		
	Swabs			
	Abdominal (6 per pkt.)	12 „ „ „		
	Anaesthetic (4 per pkt.)	24 „ „ „		
	D. & C. (6 per pkt.)	12 „ „ „		
	Eye Polythene (6 per pkt.)	12 „ „ „		
	Lint (4 per pkt.)	24 „ „ „		
	Mastoid (12 per pkt.)	24 „ „ „		
	Non-Raytec 16 ply (12 per pkt.)	12 „ „ „		
	Orthopaedic (6 per pkt.)	12 „ „ „		

Value £ s. d.	Item		Req'd	Issued
	Swabs—*continued*			
	Patties (6 per pkt.)	12 pkts. per box		
	Raytec (12 per pkt.)	12 „ „ „		
	Stockinette (3 per pkt.)	3 „ „ „		
	Miscellaneous			
	Cottenoid tissue	12 per box		
	Enucleation dressing	6 „ „		
	Eye flaps	24 „ „		
	Eye sticks (12 per pkt.)	3 pkts. „ „		
	Mersilk	24 per box		
	Paper clips	12 „ „		
	Rubber for eye cannula	3 „ „		
	Sac dressing	6 „ „		
	Waxed silk	6 „ „		

Sister's Signature _____

Received by _____ *Issued by* _____

Theatre Requisition Form (*Non-Disposables*)

The United Cambridge Hospitals

Central Sterile Supply Dept.

Non-Disposable Items

All items to be ordered by box, packet or tube

Theatre _____ Date of Issue _____

Value £ s. d.	Item		Req'd	Issued
	Bowls	3 per sack		
	Bowls and Receivers	6 + 3 „ „		
	Clothing			
	Caps	9 „ „		
	Gowns—sack	9 „ „		
	„ —boxes	6 „ „		
	Masks	12 „ „		
	Packs			
	Anstrostomy	3 „ „		
	Arteriogram	3 „ „		
	Burr hole	3 „ „		
	Craniotomy	1 „ „		
	Delivery	3 „ „		
	Dental	6 „ „		
	Eye	6 „ „		
	Gynae.	2 „ „		
	Implant	3 „ „		
	Incision	3 „ „		
	Lithotomy	3 „ „		
	Mastoid	3 „ „		
	Minor operation	6 „ „		
	Non-incision	3 „ „		
	Tonsillectomy	3 „ „		
	Sheets			
	Incision	6 „ „		
	Non-incision	6 „ „		
	Head	6 „ „		
	Towels			
	Green (6 per pkt.)	6 pkts. per box		
	Green (1 per pkt.)	12 „ „ „		
	Huckaback (6 per pkt.)	4 „ „ „		
	Ventile	6 „ „		
	Syringes			
	50 ml.	1 „ „		
	50 ml. Luer-lock	1 „ „		
	Canny Ryall	12 „ „		
	20 ml.	24 „ „		

Value £ s. d.	Item		Req'd	Issued
	Needles			
	Albon Andrew	6 per box		
	Bronchogram	6 „ „		
	Carotid	6 „ „		
	Filling	12 „ „		
	Greenfield	6 „ „		
	Infiltration	12 „ „		
	Mitchell	6 „ „		
	Oslo	3 „ „		
	Seldinger	3 „ „		
	Sternal puncture	1 „ tube		
	Vertebral	2 „ box		
	Miscellaneous			
	Anti-static pressure tubing	6 „ „		
	Cartella shield	6 „ „		
	Catheter chuck adaptor	6 „ „		
	Caudal epidural	1 set „ „		
	Cotton gloves	2 prs. „ „		
	Dakin's bulbs	3 „ „		
	Guide wires	3 „ „		
	Heavy spinal	1 set „ „		
	Lachrymal duct cannula	3 „ „		
	Lachrymal duct dilator	3 „ „		
	Light spinal	1 set „ „		
	Luer-lock 3-way tap	6 „ „		
	„ „ „ with Cath. chuck adapt.	6 „ „		
	Luer-lock Y connections	6 „ „		
	Luer-lock stopcock	6 „ „		
	Luer 3-way tap	6 „ „		
	Luer stopcock	6 „ „		
	Luke's connectors	6 „ „		
	Magnet covers	1 „ „		
	Metal rulers	1 „ „		
	Microscope slides (each 6 pkts.)	12 „ „		
	Mittens	1 pr. „ „		
	Penicillin insufflator bulbs	3 „ „		
	Towel clips	12 „ „		
	Universal container	12 „ „		
	Wooden spoon	3 „ „		

Received by _____

Sister's signature _____

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